THIRD AMERICAN EDITION OF

Nicholson's BRITISH ENCYCLOPEDIA

or Dictionary of

ARTS & SCIENCES

illustrated by upwards of 180 elegant Engravings.

PHILADELPHIA.

Published by Mitchell, Ames & White.

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OF

ARTS AND SCIENCES,

COMPRISING

AN ACCURATE AND POPULAR VIEW

OF THE PRESENT

IMPROVED STATE OF HUMAN KNOWLEDGE.

BY WILLIAM NICHOLSON,

Author and Proprietor of the Philosophical Journal, and various other Chemical, Philosophical, and Mathematical Works.

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CONCHOLOGY.

CONCHOLOGY. The study of shells, or testaceous animals, is a branch of natural history, though not greatly useful in human economy, yet, perhaps, by the beauties of the subjects it treats of, is adapted to recreate the senses, and insensibly lead to the contemplation of the glory of the Divinity in their creation.

Shells appear to form a part of the creation not immediately subservient to the purposes of human life. This being admitted, still they are a link in the great chain of nature; they constitute a department of rational enquiry, worthy the researches of the man of science; and when we consider the amazing diversity of singular and beautiful objects they embrace are such, we are persuaded, as cannot fail to arrest, in a particular degree, the regard of every common observer.

The term conchology comprehends the study of all animals which have a testaceous covering, whether inhabitants of the marine element, fresh water, or the land. Testaceology is a term synonymous with conchology, but is of later origin and application.

A precise distinction should be drawn between testaceous and crustaceous animals; they are essentially different, though both are protected by a hard exterior shell or crust, in which they are partially or entirely enveloped, and have been indiscriminately confounded together, for that reason, under the vague denomination of shell fish. Some of the old writers distinguish the testacea as a kind of stone-like calcareous covering or habitation, in which the animal, otherwise naked, resides, and from which it can protrude its molluscous arms, or other naked parts of its body, at pleasure. The crustaceous animals of those authors, on the contrary, are not naked, but have every particular limb or part separately covered with the crust, which is thus divided into many joints, insomuch that the whole animal assumes a loricated appearance, as if inclosed in a coat of mail. Among the crustaceous order, the *cancri*, or crabs and lobsters, were included. A better definition may be obtained, by attending to the chemical properties of the two substances, testaceous and crustaceous. Poli, in his work on the shells of the two Sicilies, demonstrates that testaceous bodies consist of calcareous earth united to a small portion of animal matter or gluten; and Mr. Hatchett, whose experiments on the chemical characters of those bodies are inserted in the Transactions of the Royal Society, draws a striking distinction from analysis between the testaceous and crustaceous bodies, ascertaining the first to consist only of carbonate of lime mixed with gelatinous matter, while in the other the presence of phosphate of lime was detected. The crustaceous body analysed by Mr. Hatchett was the echinus.

All testaceous animals are composed of two parts; one of which, the animal itself, is soft and molluscous; the other is the shell, or habitation, which is hard, of a stony or calcareous nature, and either partially or entirely covers the animal. The animal is attached to the shell by means of ligaments or muscles.

It was long considered as a matter of dispute among naturalists, whether the arrangement of shells should be constituted from the animals or their habitation. No one can deny, that, if we proceed on principles strictly scientific, we must regard them as a department of zoology, and should, on that account, dispose them according to the nature and structure of the animals. But the classification formed from the characters of the shells is universally followed, and we must confess, too, is for many reasons preferable to any other. Neither is it, in the hands of the skilful conchologist, attended with so much indecision as might be generally imagined.

In the first place, among the vast variety of shells hitherto discovered, how small, comparatively, is the number of those whose animal inhabitant is described or known. It is not of species only that we speak, but of whole natural families or genera, not a single species of which has been yet discovered with the animal appertaining; so little are we acquainted with the molluscous orders, or animals inhabiting the shells. Of the shells we daily see in collections few are fished up alive, the far greater number are found on shores, dead, or empty. Neither, if it were otherwise, are accurate descriptions of animals whose parts are not easily seen, or anatomical investigations, which are in many cases necessary, within the capacity of every one. Many of their parts, and their respective functions, are not to be ascertained, except by comparative analogy, and which in itself presents an insurmountable difficulty, or a field of critical inquiry so extensive and complicated, that few, even with the ability to pursue it with success, could be prevailed upon to devote that attention to the subject which it requires.

Hence it becomes impossible to arrange the far greater number of testaceous productions by the animals; the attempt must ever prove unsuccessful. Our arrangements would be partial, and three-fourths of the shells known must be either excluded from the system, or be placed at hazard; and of course without order, or connection with those whose animals we are acquainted with. The latter are chiefly such as are confined to the coasts of the European seas, and some of the terrestrial and fresh water kinds, which, from their abundance and locality, have obtruded themselves upon the investigations of the naturalist. Even our knowledge of those is exceedingly imperfect.

The best characters, upon which to found all systems of natural history, must be those most obvious and accessible. All ranks of animals, as nearly as can be with convenience, should be arranged by apparent and external characters. While we study shells, without regarding the animal, we are aware they are but considered partially. The animals that inhabit them should guide us in our researches; they alone are the fabricators of the shell, and the shell is only their habitation, to which they give the form, the bulk, hardness, colours, and all the peculiarities of elegance we admire. If we were to examine these new and almost unknown beings, we should discover a number of parts as remarkable for their structure as their functions, and an infinite variety of curious and interesting particulars relative to their general habits and manners of life. It is a subject worthy of the serious contemplation and attention of the naturalist, and should never be neglected when an opportunity offers. But a system of conchology, founded entirely on the structure of the animals, must, probably, ever remain one of the desiderata of natural science.

In the superficial arrangement taken from shells alone we are not exempt from difficulty. Shells vary exceedingly in form and colour in the different stages of their growth, and in this case we should sometimes derive material assistance from our knowledge of the animal. Young shells have been described as specifically distinct from the parent or older shells by many writers. It indeed requires a greater degree of caution in determining the species, nay, even genera, of shells, in the different periods of growth, than may be imagined; of this we could adduce many very remarkable instances; a few it may be necessary to mention, to guard the common observer from forming hasty and erroneous conlusions.

Many of the cypreæ, or cowries, when young, have the appearance of a volute, the thick denticulated fold of the exterior lip being wholly wanting, and the column being only partially plaited as in the true voluta. The young of the alated shells, in general, are destitute of that broad expansive or furcated lip, called the wing. The spires in many of the turretted kinds of shells, when young, are blunt; obtuse, or terminated in a large globular head, exceeding the size of the whorl beneath, but as the shell advances in growth, it developes itself, extending in a spiral direction, and thus in the old shells the number of spires is greater than in the young ones. The variations in the growth of the patella tribe are often so considerable, as to almost defy the critical observer to determine them. Still, however, the conchologist, by the dint of application and nice discrimination, will be at last enabled to fix on certain characters peculiar to every species, and be, by that means, enabled to decide on the species of a shell under every stage of growth.

The primary character must be taken from the shell, because this we are acquainted with, while the animal is oftentimes unknown to us. But the structure of the animal should be regarded in the construction of genera, when it can be ascertained, as a secondary consideration to guide us in the formation of new genera, or in correcting the old, as opportunities of investigating them occur.

Having defined the meaning of a testaceous animal, and endeavoured to prove that the structure of the shell is the most material object to be regarded in a primary view, we shall proceed next to an elementary elucidation of the several parts of which it is composed.

In conchology, as in any other science, the student must necessarily acquire, in the first instance, a distinct knowledge of the terms employed. These, except such as relate to subordinate characters, or specifical distinctions, and which require no explanation in this place, may be simplified and reduced to a small number. In the selection of these terms we can abide by no one particular authority: we must be general, deriving our terms from various sources, or inventing new ones. Hitherto, in treating on the different articles of conchology, it has been our aim to adhere as nearly to the authority of Linnæus as possible.

All shells or testaceous bodies, hitherto discovered, may be divided into three principal tribes, and which, after the Linnæan manner, may be denominated Multivalve, Bivalve, and Univalve.

Any external part of a shell being of a testaceous substance, and either itself forming a shield or covering for the animal, as in univalves, or in union with another, or others connected by a ligament, cartilage, hinge, teeth, or other fastening, is denominated a valve. The shells, therefore, consisting of a single piece, are called univalves, those of two parts bivalves, and those of many parts multivalves. Between bivalve and multivalve no distinction is drawn, shells consisting of more than two such parts being called multivalve, without any regard to the number. An amendment is proposed by some of the French writers, in a new order under the name of trivalve.

Shells of the simplest form are arranged by some naturalists in the first class, from which they proceed progressively to those possessing the greatest number of valves, and being of the most intricate structure. This is an ancient and very simple mode of arrangement, and has its advocates in the present day. Linnæus reverses this order, by beginning with the chiton, lepas, and pholas, which are shells of the multivalve and most complex structure; and ending with those of the simplest form. The former seems most preferable.

Univalve. In the examination of a shell of this order, the contour, or outline, is the first particular to be regarded. By this the conchologist is guided in his definition of simple, spiral, or turbinated shells, (or, as the Linnæan school divides shells, univalves with a regular spire, and univalves without a regular spire ;) discoid, flattened, or turretted shells; those with smooth or uneven anfractus ; the ventricose, alated, labiated, rostrated, and many other distinctions, all which strike the eye at the first view. It is, indeed, by attending to the contour, that the principal distinctions in shells of this kind are at once perceived, taking into consideration the back and front profile at the same time. Some few shells, as the nautilus pompilius, and others of the same family, have the spire revolving internally, in which the outline offers less assistance in the primary definitions; but the number of such shells is very small. Next to the profile of the shell, the structure of the mouth, the pillar, and expansion of the inner lip, the gutter or canaliculation, and the umbilical opening, and operculum, if any, are to be considered; and, lastly, the work on the outer surface, as well as the colours with which it is embellished.

The base or bottom of the shell we consider that part upon which it rests when supported in an erect position, with the summit or tip of the spire standing vertically. In such shells the tip is called the apex. The course of the spires or wreaths is from the left to right in most spiral shells, some few only being of the reversed or heterostrophous kind, the whorls of which are in a contrary direction. When speaking of the right and left sides of a shell, it should be understood as having the aperture downwards, and the apex towards the observer; it will be then seen, that in most shells the aperture or opening is on the left side, *i. e.* facing the right hand of the spectator. These are termed dextral, as opposed to sinistral, when the aperture is on the opposite side.

Base, the tip of the salient end of the shell, at the extremity opposite the apex of the spire; in the rostrated kind of univalves it implies the tip of the beak. Some say the shell rests on its base when laid upon a flat surface, with the mouth downwards: this is not correct, except in the patella tribe, and some other univalves; which have no regular spire, as the dentalium, &c. Apex, the summit of the shell. Front, the face of the shell with the aperture placed directly in front of the observer. Back, that part of the shell which is immediately opposed to the preceding. Sides, those parts seen longitudinally in profile, to the right and left, when the shell is viewed either in a front or back position. Body, of the shell, (corpus) the first whorl of the spire at the base. Belly, is to be distinguished from the body, as it implies only the convex or swollen part of the first whorl, formed by the convexity of the aperture near the lip. Whorl, denotes one of the wreaths, turns, or evolutions of the shell.

Spire, comprehends, in a general sense, all the whorls of the shell, the first or body wreath excepted The form of the spire is of great consideration in the definition of shells, as it affords a prominent and distinguished character; it is in general flattish, somewhat depressed or elevated; sometimes convex and slightly pointed; or with the point obtuse; or much elevated and ending in a point; plano-concave, pyramidal, subulate, or truncated. Mr. Adanson observes, that the disposition of the spires varies according to the plane they turn on, which is either horizontal, cylindrical, conic, or ovoid. These he conceives to be the four principal dispositions of the spires, but admits there are many intermediate formations. The number and form of the spires vary in the same species, in their different growths. Young shells have commonly a less number than the old ones, neither have shells of the same age always the like number of spires, a circumstance attributable to the effects of sickness, or the difference of sex. Thus in some turbinated shells we perceive that the males have the spires less numerous, smaller, and in a more lengthened form than in the females.

Suture of the spire or whorls, is the spiral line which separates the whorls, and which is sometimes sulcated, crenulated, or somewhat projecting.

Pillar, or columella, is the inner part of the left lip or column, which runs through the shell, from the lower extremity to the tip of the spire, and from which all the spires take their origin; the columella being situated as nearly as possible in the axis of the shell, and serving as its basis and support throughout. It is generally either flat, grooved, folded, or truncated, in that part which is visible at the opening.

Aperture, called, in familiar language, the mouth of the shell, is the entrance to the chamber in which the animal resides, and is applicable to the openings of univalve and multivalve shells. The aperture is either entirely open, or closed by the operculum attached to the body of the animal, when the animal retires into its dwelling. This aperture varies in form in different shells, being angular, rounded, semilunar, linear, or otherwise, and sometimes appears double, the inner margin being surrounded by an exterior one.

Lip. The expansion of the exterior part of the aperture constitutes the lip in the labiated shells, and the wing in the alated kinds.

Beak, or rostrum, is that part at the base which extends in a straight or slightly oblique direction from the bottom of the aperture, and is larger or smaller in different families. In the murex haustellum this projection is very conspicuous.

Canal, or gutter, an elongation of the aperture of the shell descending in a groove or gutter-like process. Some kinds of rostrated shells have the canal remarkably conspicuous, forming a sinus from the aperture throughout the whole length of the beak.

Umbilicus, is the opening or perforation in the lower part of the body, or first whorl of many spiral univalves, and is very conspicuous in a number of the trochus and nerita genus in particular. This umbilical perforation runs in a straight line from the base to the summit of the shell, forming throughout a spiral groove or gutter, which is wide at the entrance, and tapers gradually towards the apex. In the Linnæan nerita canrena, the structure of the umbilicus is well displayed, but is still more obvious in the staircase shell, trochus perspectivus. This opening occurs in many shells at the base of the pillar.

Operculum, is a testaceous or cartilaginous appendage, peculiar in a considerable degree to the univalve tribe of shells, and those only of the spiral or turbinated kinds. This appendage is not connected with the shell, but the animal, and serves like a lid or little door, to protect or close up the aperture of the chamber, when the creature retires within its habitation. Shells of this kind are distinguished by the name of cochleæ operculatæ, by some of the elder conchologists. The opercula are often small in comparison to the size of the shell to which they belong; their form varies in different species; and their substance in some of a horny texture, and in others testaceous, or approaching the nature of stone. Their figure in common is either perfectly round, elliptical, oval, or elongated, and sometimes wrought with spiral work, or concentric lines.

Epidermis, is a kind of skin or coating with which the exterior surfaces of many shells, both of the univalve and bivalve tribe, are covered. It is considered as a sort of periosteum or membrane, designed by nature to defend the shell from accidents and aid their growth, and to prevent other testaceous or marine animals from fixing their habitations on these shells, as they do upon most bodies in the sea, where there is no power of resistance. The epidermis is a genuine covering formed by the animal itself, peculiar to some kinds, and as constantly never observed on others. There is no doubt but the animal, to which this sort of covering is peculiar, possesses a proper apparatus for its construction. The structure of this epidermis, it should be added, is very distinct in different shells, consisting in some of a very thin pellucid film, and in others laminated, pilous, velvetty, fibrous, or rugged. Few shells, having a rugose surface, are destitute of this external covering or epidermis.

Bivalves, or shells of two valves united by means of a cartilage, hinge, connection of the teeth, or other process. In order to constitute a bivalve shell, it is only requisite that it be furnished with two connected valves, without regard to their resemblance in form or dimensions. Some of the bivalves have both valves formed alike; in others they differ only in a slight degree, and again in others they are altogether dissimilar. The first of these is well exemplified by the solen genus; in that of the Linnæan tellinæ we find examples both of the equivalve shells, and those with the valves slightly different: of the last mentioned kinds we have many; as the ostrea, spondylus, and anomia. Bivalve shells are often much compressed, some are gibbous, and when viewed at the side, or facing the ligament, have a cordated appearance, as in the venus, and the Linnæan chama cor. Shells having both valves alike, as before observed, are called equivalve. Equilateral valves imply those which have both sides of the same valve alike; as for instance, when a longitudinal line is drawn from the beak to the opposite margin, the space on each side of the line is distinguished by the appellation of the right and left side; and when the form of both those spaces correspond, the shell is equilateral, as in the scallops (ostrea Linn.:) the inequilateral valves are the reverse of this, a line drawn as above described from the beak to the opposite margin, presenting two sides of a very different shape, as we see in most of the mactra, the donax, and tellina genera, and in the mya truncata especially. Subequilateral shells, or those having the valves nearly equal at both sides, are sufficiently elucidated by shells of the cardium, or cockle genus, which are strictly "bivalvis subæquilatera."

All bivalve shells do not completely close their shells, though most of those before mentioned do so, such as the scallop, the donax, tellina, and cardium: in several other tribes of bivalves, when the shells are shut as closely as their form will allow, they still exhibit a kind of hiatus or gaping, either at the anterior or posterior end, or at both; and in some, when the valves are shut, both the anterior and posterior parts are closed, but an opening appears on one side of the beak; this last mentioned character is very obvious in charma gigas.

One of the first circumstances to be considered is, which part of a bivalve shell ought to be deemed the base, because, when this is determined, every other part will fall progressively in their relative order under our observation. We name that part of the margin or limb which is situated in a direct line opposite the beak, the base of the shell. Linnæus, in order to establish the characters, and afford some apparent reason at least for the application of the terms he bestows on the different parts of bivalves, reverses this position of the shell, and describes the beaks as the base of the shell. But the fact is, the natural position of the shell is in immediate contradiction to his axiom, for the beaks are always uppermost, being either immediately vertical, or with a slight inclination obliquely, when the animal moves along with its testaceous covering on the back. A solitary example will perhaps occur occasionally, in which the beaks may be considerably inclined when the animal crawls, but none, we believe, are known which open the valves upwards, and proceed with the beaks under the body. The beaks, if only for this reason, are to be considered as the summit, and the margin opposite as the base. Many of the bivalves are destitute of the locomotive power, or at least do not possess it in any material degree.

Summit, a word applied in a general manner to the top or most elevated part of the two protuberances observable in the greater number of bivalves. Da Costa calls that part of the shell, in which the teeth or hinge is placed, the summit or apex; we regard it as the most elevated part of the beaks. Beak, the pointed termination, apex, or tip of the protuberances last mentioned, and which, in many shells, turn spirally downwards, or obliquely, so that the beak itself is seldom the most elevated part of the shell; though it is so sometimes, as for instance in the mytilus edulis, or common muscle. Sides, the lateral parts of the valves distinguished by the epithet of right and left side; in common language, the two valves of a shell are called the sides, but it is not understood as a term in conchology in this view. Margin, or limb, the whole circumference or outline of the shell, when laid flat down on one valve. Disk, the convex centre of each valve, or exterior surface. Anterior slope, that part of the shell in which the ligament is situated; in the front view of the anterior slope, the beaks fall back, or behind. Posterior slope, that immediately opposed to the former, and in which the beaks of the shell turn forward. Lunule, the lunulated depression below the beaks, either on the anterior or posterior slope, and sometimes on both; they may be distinguished under the appellation of anterior or posterior lunules, according to the slope in which they are situated. Cartilage of the hinge, called also the ligament of the hinge, the substance of a flexible, fibrous, and somewhat horny nature, by means of which the two valves are united near the beak, and by which also the shell is opened at the will of the inhabitant Ears, the lateral processes near the beaks, as in the scallop tribe: those occur either on one side, or on both. Ligament perforation, the opening, or aperture, through which the ligature of the animal passes, as in the anomia genus, by the assistance of which it fastens itself to the rocks, or other bodies; in some it is situated in the flat valve, in others at the beak of the gibbous valve. Length and breadth of the shell. The length is measured from the cartilage or beak to the margin below, the breadth is of course taken in the opposite direction. The breadth of many bivalve shells exceeds their length: some remarkable instances of which occur in the solen tribe. Hinge, the point of union between the two valves, formed by the connection or articulation of the teeth in both valves, or by the teeth in one valve, fitting into hollow sockets in the valve opposite. The amazing variety of structure, observable in the hinge of different tribes of shells, renders this one of the most essential characters in the general definition of shells. The teeth in some are small and numerous, in others thick, solid, and few in number, or sometimes single, long, spatuliform, laminiform, acicular, &c. the principal of which may be divided into inarticulate hinge, when only furnished with callosities, or having no visible teeth; articulate, when it has teeth, but only a small number; and multarticulate, when the teeth are numerous. Cicatrix, the impression on the inside of the valves, indicating the point of connexion between the muscles of the animal and its shell. The muscles acting on the cicatrix close the shell. In some kinds, as the common oyster for example, there is only one such muscular impression in each valve; in others there are two, and some have more. The cicatrix is not of the same figure in all shells, being either round, semi-ovate, lunate, or elongataed, in different kinds. Byssus, the appendage called beard; by means of which some bivalves fasten themselves to the rocks.

Multivalves. The shells of this order are few, compared with either of the preceding; and the terms proposed for those are applicable for the most part to the multivalves. The following require more explicit mention. Base, that part of the shell upon which it rests: in the lepas tribe, it implies the part immediately seated upon the stem or pedicle; in the balani, the base is generally larger than the summit, and is the bottom, by means of which the shell is fixed upon the rocks or other extraneous bodies. Ligament, the substance, whether membranaceous or tendinous, which serves to connect the valves together. The connexion of the valves in some multivalves is formed by the parts of one valve locking into another. Operculum. The balani have the aperture at the summit closed by means of four small pieces or valves, which are commonly called the operculum; these opercula of the balani are, however, very different from those of univalve shells.

We here introduce descriptions, illustrated by figures, of a few of the land and fresh water shells of the United States, induced particularly by the silence with which these productions of our country are regarded in the Systema Naturæ. In the extensive work of Lister, entitled "Historiæ sive Synopsis Methodicæ Conchyliorum," &c. several of our shells are figured, and, to a few of them, short descriptions are annexed, not however designated with specific names; of this work we have availed ourselves, from quotations and references.

It will be readily perceived by the conchologist, that in the arrangement we have deviated from the course pursued in this work relative to the inviolability of the Linnæan system, so as to introduce some of the more recent improvements in the construction of genera, and that some considerable modifications are ventured to be made in this article.

We think it proper to state, in addition to the above remarks, which were annexed to the descriptions in the first and second American editions of this work, that several species and three new genera are now added, which, with the exception of a small number of new species now first published, we have previously given to the world, in several detached essays, in the pages of the *Journal of the Academy of Natural Sciences*, in the collection of which Academy all the species are preserved.

UNIVALVES.

GENUS HELIX.

Shell subglobose, suborbicular, broader than long, spire convex; aperture wider than long, diminished above by the convexity of the penultimate whorl.

Observation. The shells belonging to this genus are terrestrial, often inhabiting moist places; they are thin, brittle, and translucent; the young shells are umbilicate almost invariably.

SPECIES.

1. *H. Albolabris.* Shell thin, fragile; convex, imperforated; with six volutions, whorls obtusely wrinkled across, and spirally striated with very fine impressed lines, a little waved by passing over the wrinkles, both becoming extinct towards the apex, which is perfectly smooth; aperture lunated, not angulated at the base of the column, but obtusely curved, lip contracting the mouth abruptly, widely reflected, flat and white.

Length of the column, three-fifths of an inch; breadth one inch.

Plate 1. fig. 1.

Lister conch. tab. 47 ?

Rhodia ? Gmelin's Edit. Syst. Nat.

The common garden snail, frequenting moist shaded situations, and is generally well known. It is very probable this is the *Rhodia* of authors, but as in the description of that species nothing is mentioned of the reflected lip, and not having in our possession the vol. of Chemn. conch. referred to for a figure of it, we have made an interrogative reference, and for the present have adopted a new name.

2. *H. Arboreus.* Shell very thin, fragile, depressed, horn colour, pellucid, very little convex; whorls four, irregularly wrinkled across; aperture sublunated, lip thin, brittle, junction with the body whorl acute; umbilicus large and deep.

Length one-tenth of an inch nearly; breadth nearly one-fifth.

Plate 4. fig. 4.

Under the bark of decaying trees very common. Inhabitant pellucid; base white, acute behind, not extended forward before the head; head and neck dusky; tentacula four; lower ones very short;

eyes placed in the tip of the superior pair.

The application of the Goniometer, upon some commodious construction, might very much facilitate the investigation and determination of species, by ascertaining the precise angle subtended by the two sides of the spire in univalves. This angle combined with the length and breadth of the shell, and proportionate length of the mouth, would, it is conceived, give us a better idea of form, than we can have by the present mode of description; it is a plan we have adopted in describing our marine shells.

3. *H. Tridentata.* Shell depressed, spire very little raised, brownish or horn colour; whorls five, crossed by numerous raised equi-distant acute lines, separated by regular grooves; aperture lunate, three-toothed; teeth placed triangularly, one on the pillar lip situated diagonally; outer lip, abruptly contracting the aperture, widely reflected and white, furnished with two of the teeth resembling projecting angles. Umbilicus moderate.

Half an inch wide.

Inhabits the middle states.

Plate 2. fig. 1.

Cochlea parva, umbilicata, tenuiter striata, Tridens. sc. in triangulo positi, nempe unus ad fundum oris, alter ad columellam, tertius ad labrum. Lister. Conch. tab. 92. *fig.* 92.

The three curves formed by the two teeth in the outer lip of this shell bear considerable resemblance to the ornament often placed upon pannels in gothic architecture. It is found under the loose moist bark of decaying trees in some plenty.

Belongs to the genus *Polydontes*, Montf.

As many of the compound terms as possible ought to be banished from the language of Natural History, we would therefore propose, that the terms *outer lip* and *pillar lip* be substituted by *Labrum* and *Labium*; these would be equally expressive, and occupy less space in a description.

4. *H. Alternata.* Shell somewhat convex, fuscus varied or alternating with pale rays; whorls five, striated across with raised equi-distant acute lines, forming grooves between them. Aperture thin and brittle; lip regularly curved, within glossed with perlaceous, and when placed before the light the fuscus lines appear sanguineous. Umbilicus large, exhibiting all the volutions.

Three-fourths of an inch wide.

Inhabits the middle states.

Plate 1. fig. 2.

H. Radiata Gmelin's Edit. of Syst. Nat. p. 3634.

Cochlea umbilicata fusca, sive variegata capillaribus strys leviter exasperata. Lister. Conch. tab. 70, *fig.* 69.

Lister's figure, which is without doubt a representation of this species, is referred to in Gmelin as *H. radiata*, but we believe our shell to be a distinct species from that which is found in France; we therefore apply a new name. Found under bark of dead trees, and in moist places, and is not uncommon. In the young shell the whorls are less rounded, and are flattened above, so as to form almost an angle with the exterior margin; the colours are altogether paler, and may be described as pale yellow, spotted or above radiate with reddish-brown, and a row of spots interrupted from the radii by the immaculate prominent margin.

5. *H. Glaphyra.* Shell very much depressed, thin, fragile, pellucid, polished; whorls five, regularly rounded, and with obsolete and irregular wrinkles across them; beneath whitish; umbilicus moderate, not exhibiting the volutions.

Plate 1. fig. 3.

Taken by Mr. G. Ord in his garden, Philadelphia.

This species and the preceding are referable to the genus *Zonitis*, Montf. a name which is objectionable from its being used in Entomology.

It considerably resembles *Helix nitens* of Europe, particularly in being whitish beneath, and will be properly arranged next that species in the systems.

6. *H. thyroidus.* Shell thin, fragile, convex, umbilicate; whorls five, obtusely wrinkled, or rather with equi-distant, gradually elevated, obtuse lines, and spirally striate with minute, impressed lines; lip widely reflected, white and flat before, partially concealing the umbilicus; pillar lip furnished with a very oblique tooth.

Journal of the Acad. of Nat. Sciences, vol. i. p. 123.

Breadth four-fifths to nine-tenths of an inch.

This species very much resembles H. Albolabris, but is umbilicated, and toothed on the pillar lip. It is much less common.

It is referable to the genus *Cepolis*, Montf.

7. *H. minuta.* Shell rather thick; spire convex, little elevated, with three volutions; suture well defined, impressed; whorls obtusely wrinkled across; aperture nearly orbicular; lip much thickened, reflected, white, distant from the umbilicus; umbilicus large, exhibiting the volutions.

Breadth less than one-tenth of an inch.

Jour. Acad. Nat. Sciences, vol. i. p. 124.

Found under the bark of a decaying oak; is readily distinguishable from other species by its small size and conspicuous lip. It is a true *Helix*.

8. H. *labyrinthica.* Shell conic, dark reddish brown, body lighter; whorls five or six, with conspicuous, elevated, equidistant, obtuse lines across, forming grooves between them; apex obtuse; lip reflected, rounded; pillar lip with a large, lamelliform, elongated tooth, which appears to revolve within the shell parallel to the suture, a smaller raised line revolves nearer to the base within the shell, but becomes obsolete before it arrives at the pillar lip; umbilicus rather large.

Breadth one tenth of an inch.

Jour. Acad. Nat. Sciences, vol. i. p. 124.

Found on fungus in decaying wood: this shell is remarkable for the two much elevated lines, which revolve within the shell upon the penultimate whorl, the upper one larger, and terminating at the aperture very conspicuously, and resembling a tooth.

9. *H. Hirsuta.* Shell subglobose, brownish, imperforated, covered with short, numerous, rigid hairs; whorls five, but little rounded; suture distinct; aperture very narrow, almost closed by an elongated, lamelliform tooth, situated on the pillar-lip, and circularly joined to the outer-lip at the base. Outer-lip reflected back upon the whorl, and incorporated with it near the base, with a deep sinus in the middle. Breadth one-fourth of an inch.

Lister. tab. 93. *f.* 94?

Inhabits moist places. Common.

This species appears to be somewhat allied to the H. hispida, but is sufficiently distinct. Found by Mr. Lardner Vanuxem. It approaches the genus *Caprinus* Montf. but differs in having the lips disunited above.

10. *H. perspectiva.* Shell very much depressed, with about six whorls; whorls striated across, with raised, parallel, acute lines, forming strongly impressed sulcæ between them. Umbilicus very large, resembling an inverted spire, in diameter at least equal to the breadth of the body whorl, and exhibiting distinctly all the volutions. Diameter three-tenths of an inch.

Journal Acad. Nat. Sciences, vol. i. p. 18.

Found by Mr. Le Sueur, near Lake Erie. It is referable to the genus *Zonitis,* Montf.

11. *H. Lineata.* Shell very much depressed, somewhat discoidal. Whorls about four, each longer than broad, with numerous, raised, parallel, equidistant, regular, revolving lines. Suture impressed. Umbilicus very large, diameter at least equal to the body whorl, and exhibiting all the volutions distinctly. Aperture longer than wide, lunate. Diameter three-twentieths of an inch, nearly.

Jour. Acad. Nat. Sciences, vol. i. p. 18.

Found by Mr. Robert E. Griffith, near Philadelphia. Somewhat resembles the last, but is more depressed, and the striæ are transverse, not longitudinal as in that shell; the cavity beneath also, though of equal proportional diameter, is not proportionally deep. Belongs to the genus *Zonitis,* Monf.

GENUS POLYGYRA.

Shell discoidal, more or or less carinated on the upper edge of the whorls, umbilicated; aperture longer than broad; lips thickened, toothed, or folded and continued, folds concave beneath; pillar-lip raised above the preceding whorl, and concave beneath.

Animal granulated; tentacula four; eyes at tip of the superior tentacula and retractile; operculum none.

SPECIES.

1. *P. Auriculata.* Shell beneath convex; whorls five, a little rounded, crossed by numerous raised equidistant lines, forming grooves between them; spire very little raised; lateral line (extending from the outer whorl to the apex) not convex, but somewhat concave; mouth very unequal; lips prominent above, and pressed to the preceding whorl beneath; pillar-lip suddenly reflected, and pressed into the mouth at an acute angle, beneath very acutely concave; outer-lip a little more prominent in the middle, and within the edge protruded into the mouth; throat extremely narrow; suture near the mouth suddenly reflected from the preceding whorl, and carinate; umbilicus dilated, very small within, and exhibiting a groove

on the outer whorl. Breadth of the female nearly half an inch; of the male about three-tenths.

Inhabits Florida.

Jour. Acad. Nat. Sciences, vol. i. p. 277.

This curious species we found near St. Augustine, East Florida, in a moist situation. They were observed in considerable numbers; the colour is a reddish brown, indistinctly banded with whitish lines, sometimes with darker ones, mouth white.

2. *P. Avara.* Shell covered with numerous short, robust hairs; spire convex; whorls four, regularly rounded, with hardly elevated lines forming grooves, which are much more conspicuous near the mouth; mouth subreniform, two projecting, obtuse teeth on the outer lip, within separated by a deep sinus; outer lip elevated, equal, describing two-thirds of a circle; pillar lip elevated, broadly but not profoundly emarginate, concave beneath, and connected by the inner side to an elongated lamelliform tooth, which is placed obliquely on the penultimate whorl, near the middle of the mouth; lips almost equally prominent, continued; umbilicus moderate, not exhibiting the volutions, no groove on the ultimate whorl within it. Breadth one-fourth of an inch.

Inhabits Florida.

Jour. Acad. Nat. Sciences, vol. i. p. 277.

Animal longer than the breadth of the shell, acute behind, above granulated and blackish, beneath, and each side, white.

This we found in the orange groves of Mr. Fatio, on the river St. John, East Florida; it is usually covered with a black, earthy coat, which is probably collected and detained by the hairs. When unincumbered with this vesture, the shell is of a horn colour. It is by no means so common as the preceding species.

3. *P. Septemvolva.* Shell much depressed, discoidal; spire not prominent; whorls seven, perfectly lateral, compressed, depressed, and marked with conspicuous lines and grooves above, a projecting carina on the upper edge of the body whorl, beneath which the lines and grooves are obsolete: aperture subreniform, not contracted; lips equal, elevated, outer one reflected, regularly rounded so as to describe two-thirds of a circle, pillar lip projecting inwards into an angle or tooth, which is concave beneath; beneath, the four exterior volutions equally prominent, transverse diameters equal to those of the upper surface; umbilicus central, moderate, attenuated to the apex so as to exhibit the remaining volutions. Breadth, female two-fifths; male three-tenths of an inch.

Inhabits Georgia and East Florida.

Journ. Acad. Nat. Sciences, vol. i. p. 278.

A very common shell in many parts of Georgia, particularly the sea-islands, also in East Florida. We found them numerous under the ruins of old fort Picolata, on the St. John's river, and on the Oyster-shell Hammocks, near the sea, and in other situations, under decaying Palmetto logs, roots, &c.

These shells would have been referred by Linné to the genus Helix, but as that genus has been limited by Mr. Lamarck, and others, to those shells of which the apertures are broader than long, I cannot, in the present state of conchology, consider them as of that genus. Neither can I refer them to either of the genera which have been separated from Helix by Messrs. Lamarck, Montfort, &c. by the characters which those naturalists have given of their genera. They differ from others in having the pillar lip elevated considerably above the surface of the penultimate whorl, so as to be equally prominent with the outer lip, with which it forms an uninterrupted continuation, and by the concavities beneath the lips, formed by the protrusion of a portion of the shell into the aperture. In this last character it approaches the genus *Caprinus* of Mr. Montfort, but differs in being umbilicated.

GENUS OLIGYRA.

Shell rounded; aperture longer than broad, semiorbicular, emarginated by the projection of the penultimate whorl; external lip reflected; pillar lip with obsolete calcareous deposit; umbilicus none; columella slightly angulated at base.

Animal terrestrial, operculated; tentacula two, filiform; eyes prominent, placed at the external base of the tentacula; rostrum bilabiated at tip, shorter than the tentacula; foot simple.

SPECIES.

O. Orbiculata. Shell subglobular; spire not prominent, but more than convex; lateral line somewhat convex; whorls five, obsoletely striated across, regularly rounded, colour pale, greenish, yellowish, or slightly tinted with reddish, particularly on the body, and margined above by an obsolete white line, on the middle of the body a white vitta revolves, sometimes obscure or wanting; aperture acute above, regularly rounded at the base, and extending from the center of revolution or base of the column to an equidistance between the base and apex of the spire; base of the columella slightly projecting into an obtuse angle; exterior lip whitish, reflected. Length one-fifth of an inch.

Inhabits East Florida.

Jour. Acad. Nat. Sciences, vol. i. p. 283.

Animal pale; rostrum and tentacula blackish, the latter with a white line; eyes very black, elevated in form of a short tubercle; length about equal to the breadth of the shell; foot not broader than the body; tail rounded, or somewhat acute; operculum simple, not spiral, yellowish brown, minutely granulated.

This species we found in great numbers on what are called Oystershell Hammocks,* near the mouth of the river St. John, East Florida, in company with *Polygyra septemvolva.* When in motion, the tentacula are elevated and depressed alternately, as if feeling the way.

This shell is certainly a Linnæan Helix, but according to the improvements which have been made in Conchology, since the time of the Swedish naturalist, by Mr. Lamarck, and other systematists, it is at once excluded from that genus and its congeners, by having but two tentacula, and by its operculated aperture; with the genus Cyclostoma, as it now stands, our shell has more affinity than it has to any other, but a very distinct generic character is observable in the aperture, which is not orbicular as in the Cyclostoma, but is almost semi-orbicular, greater in length than in breadth, and the lips widely disunited. In addition to the characters usually given of the animal of Cyclostoma, Mr. Cuvier remarks, that the tentacula are terminated by obtuse tubercles; no such appendages are annexed to the corresponding members of this animal. Upon these considerations, I have thought proper to construct the present genus.

GENUS PLANORBIS.

Shell discoidal; spire depressed, or concave; aperture oblique, rounded, broader than long, visible from above, and emarginated by the convexity of the penultimate whorl: lips not reflected; whorls lateral.

Animal aquatic, with two filiform tentacula, having the eyes placed at the inner base; operculum none.

Observ. The species for which this genus was constructed were included by Linnæus in his Genus Helix. The spire is sometimes profoundly sunk, so much so as to be with difficulty distinguished from the base.

SPECIES.

1. *P. Trivolvis.* Shell sinistral pale yellow, brownish or chesnut colour, subcarinate above and beneath, particularly in the young shell; whorls three or four, striate across with fine, raised, equi-distant, acute lines, forming grooves between them. Spire concave; aperture large, embracing a considerable portion of the body whorl, within bluish white; lip a little thickened, internally, and of a red or brownish colour, vaulted above; umbilicus large, exhibiting the volutions.

Length one-fourth of an inch; breadth one-half of an inch.

Animal aquatic, dark ferruginous, with very numerous, confluent, pale yellowish points; tentacula long, setaceous, with confluent points; foramen on the left side.

That ingenious naturalist, Mr. C. A. Lesueur, found this species of a much larger size in French Creek, near Lake Erie; breadth three fourths of an inch nearly; colour almost black, purplish red within the mouth.

Plate 2. fig. 2.

Cochlea, trium orbium. Lister. Conch. tab. 140. *fig.* 46.

Lister figures this shell pretty accurately, and it is referred to in Gmelin's Edit. of Syst. Nat. p. 3615, as *Albella,* but it is certainly not that species.

2. *P. Bicarinatus.* Shell sinistral, pale yellow or brownish, subcarinate above, and beneath translucent. Spire retus-umbilicate, forming a cavity as deep as that of the base. Aperture large, embracing a considerable portion of the body whorl, and much vaulted above. Within red brown, with two white lines corresponding with the carina. Whorls three, wrinkled, and with minute revolving lines.

Length one-fourth of an inch; breadth nearly half an inch.

* These are elevated knolls of oyster-shells mixed with earth, which rise, by an abrupt acclivity on all sides, from the salt marshes in that country, to the elevation of fifteen or twenty feet; they exhibit to the eye the appearance of old oyster beds, (Oyster Rocks,) which, owing to their compactness, have resisted the action of the waters for centuries, while the more yielding earth around them has been washed away to its present level, by imperceptible degrees.

Inhabitant aquatic, ferruginous, with numerous yellowish dots; tentacula dotted and flexuous.

Plate 1. fig. 4.

Resembles the preceding species in its outline, but differs from that shell in the remarkable umbilicate appearance of its spire; it is also destitute of those fine parallel raised lines, and is furnished with minute striæ, never visible in *P. Trivolvis*, the superior part of the lip is more vaulted, and the carina more visible.

3. *P. Parvus*. Shell horn colour or blackish; whorls four, crossed by minute wrinkles; concave above and beneath, and equally exhibiting the volutions; body generally subcarinate on the margin; lip rounded, and not vaulted above nor thickened; mouth within bluish white.

Breadth one-fifth of an inch.

Animal aquatic brown, tentacula long, filiform, whitish, with a darker central line, tail rounded.

Plate 1. fig. 5.

Probably the same species with that figured by Lister, tab. 139. fig. 45; it is very numerous in the river Delaware, in company with the two preceding shells.

4. *P. Glabratus*. Shell sinistral; whorls about five, glabrous, or obsoletely rugose, polished, destitute of any appearance of carina; spire perfectly regular, a little concave; umbilicus large, regularly and deeply concave, exhibiting all the volutions to the summit; aperture declining, remarkably oblique with respect to the transverse diameter.

Breadth nearly nine-tenths of an inch.

Journ. Acad. Nat. Sciences, vol. i. p. 280.

Inhabits South Carolina.

Presented to the Academy by Mr. L'Hermenier of Charleston, an intelligent and zealous naturalist; he assured me that this species inhabits near Charleston. It somewhat resembles large specimens of the *P. Trivolvis*, but differs in the total absence of carina, and in having a more smooth and polished surface, as well as a declining and more oblique aperture, and a more profound and much more regularly concave umbilicus.

GENUS LYMNÆA.

Shells subovate, oblong, or somewhat tapering. Aperture entire, longitudinally oblong, the right lip joined to the left at the base, and folding back on the pillar.

Observ. These shells, as well as those of the preceding genus, were placed by Linnæus with his Helices, but they offer characters sufficiently distinct, particularly their inhabitants.

SPECIES.

1. *L. Catascopium.* Shell thin, horn coloured or blackish; whorls four or five, the first large, and generally the remainder darker and rapidly decreasing to an acute apex, and wrinkled across; aperture large, oval, not three-fourths the length of the shell.

Length seven-tenths of an inch; breadth nearly one half of an inch.

Inhabitant yellowish, sprinkled with small, often confluent, paler dots; tentacula two, broad, pyramidal; eyes black, placed at the base of the tentacula; tail obtuse rounded or emarginate, not so long as its shell.

Plate 2. fig. 3.

It is with much hesitation that we adopt a new specific name for this shell, having always heretofore considered it as the same with the *L. Putris* of authors, (which has been, perhaps, mistaken for the *Helix Limosa* of Linne.) as far as we can ascertain, the principal difference appears to be in the more oblique revolution of the whorls in the European species, and the more abrupt termination of the spire.

Inhabits the Delaware river and many other waters of the United States, in considerable numbers, and may be found plentifully, during the recess of the tide, about the small streams through which the marshy grounds are drained, in company with several other shells. When kept in a vessel of water, like others of its kind, it will proceed not only up the sides of its prison, but also along the surface of the water, the shell downward, with regularity of motion and apparent ease; in this case the reverted base of the animal is concave; and as the surface of the water is compelled to a corresponding concavity, the pressure of the atmospheric column will account for the sustentation of the animal (whose specific gravity is much greater than that of the water) in this singular position: It occasionally crawls to the margin of the water to inhale a supply of air; with this object the foramen is protruded to the surface, and opened with an audible snapping sound, similar to that produced by the resilience of the nib of a pen.

There is a species of this genus that we have named *L. Jugularis*; and which, in consequence of its having been found but once, must be considered as a doubtful inhabitant of the United States. It may be thus described. Shell tapering; whorls about six; suture not deeply impressed; aperture hardly equal to half the length of the shell, but little dilated; within brownish, particularly upon the column, which is contracted in the middle; outer lip white, and almost imperceptibly repand within; umbilicus very distinct. Length one inch.

A specimen was also brought from the West Indies by Mr. L'Hermenier of Charleston.

2. *L. Heterostropha.* Shell sinistral, subovated; colour, pale yellow, chesnut or blackish; whorls four, the first large, the others very small, terminating rather abruptly in an acute apex; aperture large, somewhat oval, three-fourths of the length of the shell, or rather more; within of a pearly lustre, often blackish; lip a little thickened on the inside, and tinged with dull red.

Inhabits with the first species, and almost as numerous.

Plate 1. fig. 6.

Animal resembles that of *L. Catascopium*, but is of a darker colour and longer than its shell, the tentacula also are longer, and setaceous; tail acute.

The mantle is trifid at the base of the pillar lip, and at the upper corner of the aperture; deposits eggs the beginning of May; eggs enveloped by a transparent gelatinous substance; the nucleus, after a few days, appears of a pale or milk white colour, and not so well defined as those of L. catascopium.

3. *L. columella.* Shell thin, fragile, horn-colour; whorls four, longitudinally wrinkled. Spire prominent, acute. Suture not much impressed. Aperture dilated, ovate. Columella much narrowed near the base, so that the view may be extended from the base almost to the interior apex of the shell. Length seven-tenths of an inch nearly; of the spire one-quarter of an inch.

Inhabits stagnant waters and miry places.

Journ. Acad. Nat. Scieuces, vol. i. p. 14.

Animal aquatic, base not so long as the aperture; dusky, with small whitish spots; tentacula broad, pyramidal, compressed; eyes small, black, placed at the inner base of the tentacula.

This species is allied to *L. Catascopium* but the revolution of the whorls is more oblique, the shell thinner, the aperture much more dilated, and the columella differently formed. For several specimens of this shell, we are indebted to Mr. Titian Peale.

GENUS SUCCINEA. DRAP.

Shell oval or oblong; aperture large, oblique; columella narrowed.

Animal terrestrial, larger than its shell; tentacula four, inferior pair smaller; eyes placed at the tip of the superior tentacula; operculum none.

SPECIES.

1. *S. Campestris.* Shell oval, very fragile; whorls three, not remarkably oblique, pale yellowish, with opaque white, and vitreous lines, irregularly alternating.

Length not quite three-fifths; breadth seven-twentieths of an inch.

Journ. Acad. Nat. Sciences, vol. i. p. 281.

This shell is extremely common in many parts of the southern states; it abounds in the sea-islands of Georgia, in the low marshy grounds behind the sand hills of the coast, where they are destroyed in great numbers by the annual conflagration of the old grass; on Amelia island, East Florida, I found them in plenty on the highest sandy ground of the island. On Cumberland Island, in Mr. James Shaw's garden, I obtained several specimens from the leaves of radishes.

The resemblance between this species and the ovalis is very great; it differs, however, in being less elongated, and of a more robust form; the revolution of the spire is much less oblique, the shell itself is thicker and less fragile.

Animal whitish; eyes, inferior tentacula, and a line passing from the eyes, disappearing under the shell, black; a gamboge coloured vitta is visible through that part of the shell which is opposed to the mouth.

2. *S. Ovalis.* Shell suboval, pale yellowish, diaphanous, very thin and fragile, with nearly three oblique volutions. Body very large. Spire small, but little prominent, somewhat obtuse. Aperture longitudinally subovate, large. Columella much narrowed, so as almost to permit the view of the interior apex from the base of the shell. Scarcely any calcareous deposit on the pillar lip. Length nine-twentieths of an inch, aperture seven-twentieths.

Inhabits marshy grounds in shaded situations. Common.

Journ. Acad. Nat. Sciences, vol. i. p. 15.

Animal longer than its shell, furnished with four tentacula, the two superior ones longer, cylindrical, supporting the eyes; inferior ones, short, conic. Colour pale with minute black points, which are assembled into fascia on the sides and fillets on the neck above; neck granulate above, a black line passes each side on the neck, from the tip of the oculiferous tentacula, gradually disappearing under the shell. Front truncate, quadrate.

When the animal is living, so vitreous is the shell, that all the markings of its body are plainly discernible. So that although the shell is of a straw-colour, immaculate, it appears of a dusky hue, with a remarkable white, flexuous, longitudinal vitta on the back, arising from the suture, and terminated about mid way to the base, often with two or three obsolete white spots near its tip.

The characters of the inhabitants are widely distinct from the animal of the Lymnæa, and are somewhat allied to those of the inhabitants of the Helices.

GENUS CYCLOSTOMA.

A subdiscoidal or conic univalve. The aperture orbicular, with a circularly continued margin, often suddenly and widely reflected.

SPECIES.

C. Tricarinata. Shell with three volutions; three revolving, carinate, prominent lines, giving to the whorls a quadrate, instead of a cylindric appearance. Suture canaliculate, in consequence of the whorls revolving below the second carina and leaving an interval. Spire convex, apex obtuse. Umbilicus large. Carina placed, one on the upper edge of the whorl, one on the lower edge, and the third on the base beneath. Breadth one-fifth of an inch.

Inhabits the river Delaware. Rare.

Found by Mr. Le Sueur, whose proposed name is here adopted.

GENUS ANCYCLUS. GEOFF. LATR.

Shell conic, not spiral, concave beneath, above with a simple apex.

Animal with the eyes placed at the inner base of the tentacula.

Observation. This genus has been confounded with the Patellæ. The European species are *Patella Lacustris,* and *Fluviatilis,* of Linné.

SPECIES.

A. rivularis. Shell corneous, opake, conic-depressed; apex obtuse, nearer to, and leaning towards one side and one end; aperture oval, rather narrower at one end, entire; within milk white.

Length one-fourth of an inch.

Journ. Acad. Nat. Sciences, vol. i. p. 124.

Common in rivulets, adhering to stones. The animal resembles the inhabitant of shells of the genus Lymnæa, the tail is very obtuse, rounded.

GENUS PALUNDINA. LAM. LATR.

Shell subovate, operculated; aperture entire, longitudinally ovate, narrowed above; lip simple, not dilated or reflected.

Observation. This genus has been very lately separated by Mr. Lamarck from the *Cyclostomæ,* with which it corresponds, except in having no dilated lip, and the aperture is angulated above. The animal has a short rostrum, two acute tentacula with eyes at their external base, a small membranaceous wing each side of the body before, foot double before, the wing of the right side is folded into a small canal, by which the water is introduced into the respiratory canal. Latr.

SPECIES.

1. *P. Limosa.* Shell conic, subumbilicate, dark horn coloured, generally incrusted with a blackish irregular covering on the spire, and sometimes on the body, which completely obscures the obsoletely wrinkled epidermis; aperture ovate-orbicular; suture impressed.

Length three-twentieths, breadth one-tenth, of an inch.

Journ. Acad. Nat. Sciences, vol. i. p. 125.

Animal whitish; head brown; mouth, tentacula, orbits, and vita on each side of the neck, white; tentacula filiform, more than half as long as the base of the animal; rostrum about half as long as the tentacula, annulate, with darker lines above; foot white, brownish above, short, suboval, truncated before, and rounded behind.

Extremely numerous on the muddy shores of the rivers Delaware and Schuylkill, between high and low water marks.

2. *P. lapidaria.* Shell turreted, subumbilicate, with six volutions, which are obsoletely wrinkled across. Suture impressed. Aperture longitudinally ovate-

orbicular, operculated, rather mere than one-third of the length of the shell.

Length about one-fifth of an inch.

Journ. Acad. Nat. Sciences, vol. i. p. 13.

Inhabitant not so long as the shell, pale; head elongated into a rostrum as long as the tentacula, and emarginate at tip; tentacula two, filiform, acuminated at tip, short; eyes prominent, situated at the external or posterior base of the tentacula; base or foot of the animal dilated, oval, obtuse before and behind.

Found under stones, &c. in moist situations, on the margins of rivers. Like those of the genera Lymnæa and Planorbis this animal possess the faculty of crawling on the surface of the water, in a reversed position, the shell downward.

3. *L. Subcarinata.* Shell with three whorls, which are rounded, and subcarinated, reticulated with striæ and wrinkles, sometimes without the striæ; suture deeply impressed; apex truncated and re-entering; aperture more than half of the length of the shell, oval; elevated lines or subcarina on the body two, three, and sometimes none.

Length half of an inch: breadth four-tenths.

Inhabits with the preceding species.

Plate 1. fig. 7.

Animal viviparous, with a chesnut, coriaceous, operculum, white spotted with orange; head pale orange, not extending beyond the shell; tentacula darker, short, subulate; eyes situated at their base, elevated, black and conspicuous; base of the animal much advanced, broad, truncate, purplish before, tail rounded behind.

4. *L. Virginica.* Shell tapering, olive, horn colour or blackish, under the epidermis tinged with green; whorls seven, but little rounded, crossed by curved wrinkles on the spire, and reclivate ones on the body: a dull red line revolves near the base of the whorls, and on the middle of the body a reddish-black broader line, from within the upper angle of the aperture, runs parallel with the other, and terminates near the base. Aperture subovate, more than one third as long as the shell, lip not thickened, but dilated at the base.

Length one inch; breadth two-fifths of an inch.

Plate 2. fig. 4.

Lister's conch. tab. 117. *fig.* 7. The basilar part of the lip in Lister's figure is deficient.

Inhabitant bluish-white beneath, with orange clouds each side of the mouth; above pale orange, shaded with dusky and banded with numerous black interrupted lines; mouth advanced into a rostrum as long as the tentacula, which are darker at the base, and setaceous; base of the animal with an undulated outline.

It often occurs in our rivers, and is readily discoverable in clear water by the channel it forms in the mud.

Specimens of this shell, brought from the Lakes and their vicinity, by *Mr. Lesueur*, had the revolving lines very obscure or obsolete.

Lister's lower figure of tab. 109, also resembles this shell.

5. *L. Vivipara.* Shell subconic, with six rounded whorls; suture impressed, colour olivaceous or pale, with three red-brown bands, of which the middle one is generally smallest; whorls of the spire with but two, aperture suborbicular, more than half the length of the shell.

Plate 2. fig. 5.

Donov. Brit. Shells. tab. 87, *Helix Vivipara.*

Lister. conch. tab. 126, *fig.* 26; *Cochlea vivipara fasciata.*

It is doubtful whether or not this is the same as the Vivipara, but it certainly approaches very near to it; we however refer it to that species until a specific difference can be indicated, which at present we are unable to do; the spire of this species is rather more obtuse, and the suture not so deeply impressed, as in the figures of the European specimens above mentioned.

6. *P. Dissimilis.* Shell conic, dark horn colour or blackish; whorls about three, with obsolete, distant wrinkles, and an abrupt, acute, prominent, carinated line, which revovles on the middle of the body whorl, and is concealed on the spire by the suture; suture not indented, aperture oval, half as long as the shell, within sanguineous beneath the carina, and at base, and apex; columella emarginated, a little flattened at the base.

Length about two-fifths of an inch.

Var. A. Carina obsolete on the ventral portion of the body whorl.

Var. B. Carina distinct on the spiral whorls, owing to their more oblique revolution.

The surface of the whorls of the spires is generally covered with inequal calcareous matter, resembling a fortuitous accumulation of mud or earth on that part, but which appears to be superposed by the animal, probably with the intention of retaining a proper specific gravity. The apex is often truncated.

This species was found by Mr. Thomas Nuttall, during a journey to Pittsburg.

7. *L. Decisa.* Shell subconic, olivaceous, truncated at the apex; whorls four, wrinkled across and banded with minute distant striæ; terminal whorl very short; suture impressed and conspicuous; aperture subovate, more than half of the length of the shell, entire; within bluish white. Operculum coriaceous, elevated on the disk and concentrically striated.

Length one inch; breadth three-fourths of an inch.

Plate 2. fig. 6.

Cochlea virginiana é flava viridescens, non fasciata. Lister. conch. tab. 127. *fig.* 27.

The young shells resemble *L. subcarinata*, but the whorls are destitute of an elevated line, the suture is not so deeply impressed, and the aperture is narrower above.

Animal with the foot large, suddenly a little dilated each side before and truncate in front, widely; foot livid, thickly maculated with irregular orange spots, which are much smaller beneath; head and tentacula spotted with orange; eyes on a prominent angle, at the external base of the tentacula.

I found the animal viviparous in October; the young shell had then three complete whorls, which were spirally striated.

GENUS PUPA.

Shell spiral produced. Aperture contracted, subangular, generally distinct, and sometimes separate from the body whorl, and usually furnished with teeth.

Observ. The shells belonging to this genus have been divided with much propriety from the Linnæan Genus Turbo; they inhabit moist places, under the bark of trees, under stones, moss, &c. many of them are sinistral.

SPECIES.

1. *P. Corticaria.* Shell dextral, cylindrical, obtuse at the apex; whorls five, not perceptibly wrinkled or striate. Aperture suborbicular, lip reflected; a single tooth on the pillar lip near the outer angle; inner angle with an angular projection resembling a second tooth, sometimes obsolete.

Length about the tenth of an inch.

Plate 4. fig. 5.—A. Natural size; C. An enlarged view.

Very common under the bark of trees near the earth, and resembles *Turbo Muscorum* of authors.

GENUS POLYPHEMUS, Montf. (ACATHNIA. LAMARCK.)

Shell oblong; aperture much longer than broad, perpendicular and parallel to the column; lip not reflected; columella gradually incurved towards the tip; tip truncated.

P. glans. This shell furnished De Montfort with the type of his genus polyphemus; he refers to Bruguiere as the first describer of it, under the name of Bulimus glans, in the Encycl. Method. The animal has not been described, but we are informed that it lives in the immense marshes formed by the overflow of the great rivers that water the vast country of Louisiana. In the sea-islands of Georgia we found them numerous in the marshy districts, immediately behind the sand-hills of the coast; in Florida in similar situations, and also on the Oyster-shell Hammocks, and generally in such situations as are tenanted by *Succinea compestris.* The colour of the shell on the spire is chesnut-brown, which gradually and very perceptibly becomes paler to the aperture, aperture occupying about half the length of the shell. On elevated situations they were small, almost transparent, and of a fragile consistence. It is only in low, marshy situations, that they attain their greatest size.

Length two inches and two-fifths—breadth one inch nearly.

Animal elongated, as long again as the shell, granulated; tentacula four, superior ones oculiferous, abruptly deflected at tip, beyond the eyes; inferior ones much shorter, and abruptly deflected at tip; lips beneath the tentacula, elongated, palpiform, almost as long as the superior tentacula, retractile, generally more or less recurved, compressed, attenuated, and acute at tip, and forming a considerable interval between their prominent bases.

When the animal is in motion, the elongated lips are used as tentacula to feel the way.

BIVALVES.

GENUS UNIO.

Shell transverse; with three deeply impressed cicatrices; hinge with a strong irregular tooth, and anterior lamelliform, elongated one in one valve, inserted between two corresponding teeth and laminæ of the other.

Obs. The shells of this genus inhabit fresh water: they were placed by Linnæus with the *myæ*, from which they differ in very essential particulars; as is obvious from the number, situation, and figure of the teeth, and the organization and habits of the included animal.

SPECIES.

1. *U. Crassus.* Shell varying in form and surface; remarkably thick and ponderous; epidermis horn-colour, different shades of brown or black; beaks carious, often much eroded, pure parlaceous, or silvery white, more prominent as the shell approaches an orbicular form; primary teeth, not very oblique. The dimensions of three specimens were as follow:

Length, 3 inches;	breadth,	4½
2		4½
2		2.

Plate 1. fig. 8.

Muscblis brevoir, admodum crassus, ex interna parte subroseus, cardine incisuris minutis exasperato. Lister. Conch. tab. 150. *fig.* 5.

Encyc. Method. vol. 63. *tab.* 249. *fig.* 1.

By these dimensions it will appear to vary very considerably, being a regular oval; much elongated; ovate or nearly orbicular; sometimes with two or three longitudinal or oblique waves; rarely tuberculate; within parlaceous or red purple; teeth very thick, crenated, and resembling those of the next species. It is very probable that we have here included several distinct species, but at present we are not sufficiently well acquainted with the inhabitants to separate them. Gmelin refers to Lister's figure for his Mytillus Cygneus, but we can discover no resemblance between them.

Found plentifully in the river Ohio and its tributary streams.

2. *U. Plicata.* Shell suboval, thick and ponderous; valves with two or three more conspicuous undulations, which are profound, very oblique, continued to the anterior basal edge, and not arising from the umbo; umbo decorticated, sometimes much eroded; within parlaceous, distinctly impressed by the undulations.

This species may be distinguished from any of the numerous varieties of the preceding species by the oblique direction of the undulations, of which those nearest the base are largest and seem to originate behind the beaks.

It was found by Mr. Lesueur in Lake Erie, and was communicated by him under the above name.

3. *U. Purpureus.* Shell sub-oval, somewhat compressed, with smaller wrinkles placed between larger ones, colour dark brown; beaks placed nearer one end, very carious, not prominent, generally the epidermis and pearly strata are removed, exhibiting a wax-yellow ground: within reddish purple, varied with green; no cavity under the beak: teeth resemble the preceding.

Length, one inch and five-eighths: breadth, two inches and four-fifths.

Plate 3. fig. 1.

This species is more numerous in the rivers Delaware and Schuylkill than any other of the genus: in the rivers of the southern states it arrives at a more considerable magnitude, measuring sometimes four inches, or more, in breadth. These large specimens, and sometimes the smaller ones, are a little shortened on the base opposite to the lamellar teeth.

4. *U. Ovatus.* Shell sub-ovate, convex, not remarkably thick, horn colour, not radiated; flattened and fuscous on the anterior margin; beaks decorated, placed nearer central; umbo prominent; within parlaceous; cavity of the beaks capacious; primary teeth very oblique, almost parallel to the posterior margin and much compressed.

Length, three inches; breadth, four inches.

Inhabits the Ohio river and its tributary streams.

Encyc. Method. vol. 63. *tab.* 248. *fig.* 5.

Plate 2. fig. 7.

5. *U. Cariosus.* Shell moderately thick, much longer before, and shorter behind the beaks; olive green, sometimes radiate with green, and with fine interrupted wrinkles placed in longitudinal rows, but usually the green radii are wanting, or only visible in the anterior margin, and the wrinkled radii indistinct; in older shells the middle of the base is a little shortened; beaks somewhat prominent, rather distant, carious, exposing a wax-yellow surface; concavity bluish-white, teeth resembling those of the preceding species: but the primary ones are not so much compressed or oblique; they are often sub-conic and crenate.

Length, one inch and a half: breadth, two and a quarter.

Plate 3. fig. 2.

Musculus latior, subfuscus, Cæruleis lineis Radiatus. Lister. Conch. tab. 152. *fig*. 7.

Martini's figure of *U. Pictorum* resembles this shell in outline. Vol. 6.

Very common in the Delaware and Schuylkill rivers.

Gmelin, Ed. Syst. Nat. p. 3220, refers to Lister's figure as a variety of *Mya Radiata*, a native of Malabar: but we have ventured to consider it a distinct species; the largest we have seen was brought from Wilkesbarre by Mr. Lard. Vanuxem, in length 2¼, breadth, 3¾ inches. The animal is rarely infested by a parasite. See the article *Hydrachne*.

6. *U. Ochraceus*. Shell thin, fragile, translucent, subovate, hinge margin somewhat rectilinear, colour from a pale reddish orange to a pale olive; generally radiate with dull green and with minute wrinkled radii; anterior margin very finely wrinkled; beaks decorticated and approximate, with two or three small concentric undulations; within bluish-white or ochraceous, tinged with red near the base; teeth very oblique and much compressed.

Length, one inch and a quarter: breadth, one and three quarters.

Plate 2. fig. 8.

This shell, in many respects, resembles the preceding, with which it is found, but is not so obtuse in front, and is much less rounded at the hinge margin, it is also much thinner, and the beaks approach each other more closely.

7. *U. Nasutus*. Shell thin, oblong, compressed, rostrated, horn colour or fuscous, with fine cronded wrinkles, obscurely radiate with green; within bluish white; beak cavity hardly any, teeth crenate.

Length, one inch and one eighth: breadth, two and three-fifths.

Very common in the Delaware and Schuylkill.

Plate 4. fig. 1.

Musculus fuscus, augustior, exaltera parte Cuneatim protensus. Lister. Conch. tab. 151. *fig*. 6.

8. *U. Alatus*. Shell moderately thick, sub-triangular, generally gaping at the posterior part of the base, fuscous, wrinkled; beaks not prominent, placed very far back and decorticated; base almost rectilinear; hinge margin remarkably oblique, rising near the termination of the cartilage into an alated projection, and forming almost a right angle with the inferior slope, which is nearly equal in length; within red-purple, often with numerous tubercles, which, upon the gaping limb, are confluent; cicatrices very rough; teeth crenate, the external laminated one obsolete, only one in each valve being very perceptible.

Length, including the projection, three inches and four-fifths; breadth, five inches and a half.

Plate 4. fig. 2.

Encyc. Meth. vol. 63, tab. 248, fig. 1. a. b?

Mr. Lesueur found this species in Lake Erie, very thin and fragile.

The specimen from which this description is taken, and also the next species, were purchased by *Mr. Joseph Watson*, at the sale of the late Professor Barton's collection, and by him presented to the *Academy of Natural Sciences of Philadelphia.* There is also a specimen in the Museum of Mr. Peale.

9. *U. Cylindricus*. Shell very thick, sub-cylindrical, emarginate before, pale horn-colour varied with greenish; hinge margin undulated obliquely across the wrinkles, rough on each side, rectilinear and parallel to the base; beaks broad and prominent, with a deeply impressed posterior lunule; within perlaceous, teeth thick and crenate; cavity of the beaks very deep.

Length, one inch and three-tenths; breadth, three inches and one fifth.

Plate 4. fig. 3.

From the collection of the late professor Barton; it is said to be found in the river Wabash.

GENUS ALASMODONTA.

Shell, transverse, equivalve, inequilateral; hinge with a primary tooth in each valve; cicatrices three.

Animal resembling that of Unio?

SPECIES.

1. *Marginata*. Shell transversely oblong sub-oval, white, covered with an olive brown epidermis, obsoletely radiate with green, numerous concentric wrinkles; umbo with about three concentric undulations; ligament slope abruptly depressed, with numerous, obtuse, oblique rugæ, decussating the concentric ones,

which are obsolete in that part; within bluish-white, margin white; cavity of the umbo not distinctly impressed by the external undulations; tooth compressed; oblique, nearly parallel with the posterior slope, and terminating abruptly behind.

Length, exclusive of the umbo, one inch and one-fourth; breadth, two inches and a half.

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The inner margin is of a chalky whiteness, in this respect resembling *Anodonta Marginata.* It was found by Mr. Isaac Lea, in the river ———

2. *U. Undulata.* Shell thin, convex, suboval, greenish or olivaceous, with obtuse concentric wrinkles and radiate with green, a little uneven before; beaks prominent, acute, approximate, decorticated, and with four or five large, obtuse, distant, undulations, disappearing towards the basal margin: within bluish-white, cavity deep; teeth one in each valve, thick and strong; that of the left valve crenated, of the right valve somewhat bifid, and gradually sloping to the hinge margin.

Length, three-fifths of an inch: breadth, nine-tenths of an inch.

Plate 3. fig. 3.

Found in the Delaware and Schuylkill rivers, but is rather rare, and resembles *Anodonta Undulata.*

This genus, in conjunction with *Dipsas* of Leach, will complete the chain of connection between the two genera *Unio* and *Anodonta.* It corresponds with these genera in the number of its cicatrices, but is separable from *Anodonta*, by its primary tooth; from *Unio* by being destitute of the lamelliform teeth; and from *Dipsas*, also by the last mentioned character, as well as by the presence of a primary tooth, which is wanting in that genus.

This new genus we proposed in the former editions of this work, when describing the *Undulata*, under the name of *Monodonta;* but as the same term has been applied to a genus of univalves, I have substituted that of Alasmodonta.

GENUS ANODONTA.

Shell transverse, with three obsolete muscular impressions, hinge simple, destitute of teeth.

Obs. The shells which constitute this genus were arranged by Linnæus and many other writers, under the genus Mytillus.

SPECIES.

1. *A. Cataracta.* Shell thin, fragile, translucent, oblong oval, convex, covered with a green olive, radiated, epidermis, within perlaceous; beaks nearer central, frontal margin brown.

Length, two inches and two-fifths: breadth, four inches and an half: concavity of one valve nearly seven-eighths of an inch.

Plate 3. fig. 4.

This large muscle occurs in lakes, mill-dams, &c. and bears some resemblance to the *A. Anatinus* of Europe.

Found by Mr. I. Lukens, in the deep part of a mill-dam.

2. *A. Marginata.* Shell very thin, fragile, somewhat compressed, translucent, subovate; epidermis green olive, paler on the disk and greener before; anterior margin fuscous; beaks nearer the posterior end; within bluish white, edged with whitish.

Length, one inch and a half: breadth, two inches.

Plate 3. fig. 3.

Resembles the preceding, but is more ovate, and the beaks are placed much further back; it is very common in our rivers.

3. *A. Undulata.* Shell thin, fragile, convex, olivaceous, obscurely radiate and obtusely wrinkled; umbo prominent, decorticated, with four or five obtuse undulations disappearing on the disk. In the right valve, immediately under the beak, the margin is curved inwards for the reception of a corresponding marginal projection of the opposite valve.

Length, nearly half an inch: breadth, nearly seven-tenths of an inch.

Plate 3. fig. 6.

This species is perhaps rare: it does not exactly agree in all its characters with the genus, but approaches nearer it than to any other; it resembles *Alasmodonta Undulata*, for the young of which it might readily be mistaken.

GENUS CYCLAS.

Shell almost orbicular, or a little transverse, without fold on the anterior margin; two or three primary teeth, and lateral, remote, lamelliform ones on each side.

Observ. The shells of which this genus is composed were formerly placed with the *Cardia* and *Tellinæ*; to the former they are more closely allied; it was originally established by Scopoli under the name of *Sphærium,* this was changed by Lamarck to *Cylas,* which is now adopted by Latreille and other writers, notwithstanding the previous application of the term to a genus of plants.

SPECIES.

1. *C. Similis.* Shell suborbicular convex, base a little flattened; with nearly equi-distant, raised, concentric lines, giving a slightly sulcated appearance to the surface, and generally a more conspicuous elevated darker wave, marking the former year's growth of the shell. Epidermis brown or ferruginous; beak nearer central and obtuse; hinge with minute very oblique teeth, lateral ones very distinct, elongated, and considerably resembling those of the next species.

Length seven-twentieths of an inch: breadth two-fifths: a specimen measured in length nearly three-fifths of an inch.

Plate 1. fig. 9.

Very much resembles *Tellina Cornea* of authors; is found in plenty in the river Delaware; animal viviparous; from one specimen three pale yellow active young ones were taken, the largest of which measured in breadth three twentieths of an inch in the month of May.

2. *C. Dubia.* Shell oblique, subovate convex, concentrically wrinkled, very pale horn colour or whitish, with some times a darker, but not raised band, marking the preceding year's growth of the shell; beaks placed much nearer one end; within whitish, primary teeth very distinct, in one valve two divaricating ones, in the other but one, exterior lateral laminal tooth very small.

Length, five-twentieths of an inch; breadth, three-tenths.

Plate 1. fig. 10.

Inhabits the river Delaware in company with *C. Similis,* and very much resembles Tellina Amnica of Authors.

GENUS CYRENA, *Lam.*

Shell triagonally rounded, turgid, inequilateral, equivalve, robust; umbo eroded or decorticated; hinge three toothed in each valve; lateral teeth two, of which one is placed nearer to the primary ones; ligament exterior placed on the longest side.

Obs.. This genus has been but lately constructed by Lamarck, to receive such shells of the former genus *Cyclas* as have three primary teeth on each valve.

SPECIES.

C. Caroliniensis. Shell cordate, turgid, brown on the disk, with a yellowish or greenish margin and sub-margin, surface with numerous membranaceous wrinkles; umbo much eroded; beaks distant; two of the primary teeth caniliculate at tip.

Length, one inch and one-fourth; breadth, one inch and seven-twentieths.

Cyclas Caroliniensis, Bosc.

Inhabits the rivers of South Carolina, and Georgia, but is not found so far north as Pennsylvania. We found it in plenty near Charleston, South Carolina, and in St. Johns' River, East Florida.

The shells here described are in the collection of the Academy of Natural Sciences of Philadelphia.

It was originally the intention of the writer of this article to insert here, not only descriptions of the fresh water and land shells, but those of the coast also; finding, however, that the descriptions of the latter were by far too voluminous to be comprised within the space allotted to this article, and that they had more generally found a place in the systems, the design is, with respect to this work, necessarily relinquished. To all the species here described, with the exception of three or four, we have been constrained to adapt specific names; but should it appear that we have been anticipated by the labours of some recent conchologist, whose writings we have no opportunity to consult, we shall readily bow to the right of priority, which ought unquestionably to be on all occasions imperative and exclusive.

The primary divisions of the Linnæan system, in the latest edition of the "Systema Naturæ," as before observed, consist of three orders, Multivalve, Bivalve, and Univalve, each of which is subdivided into genera. The Multivalves contain the chiton, leapas and pholas: the Bivalves, mya, solen, tellina, cardium, mactra, donax, venus, spondylus, chama, arca, ostrea, anomia, mytilus, and pinna; and the Univalves, argonauta, nautilus, conus, cypræa, bulla, voluta, buccinum, strombus, murex, trochus, helix, nerita, haliotis, patella, dentalium, serpula, teredo, and sabella. Which see. See also SHELLS.

CONCLAVE, the place in which the cardinals of the Romish church meet, and are shut up, in order to the election of a pope. The conclave is a range of small cells, ten feet square, made of wainscot; these are numbered, and drawn for by lot. They stand in a line along the galleries and hall of the Vatican, with a small place between each. Every cell has the arms of the cardinal over it. The conclave is not fixed to any one determinate place, for the constitutions of the church allow the cardinals to make choice of such a place for the conclave as they think most convenient; yet it is generally held in the Vatican. The conclave is very strictly guarded by troops: neither the cardinals, nor any person shut up in the conclave, are spoke to but at the hours allowed of, and then in Italian or Latin; even the provisions for the conclave are examined, that no letters be conveyed by that means from the ministers of foreign powers, or other persons, who may have an interest in the election of the pontiff.

CONCLUSION, in logic, the consequence or judgment drawn from what was asserted in the premises; or the previous judgments in reasoning, gained from combining the extreme ideas between themselves.

CONCORD, in grammar, that part of construction, or syntax, in which the words of a sentence agree; that is, in which nouns are put in the same gender, number, and case; and verbs in the same number and person with nouns and pronouns.

Concord, in music, the relation of two sounds that are always agreeable to the ear, whether applied in succession or consonance. See Music.

CONCORDANCE, a sort of dictionary of the Bible, explaining the words thereof in alphabetical order, with the several books, chapters, and verses, quoted, in which they are contained.

CONCORDAT, a covenant or agreement with the Pope concerning the acquisition, permutation, and resignation of ecclesiastical benefices. In France, the term concordat denoted formerly an agreement concluded at Bologna, in 1516, between Pope Leo X. and Francis I. of France, for regulating the manner of nominating to benefices; but at present it applies exclusively to a convention exchanged between Pope Pius VII. and the French government on the 10th of September, 1801, in which the Roman Catholic religion is acknowledged to be that of the majority of the French people, and the free exercise of their religion is conceded to Calvinists and Lutherans, under the superintendance of government.

CONCRETE, in logic, is used in contradistinction to abstract; for example, when we consider any quality, as whiteness, inhering in any subject, as suppose in snow: if we may say the snow is white, then we speak of whiteness in the concrete; but if we consider whiteness by itself, as a quality that may be in paper, in ivory, and in other things, as well as in snow, we are then said to consider or to take it in the abstract.

CONCRETIONS, *morbid*, in animal economy, hard substances that occasionally make their appearance in different parts of the body, as well in the solids as in those cavities destined to contain fluids: in the first place they are denominated concretions, or ossifications: in the other, calculi. The concretions that make their appearance in the solids of the animal body are denominated pineal concretions, from their being found in that part of the brain called the pineal gland; or salivary concretions, as being discovered occasionally in the salivary glands; or pancreatic concretions, which are hard substances found in the pancreas; or pulmonary concretions, which have been sometimes coughed up by consumptive persons; or hepatic concretions, of which the liver is sometimes full: concretions have also been found in the prostate; these have all been examined by chemists, and found to consist of phosphate of lime and other substances. Concretions have been discovered in the intestines and stomach of the human body, but more frequently in those of animals: those found in the intestines of a horse were examined by Fourcroy, and found to consist of magnesia, phosphoric acid, ammonia, water, and animal matter. See Calculi & Chalk Stones.

CONDENSER, a pneumatic engine or syringe, whereby an uncommon quantity of air may be crowded into a given space: so that sometimes ten atmospheres, or ten times as much air as there is at the same time in the same space, without the engine, may be thrown in by means of it, and its egress prevented by valves properly disposed. See Pneumatics.

CONDIMENTS. Although these are not properly alimentary matters, or such as become ingredients in the composition of the animal fluid, yet Dr. Cullen says they are taken with advantage along with the proper aliments, the digestion and assimilation of which they in some degree modify. They are of two kinds, saline or acrid; having this acrimony for the most part residing in their oily parts. Of the first, the chief is sea-salt, and it is especially employed for preserving meat, before it is employed in diet, for a longer time than it could be otherwise preserved from putrefaction. For this purpose salt is applied in large proportions, and so incorporated with the substance of the meat, that it cannot be again washed out before the meat is employed in diet. Hence it happens, that when salted meats are eaten in that condition, the salt is often taken in, in large quantity, and diffused in the mass of blood. If the salted meats, however, be taken in moderate quantity only, Dr. Cullen says the salt has the effect of exciting the powers of digestion; and such meat is often more easily digested than entirely unsalted meats are.

Another important condiment is sugar. It is certainly antiseptic, and therefore properly employed in preventing the putrefaction of meat. It is also frequently applied to vegetables; but from the preparation of boiling, which is commonly necessary in order to their being impregnated with the sugar, the condita, except a few that contain a large proportion of a more fixed aromatic substance, can be considered only as sugar. This is often applied to the acid and acescent fruits; and when applied in the consistence of a syrup, it preserves them for a long time from any fermentation, but it does not destroy their acescency; and when such preserves are taken into the stomach, the sugar introduced along with them renders them much disposed to an acescent fermentation. In the quantity that sugar is commonly employed, either for improving the relish of several kinds of food, or for correcting their acidity, it can only be hurtful by its acescency in the stomach, and can hardly make any proper part of the mass of blood. If taken in very large quantities, and in greater proportion than it can enter into the composition of the animal fluid, sugar, Dr. Cullen thinks, may increase the saline state of the blood, and induce disorders.

Vinegar, another saline condiment, is a powerful antiseptic, employed in several ways for preserving animal substances from putrefaction. We must consider vinegar as a vegetable acid, that may be taken with more safety than the fossil acid. Acrid substances are also employed as condiments. These are especially taken from the class of tetradynamia, and they are chiefly the mustard and horse-radish. Taken in with our food, they stimulate the stomach and assist digestion; and further, as they evidently promote perspiration and urine, they obviate the putrescent tendency of the system. This has been so much remarked, that the vegetables of this class, as fraught with this peculiar acrimony, are justly denominated antiscorbutic.

To the list of condiments, Dr. Cullen adds capsicum, ketchup, and soy; and concludes his strictures on them by observing, that the whole of our seasonings consists of salt, vinegar, and aromatics, combined together: and "if they are taken only in the quantity necessary to render the food more sapid, they may increase the appetite and favour full eating; but they can hardly otherwise do harm, unless when the aromatics are taken in such large quantity as to weaken the tone of the stomach."

CONDITION, in law, a restraint annexed to a thing, one of the terms upon which a grant may be made on a contingency, upon the happening of which the estate may be defeated; as a mortgage which is to cease upon payment of a certain sum. Conditions are either in deed, or express; in law, or implied; precedent; subsequent; inherent; collateral; affirmative; negative; single; copulative. A condition precedent is one, the happening of which is to precede the vesting of the estate or a thing granted. A condition subsequent, by happening after the vesting of the estate, defeats, continues, or extends it; and this distinction is of frequent occurrence and great importance. A condition in deed differs from a limitation of an estate, chiefly in that the former defines the estate, which cannot exceed the limits set to it in the original grant; but upon an express condition in deed, the estate continues until the grantor, who may take advantage of it, enters to defeat it. See LIMITATION. Conditions which are impossible, contrary to law, or repugnant to the nature of the estate, are void, and consequently the estate, if the condition be subsequent, becomes absolute, by being freed from the condition; but if precedent, the estate can never vest. Those which give or enlarge an estate are favourably, those which restrain or defeat it, strictly construed; and conditions in restraint of marriage are not favoured, unless reasonable, but must be performed where the thing is limited over to a third person. The right of taking advantage of a condition can be reserved only to the party, his heir, executor, or privities, in right and representation. A familiar instance of a condition is a bond with a penalty, conditioned to be void on payment of a less sum.

Condition, or *Condition implied*, is when a person grants an office to another as keeper of a park for life; though there be no condition expressed in the grant, yet the law makes one covertly, which is, that if the grantee does not execute all things belonging to his office, it shall be lawful for the grantor to discharge him.

CONDITIONAL *syllogism*, a syllogism where the major is a conditional proposition. Thus,

If there is a God, he ought to be worshipped.
But there is a God;
Therefore he ought to be worshipped.

CONDUCTOR, in surgery, an instrument which serves to conduct the knife in the operation of cutting for the stone, and in laying open sinuses and fistulas.

Conductors, in electricity, are long metal rods, whose points are raised so high as may be convenient, above houses, &c. for the purpose of attracting or receiving the electric fluid, and of conducting it into the earth, or into water, thereby to prevent the building from being struck by lightning. To effect this, the rod should be detached, and its point should be sharp; by which mean the electric fluid will be silently discharged. If the conductor is allowed to lay along the wall of the house, or that it is blunt, instead of being pointed, at its summit, it will attract the lightning, which in such case will do more or less damage to the building. Thus the rod should be kept from the walls, &c. by pieces of well-seasoned wood, coated with resin, or of lead, which, as well as glass, sealing-wax, sulphur, bees'-wax, oil-water, &c. are all non-conductors while cold; though, when heated to a great degree, they become conductors. The rod should pass freely from the top of the building to the ground, without the line of its continuity being any where broken. It is found that black lead is an excellent aid, both to affix as a sharp point to the apex, and to be laid at a few feet deep in the earth, where it is moist and surrounded by a bed of charcoal. The rod should pass into the mass of black lead, which will cause the electric fluid to be extinguished. Where buildings are extensive, and especially where there are many high chimneys, turrets, &c. two or more conductors should be used, else the electric fluid, in its passage from a charged cloud, may be intercepted by such heights, and do considerable injury. Trees standing single on plains are very dangerous conductors, as are those lofty trees that rear their heads conspicuously in large woods. Hence we so often see them rent to pieces by lightning, and such cattle as take refuge under their inviting shelter destroyed. Walls are conductors when lightning has entered a room; therefore all persons should avoid sitting near them during thunder storms; and in countries where lightning is frequent, care should be taken to remove iron bars, &c. For the various amusing and interesting matters relating to Electricity, we must refer the reader to that article, and to Galvanism.

CONDYLOMA, in medicine, a tubercle or callous eminence which arises in the folds of the anus, or rather a swelling or hardening of the wrinkles of that part.

CONE, in geometry, a solid figure, having a circle for its base, and its top terminated in a point or vertex.

Cone, *Properties of the*. 1. Cones and pyramids having the same bases and altitudes are equal to each other. It is shewn, that every triangular prism may be divided into three equal pyramids, and therefore that a triangular pyramid is one-third of a prism standing on the same base, and having the same altitude. Hence, since every multangular body may be resolved into triangular ones, every pyramid is the third part of a prism standing upon the same base, and having the same altitude; and as a cone may be esteemed an infinite angular pyramid, and a cylinder an infinite angular prism, a cone is the third part of a cylinder which has the same base and altitude. Hence we have a method of measuring the solidity and surface of a cone and pyramid. Thus, find the solidity of a prism or cylinder, having the same base with the cone or pyramid, which found, divide by three, the quotient will be the solidity of the cone or pyramid. Or the solidity of any cone is equal to the area of the base, multiplied into one third part of its altitude. As for the surfaces, that of a right cone, not taking in the base, is equal to a triangle, whose base is the periphery and altitude of the side of the cone; therefore the surface of a right cone is had by multiplying the periphery of the base into half of the side, and adding the product to that of the base.

2. The altitudes of similar cones are as the radii of the bases, and the axes, like-

wise, are as the radii of the bases, and form the same angle with them.

3. Cones are to one another in a ratio compounded of their bases and altitudes.

4. Similar cones are in a triplicate ratio of their homologous sides, and likewise of their altitudes.

5. Of the cones standing upon the same base, and having the same altitude, the superfices of that which is most oblique is the greatest, and so the superfices of the right cone is the least; but the proportion of the superfices of an oblique cone to that of a right one, or, which is the same thing, the comparison thereof to a circle, or the conic sections, has not yet been determined.

Cones of the higher kinds, those whose bases, and sections parallel to the bases, are circles of the higher kinds. They are generated by supposing a right line fixed in a point on high, but conceived to be capable of being extended more or less on occasion, and moved round the periphery of a circle.

CONFECTION. See Pharmacy.

CONFEDERACY, is when two or more confederate, to do any damage or injury to another, or to commit any unlawful act. And though a writ of confederacy do not lie, if the party be not indicted, and in a lawful manner acquitted, yet false confederacy between divers persons shall be punished, though nothing be put in execution.

CONFERVA, in botany, river weed, a genus of the Cryptogamia Algæ. Essential character: unequal tubercles, in very long capillary filaments. Twenty-one species are recited in Linnæus's system of vegetables. These are all inhabitants of the water, some in fresh, but more in salt water. A singular instance of irritability has been observed in the Conferva corallina, upon its being immersed into fresh water; after it had been in a few minutes, several fibres were observed to move in a horizontal direction with a quick convulsive twitch, and then to stop suddenly; this they continued to do for some length of time, and the same effect may be produced several times, provided the plant be fresh. The experiment does not succeed in salt water.

CONFESSION of an offence, is when a prisoner is arraigned, and his indictment being read, either he confesses the offence, or pleads not guilty. Confession is express or implicit. Express, where one in open court confesses the crime, is the most satifactory ground of conviction. Implied, is where the defendant, in a case not capital, yields to the king's mercy, and desires to submit to a small fine; which the court may accept without requiring a direct confession. The presumption of guilt in this case is so strong, that the defendant cannot afterwards in a civil action deny the trespass.

Confession, previous to trial, before a justice, &c. may also be given in evidence afterwards, as against the individual confessing; but it must be voluntary, not upon promise or threats, and must be taken in time. After confession, the party may take advantage of errors in the indictment in arrest of judgment. Confession may also be in a civil action, and is commonly on a warrant of attorney for that purpose, which, being after accompanied with a bond, is vulgarly called a bond and judgment.

CONFIRMATION, is a conveyance of an actual, not a reversionary, estate or right, which one has to lands, &c. to another having the possession of, or having an estate in them, whereby that estate is increased, the possession made perfect, or, if voidable, it is rendered secure. It does not regularly create an estate, but may be connected with words which create a further estate. It is necessary that the one party should have an estate in possession by right or wrong, and the other an estate on right from which the confirmation may come, and the one estate must continue till the other operates.

Confirmation, in rhetoric, the third part of an oration, wherein the orator undertakes to prove the truth of the proposition advanced in his narration: and is either direct or indirect. Direct, confirms what he has to urge for strengthening his own cause. Indirect, properly called confutation, tends to refute the arguments of his adversaries.

CONFISCATE, from *confiscase*, and that from *fiscus*, the emperor's treasure. Any goods, which, being disclaimed by another, as a felon upon trial, comes to the king, although they are the felon's own. Those which he claims, as his own, are, upon conviction, not confiscate, but forfeited to to the king.

CONFLUENT, in natural history, running into each other; joined.

CONFUSION *of tongues*, a memorable event which happened, according to the Hebrew chronology, one hundred and one years after the flood, at the overthrow of Babel, and which was providentially brought about to facilitate the dispersion of mankind, and the population of the earth. Hitherto there had been but one common language, which formed a bond of union that prevented the separation of mankind into distinct nations; and some have imagined that the tower of Babel was erected as a kind of fortress, by which the people intended to defend themselves against that separation which Noah had projected.

CONGE D'ELIRE. The king's permission royal to a dean and chapter, in time of a vacation of the see, to choose or elect a bishop. See BISHOP.

CONGELATION, may be defined the transition of a liquid into a solid state, in consequence of an abstraction of heat: thus metals, oil, water, &c. are said to congeal when they pass from a fluid into a solid state. With regard to fluids, congelation and freezing mean the same thing. Water congeals at 32°, and there are few liquids that will not congeal, if the temperature be brought sufficiently low. The only difficulty is, to obtain a temperature equal to the effect; hence it has been inferred that fluidity is the consequence of caloric. See FLUIDITY. Every particular kind of substance requires a different degree of temperature for its congelation, which affords an obvious reason why particular substances remain always fluid, while others remain always solid, in the common temperature of the atmosphere; and why others are sometimes fluid, and at others solid, according to the vicissitudes of the seasons, and the variety of climates. See COLD, FREEZING.

CONGREGATION, an assembly of several ecclesiastics united, so as to constitute one body; as an assembly of cardinals, in the constitution of the pope's court, met for the dispatch of some particular business.

CONGREGATION, is likewise used for assemblies of pious persons, in manner of fraternities.

CONGREGATIONALISTS, in church history, a sect of protestants who reject all church government, except that of a single congregation. In other matters, they agree with the presbyterians. See PRESBYTERIANS.

CONGRESS, in political affairs, an assembly of commissioners, envoys, deputies, &c. from several courts, meeting to concert matters for their common good.

CONGRUITY, in geometry, is applied to figures, lines, &c. which, being laid upon each other, exactly agree in all their parts, as having the very same dimensions.

CONIC *sections*, as the name imports, are such curve lines as are produced by the mutual intersection of a plane and the surface of a solid cone. The nature and properties of these figures were the subject of an extensive branch of the ancient geometry, and formed a speculation well suited to the subtle genius of the Greeks. In modern times the conic geometry is intimately connected with every part of the higher mathematics and natural philosophy. A knowledge of those discoveries, that do the greatest honour to the last and the present centuries, cannot be attained without a familiar acquaintance with the figures that are now to engage our attention.

We are chiefly indebted to the preservation of the writings of Apollonius for a knowledge of the theory of the ancient geometricians concerning the conic sections. Apollonius was born at Perga, a town of Phamphylia, and he is said to have lived under Ptolemy Philopater, about forty years posterior to Archimedes. Besides his great work on the conic sections, he published many smaller treatises, relating chiefly to the geometrical analysis, which have all perished. The treatise of Apollonius on the conic sections is written in eight books, and it was esteemed a work of so much merit by his contemporaries, as to procure for its author the title of the great geometrician Only the four first books have come down to us in the original Greek. On the revival of learning, the lovers of the mathematics had long to regret the original of the four last books In the year 1658, Borelli, passing through Florence, found an Arabic manuscript in the library of the Medici family, which he judged to be a translation of all the eight books of the conics of Apollonius: but on examination, it was found to contain the first seven books only. Two other Arabic translations of the conics of Apollonius have been discovered by the industry of learned men: and as they all agree in the want of the eighth book, we may now regard that part of the treatise as irrecoverably lost. The work of Apollonius contains a very extensive, if not a complete, theory of the conic sections. The best edition of it is that published by Dr. Halley, in 1710: to which the learned author has added a restoration of the eighth book, executed with so much ability as to leave little room to regret the original.

Since the revival of learning, the theory of the conic sections has been much cultivated, and is the subject of a great variety of ingenious writings. Dr. Wallis, in his treatise "De Sectionibus Conicis," published at Oxford, in 1655, deduced the properties of the curves from a description of them on a plane. Since this time authors have been much divided as to the best way of defining the curves, and demonstrating their elementary properties; many, in imitation of the ancient geometricians, making the cone the groundwork of their theories; while others have followed the example of Dr. Wallis.

OF THE CONE AND ITS SECTIONS.

Definitions.

Let ADB be a circle (Fig. 1, Plate I. Conic Sections) and V a fixed point without the plane of the circle; then if a right line passing continually through the point V, be carried round the whole periphery of the circle ADB, that right line being extended indefinitely on the same side of V as the circle, will describe a conic surface; and if it be likewise extended indefinitely on the other side of V, it will describe two opposite conic surfaces.

Cor. A straight line drawn from the vertex to any point in a conic surface, being produced indefinitely, is wholly in the opposite surfaces.

For a line so drawn will coincide with the line that generates the conic surfaces, when this line, by being carried round the circumference of the base, comes to the proposed point.

II. The solid figure, contained by the conic surface and the circle ADB, is called a cone. The point V is named the vertex of the cone; the line, CV, drawn to the centre of the circle, the axis of the cone; and the circle ADB, the base of the cone.

III. A right cone is when the axis is perpendicular to the plane of the base; otherwise it is a scalene, or oblique cone.

IV. A right line that meets a conic surface in one point only, and is every where else without that surface, is called a tangent.

PROP. I.

Fig. 1. The common intersection of a conic surface and a plane, V D E, that passes through the vertex, and cuts the base of the cone, is a rectilineal triangle.

For the common section of the plane of the base, and the plane drawn through the vertex (which is a right line 3. 11. E) will cut the periphery of the base in two points, D and E, and in these two points only: then, having drawn DV and EV to the vertex of the cone, these lines will be both in the conic surface (Cor. Def. 1.) and also in the plane surface; and there are no points, excepting in these lines indefinitely produced, which are common to both the surfaces. Therefore the figure D V E, which is the common intersection of the cone and a plane through the vertex, is a rectilineal triangle.

PROP. II.

Fig. 2. If a point E, be assumed in a conic surface, and a line, PQ, be drawn through it so as to be parallel to a right line, VB, passing through the vertex, and contained in the conic surfaces: then the right line P Q, will not meet either of the opposite surfaces in another point, but it will fall within the surface in which the assumed point E is, on the one side, and it will be wholly without both surfaces on the other side.

For if a plane be conceived to be drawn through the line VB and the point E, the line P Q, parallel to V B, will be wholly in that plane, 7. 11 E; and the common sections of the plane and the conic surfaces will be the line V B and the line V E C, drawn through the vertex and the point E, Pr. I. Now the line, QP, does not meet either of the lines V B or V C in another point different from E. Also QE, the part of the line that is contained in the angle B V C, is within the cone; and P E, the part of it that is contained in the angle CVN, is without both the opposite surfaces.

PROP. III.

Fig 3. If a plane be drawn through the vertex of a cone and a tangent of the conic surface GH, it will meet the conic surface only in the line V D, drawn through the vertex of the cone and the point of contact of the tangent.

For, because the point D and the vertex V are common both to the plane surface and to the conic surface, therefore the line VD, indefinitely produced, is likewise common to both surfaces. And because G H meets the conic surface only in the point D, and is every where else without the surface, therefore any line (different from V D) as VF, drawn in one of the conic surfaces, is contained on one side of the plane; and the same line continued in the opposite conic surface, as V K, is contained on the other side of the plane.

Cor. 1. Any straight line drawn in the plane VGH, so as to meet the line VD, is a tangent of the conic surfaces.

Cor. 2. No other plane, besides the plane VGH, can be drawn so as to touch the conic surfaces in the line VD, without cutting them.

For RS, the common section of the plane VGH, and the plane of the base, is a tangent to the periphery of the base, Cor. 1. And if there were two such planes, there would likewise be two tangents of a circle drawn through the same point of the periphery, which is absurd.

PROP. IV.

Fig. 4. A right line drawn through a point of a conic surface, so as neither to be a tangent, nor to be parallel to a right line contained in the conic surface, will meet either the same, or the opposite, conic surface again in another point.

Let a plane be drawn through the vertex of the cone and the right line (DB or DC) then that plane will cut the cone; for if it did not, the right line (DB or DC) would be a tangent contrary to the hypothesis. Let VG and VH be the common sections of the plane and the conic surface; then the right line (DB or DC) will not be parallel to VH contained in the conic surface (*h y p*), therefore it will meet VH either in the same conic surface (as DB), or when produced in the opposite conic surface (as DC.)

PROP. V.

Fig. 5. If either of two opposite conic surfaces be cut by a plane parallel to the base of the cone, the section is a circle, having its centre in the axis of the cone.

Through V C, the axis of the cone, let two planes be drawn, cutting the base in the lines CD and CE, and the plane parallel to the base in the lines GH and GL, and the conic surfaces in the lines V H D and V L E: then because the base is parallel to the cutting plane, therefore C D is parallel to G H, and C E to G L, 16. 11. E. Therefore, on account of equiangular triangles, 4. 6. E.

DC : CV : : HG : GV
CV : CE : : GV : GL
Ex æquo DC : CE : : HG : GL

But DC = CE, therefore HG = GL. And in like manner it may be shown that any right line drawn from G to a point in the intersection of the plane, and the conic surface, is equal to GH; therefore the section is a circle.

Cor. If through a point situated within or without a conic surface, two straight lines, both parallel to the plane of the base of the cone, (that is parallel to straight lines in that plane,) be drawn to cut or touch the conic surface: then the rectangle contained by the two segments (between the point and the conic surface,) of one of the lines when it cuts, or the square of its segments when it touches the conic surface, is equal to the rectangle contained by the two segments of the other line when it cuts, or to the square of its segment when it touches the conic surface.

For a plane drawn through the two lines will be parallel to the plane of the base, 15. 16. E; and it will intersect the conic surface of the periphery of a circle; whence the corollory is manifest, 35 and 36. 3. E.

When a straight line drawn through a point, situated within or without a cone, meets one or both of the conic surfaces in two points, it is called a secant; and the two parts of such a line, between the point through which it is drawn, and the conic surface or surfaces, are called the segments of the secant. And when a line, drawn from a point without a cone, touches one of the conic surfaces, that part of it between the point from which it is drawn and the conic surface is denoted by the word tangent, in the following propositions.

PROP. VI.

Fig. 6, 7, and 8. If a straight line be drawn from the vertex of a cone, to a point, as B, in the plane of the base, but not in the periphery of the base; and, through any point, as P, situated without or within the cone, another straight line, parallel to the former, be drawn to cut or touch the conic surface or opposite surfaces; then the square of the line drawn from the vertex of the cone to the point B is to the rectangle under the segments of the secant, or to the square of the tangent, drawn from the point P, as the rectangle under the segments of any line drawn from B, to cut the base of the cone, is to the rectangle under the segments of any line parallel to the base of the cone, drawn through the point P, to cut the conic surface.

Fig. 6. Let the point B be without the base of the cone, and let QR, drawn through P, without or within the conic surface, be parallel to VB, and let it cut the conic surface in Q and R: through P and the line VB draw a plane cutting the conic surface in the lines V G and V H, and the plane of the base in the line B G H; and through P draw L K parallel to G H. Because V B and PRQ are parallel, therefore the line P R Q is contained in the plane B V P, 7. 11. E.; and the points Q and R are in the lines V H and V G, the common sections of the plane and the conic surface. Because Q P is parallel to V B, and L K to GH, therefore the triangle QPL is equiangular to the triangle VBH, and the triangle PKR to the triangle V G B: therefore 4. 6. E.

$$VB : PR :: BG : PK$$
$$VB : PQ :: BH : PL$$

Consequently, $VB^2 : PR \times PQ :: BG \times BH : PK \times PL$, 23. 6. E. But the rectangle $BG \times BH$ is equal to the rectangle under the segments of any other line drawn from B to cut the base of the cone, 35, and 36. 3. E; and the rectangle $PK \times KL$ is equal to the rectangle under the segments of any other line, parallel to the plane of the base, drawn from P to cut the conic surface, Cor. Pr. 5; and hence the proportion is manifest in this case.

Fig. 7. And if the point B be within the base of the cone, and a straight line as (PQR), parallel to the line V B that joins the point B and the vertex of the cone, be drawn to cut the opposite surfaces through a point P, situated without or within the cone: the proposition may be demonstrated, in this case, in the very same words as in the former case.

And if the point P (fig 8.) be without the cone as well as the line V B, and PS, parallel to V B, be drawn to touch the conic surface, instead of cutting it; then the plane PVB will meet the conic surface in a line V S M; and B M will touch the base of the cone, and P N, parallel to B M, will touch the conic surface. And because the two triangles S P N and V B M are equiangular, therefore,

$$VB : PS :: BM : PN$$
$$\text{And } VB^2 : PS^2 :: BM^2 : PN^2$$

But BM^2 is equal to the rectangle under the segments of any line drawn from B to cut the base of the cone; and PN^2 is equal to the rectangle under the segments of any line, parallel to the base of the cone, drawn from P to cut the conic surface; and hence the proposition is manifest in this case also.

PROP. VII.

Fig. 9. If a point be assumed without or within a cone, and two lines be drawn through it to meet a conic surface, or opposite surfaces, and so as to be parallel to two straight lines given by position; then the rectangle under the segments of the secant, or the square of the tangent, parallel to one of the lines given by position, has to the rectangle under the segments of the secant, or to the square of the tangent parallel to the other line given by position, a ratio that is constantly the same, wherever the point (from which the lines are drawn) is assumed, without or within the cone.

Let VB and VC be two straight lines, (fig. 9.) drawn from the vertex of a cone to the plane of the base, and given by position (or parallel to lines given by position:) and let P Q and M N be two straight lines drawn through any assumed point, as R, to cut the conic surface, and so as to be respectively parallel to C V and V B: and as CV^2 is to the rectangle $CK \times CL$ (contained by the segments of any line drawn from C to cut the base of the cone,) so let D, any assumed line or magnitude be to E: and as VB^2 is to $BG \times BH$ (the rectangle contained by the segments of any line drawn from B to cut the base of the cone,) so let F be to E: and draw S T parallel to the base of the cone through the point R; then, Pr. 6.

($CV^2 : CK \times CL$, or) ($D : E :: PR \times RQ : SR \times RT$, and $BV^2 : BG^2 \times BH$, or) $F : E :: MR \times RN : SR \times RT$. Therefore, invertendo and ex æquo.

$$D : F :: PR \times RQ : MR \times RN.$$

And as the same reasoning applies wherever the point R is assumed, therefore the ratio of the rectangles $PR \times RQ$, and $MR \times RN$, is the same with, or equal to the constant ratio of D to F, wherever the point R is assumed.

And in like manner may the proposition be demonstrated in all other cases, or in all positions of the lines P Q, and M N, whether they cut, or touch, the same or opposite surfaces.

PROP. VIII.

Fig. 10. If a right line, as P T, drawn through a point P in the surface of a cone, so as to be parallel to a right line V B contained in the conic surface meet two parallel lines (in the points R and S) that cut or touch the conic surface or opposite surfaces: then P R is to P S as the rectangle under the segments of the secant, or the square of the tangent, drawn through the point R, is to the rectangle under the segments of the secant, or to the square of the tangent drawn through the point S.

Through the two parallels P T and V B (fig. 10.) draw a plane cutting the conic surface again in the line V A, and the plane of the base in the line B A; and, through R and S, draw M N and H G parallel to A B. Because P T is parallel to V B, and R N to S G, therefore R N G S is a parallelogram; and R N is = G S. It is obvious that the triangles P M R and P H S are equiangular: therefore P R is to P S as M R is to H S, 4. 6. E, or as M R × R N is to H S × S G, 1. 6. E. But M R × R N and H S × S G are respectively equal to the rectangles contained by the segments of any two lines, parallel to the base of the cone, drawn through R and S to cut the conic surface, Cor. Pr; 5, and hence the proposition is manifest, when P T meets two lines parallel to the plane of the base.

And if P T meet two parallel lines D E and I K, not parallel to the plane of the base; then let the same construction be made as before: and because D E is parallel to I K, and M N to G H; therefore,

D R × R E : M R × R N :: I S × S K : H S × S G;

Alternando, D R × R E : I S × S K :: M R × R N : H S × S G. Therefore, as is obvious from what has already been shewn,

P R : P S :: D R × R E : I S × S K.

And if S be without the cone, and the line drawn through it touch the conic surface instead of cutting it, the reasoning is still the same, when the square of the tangent is taken in place of the rectangle under the segments of the secant.

PROP. IX.

Fig. 11. Let a scalene cone be cut by a plane drawn through the axis perpendiculiar to the plane of the base, making the triangular section V A B; and let V D, cutting A B produced in D, be drawn so as to make the angle B V D equal to the angle V A B, and draw M N in the plane of the base, perpendicular to A D; then every section of the cone, as P S Q, made by a plane parallel to the plane V M N (called a subcontrary section) is a circle; and every circular section of the cone, which is not parallel to the base, is a subcontrary section.

Draw T S in the plane of the section parallel to M N, which is plainly possible, because the two planes P Q and V M N are parallel: because T S is parallel to M N, a line in the plane of the base, therefore every plane drawn through S T will cut the base in a line parallel to S T (16. 11. E.:) therefore L O K, the common section of the base, and a plane drawn through V and S T is parallel to S T and M N (9. 11. E.): therefore K O L is perpendicular to A B, and it is bisected in O; therefore S T is bisected in R. Again, the line P Q is parallel to V D, therefore $VD^2 : PR \times RQ :: AD \times DB : TR \times RS$ (6.) But if a circle be described about the triangle A V B, D V will be a tangent of that circle (32. 3. E): therefore $VD^2 = AD \times DB$, and consequently, $PR \times RQ = TR \times RS$, or RT^2 (36. 3. E.) Because the plane A V D is perpendicular to the base (*h y p*) and M N is perpendicular to A D: therefore M N is perpendicular to the plane A V D: therefore, T R, parallel to M N, is perpendicular to the same plane, and to P Q. And hence, from what has already been shewn, the section P Q is a circle.

Next, let P Q be a circular section, not parallel to the base of the cone: draw a plane through the vertex, parallel to the plane P Q, and let it cut the base in the line M N: draw A D through the centre of the base perpendicular to M N, and let a plane drawn through V and A D cut the parallel planes in the lines P Q and V D, and the conic surface in the lines A V and V B: draw the plane V T L K S through S T parallel to M N, as before. It is shewn, as above, that T S is bisected in R: and, in like manner, it may be proved that any other line, as G H, parallel to M N, is bisected. Because P Q, a line in a circle, bisects two or more parallels, it is a diameter of the circle, and it cuts all the parallels at right angles. Because T S is perpendicular to P Q, therefore M N is perpendicular to D V (parallel to P Q); but M N is also perpendicular to D A, therefore it is perpendicular to the plane D A V (4. 11. E.): therefore A V B is a section of the cone through the axis at right angles to the base (18. 11. E.) Again, because the section is a circle, therefore P R × R Q = S R × R T: consequently $VD^2 = AD \times DB$ (Pr. 6.) Therefore V D is a tangent of the circle described about the triangle A V B, and the angle D V B is equal to the angle A V B (32. 3. E.) Therefore the circular section is a subcontrary one.

Cor. No other than a parallel and a subcontrary section of a cone is a circle.

Fig. 12, 13, 14. If a cone be cut by a plane P Q, which neither passes through the vertex, nor is parallel to the base, then a plane, as V M N, being drawn through the vertex parallel to the cutting plane, it will necessarily meet the plane of the base of the cone. The line of common section of the parallel plane, and the base of the cone M N, may have one or other of these three different positions, *viz.*

1. It may be without the base of the cone.
2. It may touch the periphery of the base.
3. It may cut the periphery of the base.

These three different cases offer three sections for our consideration, that are very different from one another, and possess many properties peculiar to each, while they have many common to all the three.

Def. 5. *Fig.* 12. If the line of common section M N be without the base of the cone, then the plane V M N drawn through the vertex will be entirely between the two conic surfaces, not meeting either of them. In this case the cutting plane P Q will meet every line drawn in one of the conic surfaces, and the curve line of common section will surround that conic surface, and will completely inclose a space. In this position of the cutting plane, the line of common section, unless when it is a circle, is called an ellipse.

Def. 6. *Fig.* 13. If the line of common section M N, touch the periphery of the base of the cone, then the plane drawn through the vertex will touch the conic surfaces (Pr. 3.) and the opposite surfaces will be on opposite sides of it. In this case the cutting plane will meet every line drawn from the vertex in one of the conic surfaces, excepting only the line V B, in which the touching plane meets the conic surface; and as the cutting plane is indefinitely extended along the touching plane without meeting it, it is obvious that the curve line, formed by the common section of the cutting plane and the conic surface, does not return into itself so as to inclose a space, but it is open on the side opposite to the vertex of the cone. In this position of the cutting plane, the conic section is called a parabola.

Cor. 1. Every right line drawn in the plane of a parabola, which meets the curve in one point, but neither touches the curve, (see Def. 8,) nor is parallel to the line V B in the conic surface, will meet the parabola again in another point. This is manifest from Prop. IV.

Cor. 2. All right lines drawn in the plane of a parabola, which meet the curve in one point only, but are not tangents, are parallel to one another. For they are all parallel to the line V B in the conic surface. (Cor. 1.)

Def. 7. *Fig.* 14. If the line of common section MN cut the periphery of the base, then the plane drawn through the vertex will divide each of the opposite conic surfaces into two parts, lying on opposite sides of it. In this case the cutting plane, being indefinitely extended, will meet every line drawn from the vertex in those parts of the two conic surfaces that lie on the same side of the plane through the vertex as the cutting plane itself; and thus two curves will be formed by the common intersection of the cutting plane, and the two opposite conic surfaces. It is obvious, that these curve lines may be indefinitely extended, and that they do not return into themselves so as to inclose a space. In this position of the cutting plane, the conic section formed by its intersection with one of the conic surfaces is called a hyperbola; and the two conic sections formed by its intersection with the two opposite conic surfaces are called opposite hyperbolas, or opposite sections.

Cor. 1. Let m V n be the common section of the cone, and a plane drawn through the vertex parallel to the plane of the two hyperbolas: then every right line drawn through a point of one of the hyperbolas, so as to be parallel to either of the two lines V m or V n will not meet either of the two curves again in another point. (Pr. 2.)

Cor. 2. Every right line drawn in the plane of the hyperbolas, which meets one of the curves, but is not a tangent, nor parallel to V m nor V n, will meet the same, or the opposite hyperbola, again in another point. (Pr. 4.) If it be parallel to VO, a line contained in the angle m V n will meet the opposite hyperbola: but if it be parallel to RVS, without the angle m V n, it will meet the same hyperbola again.

Def. 8. A right line drawn in the plane of a conic section, so as to meet the curve of the section in one point only, and which, being produced both ways, is contained on one and the same side of the section, is called a tangent of the section.

Cor. 1. A tangent of a conic section is a tangent of the conic surface. For it can meet the conic surface only in the point in which it meets the section.

Cor. 2. There cannot be more than one tangent of a conic section at the same point of the curve. For if there were two tangents, then two planes drawn through them and the vertex of the cone would meet the conic surface in the same right line without cutting the conic surface, which is absurd. (Cor. 2. Pr. 3.)

PROP. X.

If a point be assumed without or within a conic section, and two straight lines be drawn through it to cut the section, or opposite sections, and so as to be parallel to two lines given by position: then the rectangle under the segments of the secant, or the square of the tangent, parallel to one of the lines given by position, will have to the rectangl under the segments of the secant, or to the square of the tangent, parallel to the other line given by position, a ratio that is always the same, wherever the point (through which the line is drawn) is assumed without or within the section. For secants and tangents of a conic section are secants and tangents of a conic surface: and thus this proposition is included in Proposition VII.

LEMMA I.

Fig. 15. If there be any number of right lines, as DE, PQ, and FG, all parallel to one another, and all terminating in the same two right lines DF and EG; then a right line, as BC, which bisects two of the parallels, will bisect all the rest.

Draw DHL and EKR parallel to BC: because DB = BE and FC = CG, therefore FL = RG. It is plain that FL : PH :: RG : KQ; and therefore PH = KQ, consequently PO = OQ.

LEMMA II.

Fig. 16. If a right line AB, or a right line produced, be so divided in C and D, that AC × CB = AD × DB : then AC = BD, and AD = CB.

Bisect AB in O. Then the difference of AO^2 and AC × CB is equal to CO^2 (5 and 6. 2. E): and the difference of AO^2 and AD × DB is equal to DO^2 : therefore $CO^2 = DO^2$, whence the lemma is manifest.

PROP. XI.

Fig. 17, 18, 19, 20. If a right line, as BC, bisect two parallel right lines, DE and FG, terminated both ways by a conic section, or opposite sections; the same right line BC will bisect every other right line, as PQ, terminated by the section, or opposite sections, and parallel to the two former right lines.

Join DF and EG: then these lines are either parallel to one another, or, being produced, if necessary, they will meet.

1. When FE and EG are parallel: (fig. 17.) let PQ meet these lines in M and N: then DM × MF : PM × MQ :: EN × NG : PN × NG (Pr. 10): but it is plain that DM × MF = EN × NG; therefore PM × MQ = PN × NG. Therefore PM = NQ (Lem. 2.); and it is obvious that the right line BC, which bisects DE and FG, likewise bisects PQ (Lem. 1.)

II. Let FD and EG meet in a point H: (fig. 18, 19, 20.) assume any point, O, in the plane of the conic section, and through it draw TK, RS, and LI, terminated by the conic section, and respectively parallel to EG, DF, and DE or FG: let PQ meet DF and EG in M and N. It is manifest that DF and EG are similarly divided in M and N, and also in the point of concourse H. Therefore.

DM × MF : EN×NG :: FH × HD : GN × HE.

Because TK is parallel to EG, and RS to DF : therefore.

FH × HD : GH× HE :: RO × OS : TO × OK.

Consequently DM × MF : EN × NG : RO×OS : TO×OK. Hence, and by Prop. 10, we have the following proportions:

PM ×MQ : DM × MF :: LO × OI : RO × OS.

DM × MF : EN × NG :: RO × OS : TO × OK.

$EN \times NG : PN \times NQ :: TO \times OK : LO \times OI$.

Therefore, ex æquo, $PM \times MQ \cdot PN \times NQ :: LO \times OI : LO \times OI$.

Consequently $PM \times MQ = PN \times NQ$; and $PM = QN$ (Lem. 2). Therefore the right line BC, which bisects DE and FG, will likewise bisect PQ. (Lem. 1).

Def. 9. A right line which bisects two parallel right lines, both terminated by a conic section or opposite sections, is called a diameter of the section, or opposite sections. This definition relates merely to the position of the diameters, and not to their magnitude.

Def. 10. The center of an ellipse, or opposite hyperbolas, is a point in which is besected every right line drawn through it, and terminated both ways by the ellipse, or opposite hyperbolas.

PROP. XII.

Fig. 21, 22. To find the centre of an ellipse, or opposite hyperbolas, giving by position,

Draw two parallel right lines, as DE and FG, terminated both ways in the ellipse, or one hyperbola, or one of them in one hyperbola, and the other in the opposite hyperbola: draw the right line BC to bisect both the parallels DE and FG: then it is plain that BC will in all cases meet both the opposite hyperbolas; for it will bisect all the right lines that can be drawn in both, parallel to DE and FG (11.): let it meet the ellipse and opposite hyperbolas in B and C, and bisect BC in A, then is A the centre required.

Let H be a point in the ellipse, or one of the hyperbolas, and draw HLM parallel to DE or FG: take $AN = AL$, and draw PK through N parallel to DE or FG,—Then HM and KP terminated by the ellipse, or opposite hyperbolas, are bisected in L and N: and because $BL \times LC = BN \times NC$, therefore $HL \times LM$, or $HL^2 = KN \times NP$, or KN^2 (Pr. 10): therefore $HL = KN$; and it is plain that HA passes through K, and that HK is bisected in the centre A.

Cor. It follows from this proposition, that a right line drawn through the centre of two opposite hyperbolas from a point H in one of them will meet the other.

PROP. XIII.

Fig. 23. An ellipse, or opposite hyperbolas, have only one centre.

If there were two centres of an ellipse, then the right line drawn through them and terminated by the periphery, would be bisected in two different points (12), which is absurd.

If it be possible, let A and D be both centres of two opposite hyperbolas, and from C, a point in one of the hyperbolas, draw C A B and C D F through A and D to meet the opposite hyperbola: also from B and F draw B D E and F A G to meet the first hyperbola, and join D A, G C, and C E. Because A and D are both centres, therefore $BA = AC$, and $BD = DE$, and C E is parallel to D A. In like manner, because $FD = CD$, and $FA = AG$, therefore C G is parallel to D A. Therefore G C and C E, drawn through the same point and parallel to the same line, make only one right line, that meets a conic section in three points, which is absurd.

Cor. All the diameters of an ellipse, or opposite hyperbolas, intersect in the center, and mutually bisect one another.

For if not, then there would be more than one centre.

PROP. XIV.

Fig. 24, 25, 26. Every right line drawn through the centre of an ellipse is a diameter: and every right line drawn through the centre of two opposite hyperbolas, so as to be terminated by the opposite hyperbolas, or so as to be parallel to a right line terminated by one of the hyperbolas, is a diameter.

When a line drawn through the centre A of two opposite hyperbolas is parallel to H K (fig. 23.), a line terminated in one hyperbola draw the diameters H A G, F A K, and join F H and G K; and when a line drawn through the centre is terminated by an ellipse (fig. 24, 25), or opposite hyperbolas, drawn H K parallel to it, and make the same construction as before. Because $HA = AG$, and $K = AF$ (Def. 10.) the two triangles F A H and G A K are equal in all respects, and it is manifest that F H and G K are parallel, and are bisected by the line through the centre parallel to H K: therefore that line is a diameter. (Def. 9.)

Cor. A right line drawn through the centre of an ellipse, or opposite hyperbolas, which bisect one right line not passing through the centre, and terminated by the ellipse, or one of the hyperbolas, or both, will bisect all right lines terminated in the like manner, and parallel to the former line.

For the right line which bisects all the parallel passes through the centre; and therefore it must coincide with the line that bisects one of the parallels, and is drawn through the centre.

PROP. XV.

Fig. 27. All the diameters of a parabola are parallel to one another.

Let B C be a diameter of a parabola bisecting the lines D E and F G: take any point L within the parabola, and draw M N through it parallel to D E or F G, and terminated by the curve: then B C will bisect M N; and as this is true, however remote from the lines D E and F G the line M N is drawn, it follows that the diameter B C cannot meet the curve in more than one point: and the same thing may be shewn of every other diameter as P Q. But all those right lines are parallel to one another which cut a parabola in one point only. (Cor. 2. Def. 6.)

Cor. A right line parallel to a diameter of a parabola, which bisects one right line, terminated by the parabola, will bisect all other right lines parallel to the former and terminated by the parabola.

Def. 11. A diameter of two opposite hyperbolas, which is terminated by the two curves, is called a tranverse diameter: and a diameter which meets neither of the curves is called a second diameter.

Def. 12. A vertex of a diameter is a point where the diameter meets the conic section.

The magnitude of a diameter, that meets a conic section or opposite sections in two points, is the line between the two vertices.

Def. 13. A right line, not passing through the centre, terminated by a conic section, or opposite sections, and bisected by a diameter, is said to be ordinately applied to that diameter: or it is called a double ordinate, and the half of it an ordinate.

PROP. XVI.

Fig. 28. A right line drawn from a vertex of a diameter of an ellipse, or a parabola, or from the vertex of a transverse diameter of a hyperbola, so as to be parallel to a line ordinately applied to that diameter, is a tangent of the curve.

Fig. 28. Let F H be a diameter of an ellipse or a parabola, or a transverse diameter of a hyperbola, and R S T, a line ordinately applied to that diameter; then F M, drawn from a vertex of the diameter, so as to be parallel to R T, is a tangent of the curve. For, if F M be not a tangent, it will cut the section again in another point (Cor. 2 Def. 8,) let it cut the section again in K, and bisect F K in I. Then, if a diameter of the section be drawn through I, that diameter would bisect R T parallel to F K, Pr. 15. Therefore R T would be bisected by two different diameters; *viz.* by the diameter F H, and by that drawn through I. But, in the ellipse and hyperbola, all the diameters pass through the centre; and in the parabola, they are all parallel to one another; therefore two diameters of a conic section will cut every straight line (which does not pass through the centre of the ellipse and hyperbola) in two different points. Therefore R T cannot be bisected by two different diameters. Therefore F M, parallel to R T, does not cut the curve again; that is, F M is a tangent of the conic section.

Cor. 1. If R T be ordinately applied to the diameter F H, it is parallel to a tangent, F M, at a vertex of that diameter.

For there cannot be two tangents of a conic section at the same point of the curve.

Cor. 2. All right lines ordinately applied to the same diameter of a conic section are parallel to one another.

For they are all parallel to a tangent at a vertex of that diameter.

PROP. XVII.

Fig. 29. A right line D E terminated both ways by the curve of a conic section, and parallel to a tangent F H, is ordinately applied to the diameter B C drawn through the point of contact B.

Take B F and B H, in the tangent on opposite sides of the point of contact, equal to one another, and of such a magnitude that lines drawn through F and H parallel to the diameter B C may cut the curve in K and L: join K L. It is plain that K L is bisected by B C: therefore K L is parallel to the tangent F H (Cor. 1, 16.); and consequently it is also parallel to D E (30. 1. E.); therefore D E is bisected by the same diameter which bisects K L (Cor. 14.)

Def 14. Two diameters of an ellipse, or of opposite hyperbolas, that are mutually parallel to one another's ordinate, are called conjugate diameters.

Cor. It is plain that two conjugate diameters of opposite hyperbolas cannot be both transverse, nor both second diameters.

PROP. XVIII.

Fig. 30 and 31. If a diameter of an ellipse, or of opposite hyperbolas, be parallel to the ordinates of another diameter, these two are conjugate diameters.

Let the diameter E D be parallel to P Q S, an ordinate of the diameter F H; draw the diameter P R and join S R cutting E D in T. Because P Q = Q S, and P G = G R; therefore S R is parallel to F H. And because E D is parallel to P Q S and P G = G R; therefore R T = T S. Therefore R S is an ordinate of the diameter E D, and it is parallel to F H; therefore E D and F H are conjugate diameters. Def. 14.

Cor. If a diameter of an ellipse, as E D, be parallel to F O, a tangent at a vertex of another diameter F H; then F H is parallel to D I, a tangent at a vertex of E D.

For a tangent at a vertex of a diameter is parallel to the ordinates of that diameter.

PROP. XIX.

If a point be assumed without or within an ellipse, and two right lines, parallel to two diameters, be drawn from it to cut or touch the ellipse; then, as the rectangle under the segments of the secant, or the square of the tangent, parallel to one of the diameters, is to the rectangle under the segments of the secant, or the square of the tangent, parallel to the other diameter, so is the square of the first diameter to the square of the second diameter. And the same thing is true of two transverse diameters of opposite hyperbolas, and any two lines, parallel to these, drawn through a point to cut the two curves.

For diameters of an ellipse, and of opposite hyperbolas, are secants that intersect in the centre: and because they are bisected there, this proposition is manifest from Pr. 10.

Def 15. *Fig*. 32. Let a point, as O, be assumed in the plane of two opposite hyperbolas, and let the secant, O H K, be drawn through it parallel to a transverse diameter B A; and the secants R O S, G O L, &c. parallel to any second diameters, M N, P Q, &c.: in these diameters take the segments M N, P Q, &c. all bisected in the centre, such that the squares of M N, P Q, &c. may severally be to the square of the transverse diameters A B, as the rectangles R O × O S, G O × O H, &c. contained by the segments of the secants parallel to the second diameters are to K O × O H, the rectangle under the segments of the secant parallel to the transverse diameter: then the magnitudes of the second diameters are the segments M N, P Q, &c.

Because the ratios of the rectangles K O × O H, S O × O R, G O × O H, &c. are invariably the same wherever the point O is assumed, (10,) it is plain that the magnitudes of the second diameters M N, P Q, &c. are also invariably the same wherever the point O is assumed.

And because the ratio of the rectangles K O × O H to the square of the transverse diameter A B is the same as the ratio of the rectangle, contained by the segments of any secant drawn through O, parallel to a transverse diameter, to the square of the transverse diameter to which it is parallel, (19,) it is also manifest that the magnitudes of the second diameters are the same, from whatever transverse diameter they are deduced.

Cor. 1. And hence, taking the magnitudes of the transverse diameters as here defined, Prop. 19, may be enunciated for the hyperbola as generally as it is for the ellipse: that is, the rectangle under the segments of a secant, or the square of a tangent parallel to one diameter (whether a transverse or a second diameter) of opposite hyperbolas, is to the rectangle under the segments of a secant, or the square of a tangent, parallel to another diameter, as the square of the first diameter is to the square of the second diameter.

Cor. 2. If two tangents be drawn to an ellipse, or a hyperbola, or opposite hyperbolas, from the same point, then these tangents are proportional to the diameters, or semi-diameters, drawn parallel to the tangents.

For the squares of the tangents are proportional to the squares of the diameters.

Cor. 3. If a right line be ordinately applied to a diameter of an ellipse, or to a transverse diameter of a hyperbola; then as the square of the diameter is to the square of the conjugate diameter, so is the rectangle contained by the abscisses of the diameter, between the vertices and ordinate, to the square of the ordinate.

For the double-ordinate is bisected by the diameter, and it is parallel to the conjugate diameter.

PROP. XX.

Fig. 33. If an ordinate be drawn to a second diameter of opposite hyperbolas: the square of this second diameter, is to the square of the conjugate diameter, as the sum of the squares of half the second diameter, and the part of it between the ordinate and the centre, is to the square of the ordinate.

Let A B and M N be conjugate diameters of opposite hyperbolas, H K an ordinate to the second diameter M N, and draw K D S parallel to M N: then K D S is ordinately applied to A B (18); therefore

$MC^2 : CB^2 :: KR^2$, or $CL^2 : AD \times DB$, or $CD^2 - CB^2$ (Cor. 3 Def. 15.) therefore, $MC^2 : CB^2 :: MC^2 + CL^2 : CD^2$, or KL^2.

PROP XXI.

Fig. 34. If two parallel lines be drawn from two points in the diameter of a parabola to cut or touch the curve: then, as the rectangle under the segments of the secant, or the square of the tangent, drawn from one point, is to the rectangle under the segment of the secant, or the square of the tangent drawn from the other point, so is the abscissa of the diameter between the first point and the curve to the abscissa between the second point and the curve.

Let the parallel secants M N and P Q meet the diameter of a parabola in D and E: it has been shewn (Prop. 15.) that the diameters of a parabola meet the curve only in one point; and therefore (Cor. 1st. Def. 7.) they are all parallel to a line in the surface of the cone by the section of which the parabola is produced (*viz.* to the line V B (fig. 13.) in which the touching plane, parallel to the plane of the parabola, meets the conic surface): therefore, Prop 8.

$MD \times DN : PE \times EQ :: BD : BE$.

Cor. 1. The squares of the ordinates drawn to a diameter of a parabola are proportional to the abscissas of the diameter between the ordinates and the vertex.

For the double ordinates R D G and H E K are parallel to one another: therefore, by this proposition,

$RD \times DG$, or $RD^2 : HE \times EK$ or $HE^2 :: BD : BE$.

Cor. 2. If the square of one ordinate, of the diameter of a parabola, as R D, be made equal to a rectangle contained by the corresponding abscissa B D, and the line P: then, it is manifest, from the last corollary, that the square of any other ordinate of the same diameter, as H E, will be equal to a rectangle under the corresponding abscissa B E, and the same line P.

The line P is called the parameter of the diameter to which the ordinates are drawn.

Fig. 35. *Def.* 16. If two right lines, as G C S and F C T, be drawn through the centre of two opposite hyperbolas, so as to be parallel to the two lines in the conic surface, which are the intersections of that surface, and a plane drawn through the vertex of the cone, parallel to the plane of the hyperbolas, (*viz.* to the lines V *m* and V *n*, in fig. 14:) these two lines G S and F T are called the asymptotes of the hyperbolas.

Cor. 1. Every line drawn through the centre, within the angles of the asymptotes that are turned to the hyperbolas, is a transverse diameter; and every line drawn through the centre within the adjacent angle is a second diameter.

For the former lines are parallel to lines (such as V O in fig. 14.) drawn within the cone in the angle contained by the two lines (*m* V and *n* V, fig. 14) in the conic surface, that are parallel to the asymptotes; and the latter lines are parallel to lines (such as R V S, fig. 14.) without the cone: whence the truth of the corollary is manifest by Cor. 2, Def. 7. and Prop. 14.

PROP. XXII.

The asymptotes do not meet either of the opposite hyperbolas.

For if an asymptote be supposed to meet one of the hyperbolas, being drawn through the centre, it will likewise meet the other hyperbola (Cor. 12); and thus a line, drawn parallel to a line contained in the surface of a cone, would meet both the opposite conic surfaces, which is impossible (Pr. 2).

PROP. XXIII.

Fig. 35 and 36. If a point be assumed without a hyperbola, but within the asymptotes, and a right line be drawn from it to touch or cut the hyperbola, or opposite hyperbolas; then the square of the tangent, or the rectangle under the segments of the secant, is less than the square of the semi-diameter parallel to the tangent or secant; but if the point be assumed without both the hyperbola and the asymptotes, the square of the tangent, or the rectangle under the segments of the secant, is greater than the square of the semi-diameter parallel to the tangent or secant.

First, let the point P be without the hyperbola, and within the asymptotes, and let P H, (fig. 35.) parallel to the semi-diameter C D, touch the hyperbola; because P is a point within the asymptotes, the line drawn from it through the centre will be a transverse diameter: thus,

$C E^2 : C D^2 :: E P \times P K : P H^2$ (19 and Cor. 1. Def. 15.)

But $C E^2$ is greater than $E P \times P K$; therefore $C D^2$ is greater than $P H^2$. And in like manner may the proposition be demonstrated, when the line drawn from P does not touch, but cuts the hyperbola, or opposite hyperbolas.

Next, let P be without the asymptotes: draw R S (fig. 36), terminated by one of the hyperbolas parallel to C P, the line drawn from P to the centre: draw the diameter C E to bisect R S and M N through P parallel to C E. Because the diameter C E bisects R S parallel to C P, therefore M N, parallel to C E, is ordinately applied to the second diameter C P (18.). Let C Q be the magnitude of this semi-diameter, then

$C Q^2 : C E :: C Q^2 + C P^2 : P N^2$ (20)
And $C E^2 : C D^2 :: M P \times P N$ or $P N^2 : P H^2$

Ex æquo, $C Q^2 : C D^2 :: C Q^2 + C P : P H^2$. But $C Q^2 + C P^2$ is greater than $C Q^2$, therefore $P H^2$ is greater than $C D^2$. And in like manner may the proposition be proved, when the line drawn through P does not touch, but cuts a hyperbola, or opposite hyperbolas.

PROP. XXIV.

Fig. 37, 38. If from a point (P or Q) in an asymptote of a right line be drawn to touch or cut the hyperbola, or opposite hyperbolas (P H or Q R S): the square of the tangent, or the rectangle under the segments of the secant ($P H^2$ or $Q R \times Q S$) is equal to the square of the semi-diameter ($C D^2$) parallel to the tangent or secant.

For if not, make $H O^2$ and $R O^1 \times O^1 S$ equal to $C D^2$: then O and O^1 are without the hyperbola, and they must be either within the asymptotes or without them. In the former case $H O^2$ and $R O^1 \times O S$ would be less than $C D^2$ (23.); and in the latter case $H O^2$ and $R O^1 \times O^1 S$ would be greater than $C D^2$ (23.) which are equally absurd. Therefore $P H^2$ and $Q R \times Q S$ are equal to $C D^2$.

Cor. 1. If a tangent of a hyperbola meet both asymptotes, as P M, the segments P H and H M between the asymptotes and the point of contact are equal. And if a right line cut a hyperbola, or opposite hyperbolas, and both the asymptotes, as Q T, the segments between the curve or curves and the asymptotes are equal to one another: that is $Q R = T S$, and $Q S = T R$.

For $P H^2$, $H M^2$, $Q R \times Q S$, and $T R \times T S$, are all equal to $C D^2$.

Cor. 2. On the contrary, if P M, intercepted between the asymptotes, meet the hyperbola in H, and is bisected there; then P M is a tangent of the hyperbola.

Cor. 3. If any number of lines all parallel to one another, as Q T and M N, cut a hyperbola and the asymptotes, the rectangles $Q R \times R T$, $M L \times L N$, under the segments between the curve and the asymptotes, are all equal.

For it is plain (Cor. 1.) that the rectangles are all equal to $C D^2$.

Def. 17. A diameter of a conic section that cuts its ordinates at right angles is called an axis.

Cor. Because two conjugate diameters of an ellipse, and opposite hyperbolas, cut their ordinates in the same angles, Pr. 18; therefore, if there be one axis of these curves, there will necessarily be two, and these will be conjugate diameters, and they will cut one another at right angles.

PROP. XXV.

Fig. 39, 40. An ellipse, and opposite hyperbolas, have two axes.

Find the centre of the ellipse C (fig. 39.) and draw two diameters.

Then if the two diameters be equal to one another, as E F and D I, two other diameters, A B and G H, drawn to bisect the angles contained by D I and E F, will be axes of the ellipse. Join E D and D F: then the lines A B and G H, which bisect the vertical angles of the isosceles triangles F C D and E C D, will bisect the bases D E and D F, and likewise cut these lines at right angles. Hence it is plain that A B and G H are conjugate diameters and axes of the ellipse.

But if the two diameters be not equal, as M N and P Q, describe a circle from the centre C with a radius less than the greater semidiameter C M, but greater than the less semidiameter C P; then the circle will cut the diameter M N on both sides of the centre within the ellipse, and it will be without the ellipse towards the point P: therefore the circle will cut the periphery of the ellipse both between P and M, and between P and N: let E and D be the points of section; then two diameters drawn through them will be equal, and the axes of the ellipse will be found as above.

In the case of opposite hyperbolas, (fig. 39.) find the centre C, and from C as a centre describe a circle through a point within one of the hyperbolas: then that circle will cut the hyperbola in two points D and E, and two transverse diameters drawn through these will be equal to one another; and two diameters A B and G H, drawn to bisect the angles comprehended by the equal diameters D I and E F, will be conjugate diameters and axes of the hyperbolas. The demonstration is the same as for the ellipse.

PROP. XXVI.

Fig. 41 and 42. The two axes of an ellipse are always unequal; and the greater axis is the greatest diameter, and the less axis the least diameter, of the curve. And that axis of a hyperbola, which is a transverse diameter, is the least of all the transverse diameters.

Let A B and D E (Fig. 41.) be the two axes of an ellipse, C the centre, and C H any semidiameter; draw H P perpendicular to A B, and H Q perpendicular to D E. Because A B and D E are conjugate diameters; and H P an ordinate to A B, and H Q an ordinate to D E: therefore,

$$AB^2 : DE^2 :: AP \times PB :: HP^2,$$
Cor. 3, Def. 15.

Now, if A B be supposed to be equal to D E, it will follow that $AP \times PB = HP^2$; therefore $AP \times PB + CP^2 = HP^2 + CP^2$, or $AC^2 = CH^2$. Therefore, $AC = CH$: and the ellipse will be a circle, which is not the case, Cor. 9. Therefore A B and D E are unequal: let A B be supposed to be greater than D E.

Because AB^2 is greater than DE^2, therefore $AP \times PB$ is greater than HP^2; and $AP \times PB + CP^2$, or AC^2, is greater than $HP^2 + PC^2$, or CH^2. Therefore the semi-axis A C is greater than any other semi-diameter H C.

In like manner.
$$DM^2 : AB^2 :: DQ \times QE : HQ^2.$$

Therefore $DQ \times QE$ is less than HQ^2; and $DQ \times QE + CQ^2$, or CD^2, is less than $HQ^2 + CQ^2$, or CH^2. Therefore the semi-axis D C is less than any other semidiameter C H.

Fig. 42. In the hyperbola, a tangent of the curve drawn from the extremity of the axis C A, at A T, falls between the centre and the curve; and because C A, the semi-axis, is less than any other line drawn from C to A T, much more is it less than a semidiameter C H drawn from C to the curve on the other side of A T.

Cor Hence it is plain, that an ellipse, or opposite hyperbolas, have only two axes

Def. 17 The greater axis of an ellipse is called the transverse axis; and the less, the conjugate axis; and, in the hyperbola, that one is the transverse axis which is a transverse diameter, and the other is the conjugate axis.

PROP. XXVII.

Fig. 41 and 42. A diameter of an ellipse nearer the transverse axis is greater than one more remote; and a transverse diameter of the hyperbola nearer the transverse axis is less than one more remote.

Let C K and C H (fig. 41.) be two semidiameters of an ellipse; join HK, and draw A G parallel to H K, join C G, and draw C L to bisect H K. Because C L bisects H K, it will likewise bisect A G Cor. 14. And because $AM = MG$, and A C is greater than C G, therefore the angle A M C is greater than the angle G M C, (25. 1. E.) that is, the angle K L C is greater than the angle H L C. And because $HL = LK$, therefore K C, nearer to C A, is greater than H C, more remote from C A, 24. 1. E.

In the hyperbola, the same construction being made, because A C is less than C G, therefore the angle A M C, or K L C, is less than the angle G M C, or H L C. Therefore C K is less than C H.

PROP. XXVIII.

Fig. 43. A parabola has only one axis.

Let O S, terminated by the curve, be perpendicular to any diameter, and draw the diameter P Q to bisect O S, and, because all the diameters of the curve are parallel, therefore P Q is perpendicular to O S, and an axis of the curve, Def. 17. And because O S can be an ordinate of only one diameter, therefore there is only one axis.

Def. 19. *Fig.* 44, 45, and 46. Let A B (fig. 44 and 46.) be the transverse axis, D E the conjugate axis, and C the centre of an ellipse, or hyperbola, or opposite hyperbolas: and let C F and C *f* be taken in the transverse axis, such that CF^2 and Cf^2 are each equal to $CA^2 - CD^2$ in the ellipse, and to $CA^2 + CD^2$ in the hyperbola; then the two points F and *f* are called the foci of the ellipse, hyperbola, or opposite hyperbolas.

But the focus of a parabola (fig. 45.) is a point F in the axis within the curve, and distant from the vertex by a line equal to one-fourth part of the parameter of the axis.

Cor. The distance of each foci of an ellipse from either extremity of the conjugate axis is equal to half the transverse axis; and the distance of either of the foci of a hyperbola from the centre is equal to the distance between the extremities of the transverse and conjugated axes.

Def. 20. If F (fig. 44 and 46) be a focus of an ellipse, or hyperbola, or opposite hyperbolas, and A G be taken in the transverse axis (on the opposite side of the vertex to the focus F,) such, that A F is to A G as C F is to C A; then a line, as H K, drawn through G perpendicular to the transverse axis, is called a directrix of the ellipse, or hyperbola, or opposite hyperbolas.

Fig. 45. But the directrix of a parabola is a line, as H K, perpendicular to the axis, drawn through a point G, as far distant from the vertex of the axis on the one side as the focus is on the other side.

Cor. An ellipse, hyperbola, or opposite hyperbolas, have two directrices; one corresponding to each focus. For the same construction that is made for one focus may be made for the other focus.

PROP. XXIX.

Fig. 44 and 46. Let A B be the transverse, and D E the conjugate axis of an ellipse, or hyperbola, or opposite hyperbolas; from any point in the curve, or opposite curves, as M, let M C be drawn to the centre, and MP perpendicular to the transverse axis, and take C O in the same axis, such that CO^2 may be equal to $MC^2 - CD^2$ in the ellipse, and to $MC^2 + CD^2$ in the hyperbola; then as A C is to C F, so is P C to C O.

For, because A B and D E are conjugate diameters, therefore,

$AC^2 : CD^2 :: AP \times PB : MP^2$, (Cor. 3. Def. 15.) therefore, $AC^2 : AC^2 \mp CD^2 :: AP \times PB : AP \times PB \mp MP^2$ But in the ellipse $AC^2 - CD^2 = CF^2$; and $AP \times PB - MP^2 = AC^2 - CP^2 - MP^2 = AC^2 - MC^2 = AC^2 - CD^2 - CO^2 = CF^2 - CO^2$: and, in the hyperbola, $AC^2 + CD^2 = CF^2$; and $AP \times PB + MP^2 = PC^2 - AC^2 + MP^2 = MC^2 - AC^2 = CO^2 - CD^2 - CA^2 = CO^2 - CF^2$. Therefore the last analogy becomes,

$AC^2 : CF^2 :: AC^2 \mp CP^2 : CF^2 \mp CO^2$
Consequently, $AC^2 : CF^2 :: CP^2 : CO^2$
19. 5. E.
And, A C : C F :: C P : C O.

PROP. XXX.

Fig. 44 and 46. If M be a point in an ellipse or hyperbola, and M F and M *f* be drawn to the foci; then, in the ellipse, the sum of M F and M *f* is equal to the transverse axis; and, in the hyperbola, the difference of M F and M *f* is equal to the transverse axis.

Draw M P perpendicular to the transverse axis, and take C O as in the last proposition. And, because

A C : C F :: C P : C O, Pr. 29.

Therefore, $AC \times CO = FC \times CP$; and $4\,AC \times CO = 4\,CF \times FO$. But because A B and F *f* are bisected in C, therefore $4\,AC \times CO = BO^2 - AO^2$ 8. 2. E. and $4\,FC \times CP = Pf^2 - PF^2 = fM^2 - MF^2$, 47. 1. E; therefore $BO^2 - AO^2 = fM^2 - MF^2$.

Again, $MF^2 + Mf^2 = fP^2 + FP^2 + 2\,MP^2 = 2\,FC^2 + 2\,CP^2 + 2\,MP^2 = 2\,FC^2 + 2\,MC^2 = 2\,FC^2 \pm 2\,CD^2 + 2\,CO^2 = 2\,AC^2 + 2\,CO^2 = BO^2 + AO^2$.

And, because $BO^2 + AO^2 = fM^2 + MF^2$, and $BO^2 - AO^2 = fM^2 - MF^2$; therefore, by adding the equals, $2\,BO^2 = 2\,fM^2$; and, by subtracting the equals, $2\,MF^2 = 2\,AO^2$. Therefore $fM = BO$, and $FM = AO$; whence the proposition is manifest.

PROP. XXXI.

Fig. 44, 45, and 46. A straight line drawn from any point in a conic section to a focus has to a perpendicular drawn to the corresponding directrix, a ratio that is constantly the same wherever the point is assumed in the curve; and in the ellipse the constant ratio is a ratio of minority (or of a less magnitude to a greater;) in the hyperbola the constant ratio is a ratio of majority (or of a greater magnitude to a less;) and in the parabola the constant ratio is a ratio of equality.

Let M (fig. 44 and 46) be a point in an ellipse or hyperbola, and draw M F to a focus, and M K perpendicular to the directrix H G, which corresponds to that focus, draw M P perpendicular to the transverse axis, and take C O as in Prop. 29. Then

AC : CF :: CP : CO, Pr. 29.
Invertendo, CF : CA :: CO : CP;
Therefore, CF : CA :: FO : AP, 19.5. E.
But, CF : CA :: AF : AG, Def. XX.
Therefore, CF : CA :: AO : GP, 12.5. E.
But, as has been shewn in the demonstration of the last proposition, $A O = M F$, and $G P = M K$; therefore
CF : CA :: MF : MK.
But the ratio of C F to C A is a constant ratio; and it is a ratio of minority in the ellipse, and a ratio of majority in the hyperbola.

Fig. 45. In the parabola, $G A = A F$, and $4 A F \times A P = M P^2$, Def. 1.; but $4 A F \times A P = G P^2 - P F^2$, 8. 2. E; therefore $M P^2 = G P^2 - P F^2$; and $M P^2 + P F^2$, or $M F^2 = G P^2$, or $M K^2$. Therefore $M F = M K$.

CONIFERÆ, in botany, the name of one of the orders of Linnæus's fragments of a natural method, consisting of plants, whose female flowers, placed at a distance from the male, either on the same or distinct roots, are formed into a cone. Of this order are the Abies, Cypressus, &c.

All the coniferæ yield a resin which renders most of them evergreen. The fruit in all is biennial, being produced in the spring, but not ripening and dropping its seeds until the spring after. The coniferæ compose also one of the natural orders of Jussieu.

CONIUM, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Umbellatæ. Essential character: partial involucre halved, three-leaved; fruit nearly globular, five streaked, notched on each side. There are five species, of which C. maculatum, common hemlock, is obviously distinguished by its large and spotted stalk; by the dark-green shining leaves; and particularly by their disagreeable smell when bruised. The root is biennial, resembling that of a small parsnip. The stem is from four to six feet high, hollow, and covered with a bluish powder, which easily wipes off. The leaves which grow near the bottom of the plant are about two feet in length. Calyx entire; corolla white, outer petals largest; seeds brownish, resembling those of anniseed.

CONJUGATE, *diameter*, or *axis of an ellipsis*, the shortest of the two diameters, or that bisecting the transverse axis.

CONJUGATE *hyperbolas*. See CONIC SECTIONS.

CONJUGATION, in grammar, a regular distribution of the several inflexions of verbs in their different voices, moods, tenses, numbers, and persons, so as to distinguish them from one another.

CONJUNCT, or CONJOINT. See the article CONJOINT.

CONJUNCTION, in astronomy, the meeting of two stars or planets in the same degree of the zodiac. This conjunction is either true or apparent. The true conjunction is, when a right line, drawn from the eye through the centre of one of the bodies, would pass through that of the other: in this case the bodies are in the same degree of longitude and latitude; and here the conjunction is also said to be central, if the same line, continued from the two centres through the eye, do also pass through the centre of the earth.

Apparent conjunction, is when the two bodies do not meet precisely in the same point, but are joined with some latitude. In this case a right line, drawn through the centre of the two bodies, would not pass through the centre of the earth, but through the eye of the spectator.

The moon is in conjunction with the sun, when they meet in the same point of the ecliptic, which happens every month; and eclipses of the sun are always occasioned by the conjunction of the sun and moon in or near the nodes of the ecliptic.

CONJUNCTION, in grammar, an undeclinable word or particle, which serves to join words and sentences together, and thereby shews their relation or dependence one upon another.

CONJURATION, strictly means combining together by oath, especially with evil spirits, to do a public harm. The using of witchcraft, conjuration, &c. was felony, by 1 Jac. c. 12. but that was repealed by the 9. Geo. II. c. 5. and the offences and all prosecutions for them abolished; but if any pretend to witchcraft, or conjuration, or to tell fortunes, or, from skill in occult or crafty science, to discover goods or chattels stolen, they shall be imprisoned a year, and stand in the pillory once a quarter, and may be ordered to give security for good behaviour,

CONNARUS, in botany, a genus of the Monadelphia Decandria class and order. Natural order of Dumosæ. Terebintaceæ, Jussieu. Essential character: style one, stigma simple; capsules two-valved, one-celled, one seeded. There are four species, natives of warm climates.

CONOCARPUS, in botany, Jamaica button tree, a genus of the Pentandria Monoygnia class and order. Natural order of Aggregatæ. Elæagni, Jussieu. Essential character: petals five, or none; calyx, bell form; seeds naked, solitary, inferior; flowers aggregate. There are three species found in the West Indies, where the natives use the bark for tanning leather.

CONOID, in geometry, a solid body, generated by the revolution of a conic section about its axis.

CONOPEA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Lysimachiæ, Jussieu. Essential character: calyx five-cleft; corolla ringent, two-lipped, lower lip trifid; stigma two-lobed; capsule one celled, four-valved, many seeded. There is but one species, *viz.* C. aquatica, a native of Guiana, flowering in June.

CONOPS, in natural history, a genus of insects of the order Diptera. Generic character: mouth with a projecting geniculate proboscis; antennæ clavate, and pointed at the end. There are 22 species in two sections. A. sucker, geniculate near the base, with a single-valved abbreviated sheath, inclosing a single bristle. B. sucker, geniculate at the base and middle, the sheath with two equal valves. The insects of this genus are remarkably active, and are found in gardens, where they subsist on the nectareous juices of flowers; their larvæ are not known. In the true conops the head is large and nearly hemispherical; the eyes large and almost oval; and the antennæ formed of three articulations, the middle one of which is long and cylindrical, the last joint terminating in a little point.

CONSANGUINITY, the relation subsisting between persons of the same blood, or who are sprung from the same root.

Consanguinity terminates in the sixth and seventh degree, excepting in the succession of the crown, in which case it is continued to infinity.

Marriage is prohibited by the church to the fourth degree of consanguinity inclusive: but by the law of nature, consanguinity is no obstacle to marriage, except it be in the direct line.

CONSCIENCE, in ethics, a secret testimony of the soul, whereby it gives its approbation to things that are naturally good, and condemns those that are evil.

CONSCRIPTS, men raised to recruit the French armies. All men capable of bearing arms in France and its dependencies are registered, and, when called upon by the government, are obliged to join the army on any service.

CONSEQUENCE, in logic, the conclusion, or what results from reason or argument.

CONSEQUENT *of a ratio*, in mathematics, the latter of the two terms of a ratio, or that to which the antecedent is compared; thus is $m : n$, or m to n; n is the consequent, and m the antecedent.

CONSERVATOR, an officer ordained for the security and preservation of the privileges of some cities and communities, having a commission to judge of and determine the differences among them.

Conservator *of the peace*, in our ancient customs, a person who had a special charge to keep the king's peace. Till the appointment of Justices of the peace by Edward III., there were several persons, who, by common law, were interested in keeping the same: some having that charge as incident to other offices, and others called conservators of the peace. Those that were so by virtue of their office still continue, but the latter are superseded by the modern justices. The chamberlain of Chester is still a conservator in that county; and petty constables are, by the common law, conservators, &c. of the king's peace. The king's majesty is, by his office and dignity royal, the principal conservator of the peace within all his dominions, and may give authority to any other to see the peace kept, and to punish such as break it; hence it is usually called the king's peace.

CONSERVATORY, a term sometimes used for a green-house, or ice-house.

CONSERVE, a form of medicine. See Pharmacy.

CONSIDERATION, in law, the material cause or ground of a contract, without which the party contracting would not be bound. Consideration in contracts, is something given in exchange, something that is mutual and reciprocal; as money given for goods sold, work performed for wages. And a consideration of some sort or other is so absolutely necessary to the forming a contract, that a *nudum pactum*, or agreement to do or pay any thing on one side, without any compensation on the other, is totally void in law; and a man cannot be compelled to perform it. A consideration is necessary to create a debt.

CONSIGNMENT, in law, the depositing any sum of money, bills, papers, or commodities, in good hands; either by appointment of a court of justice, in order to be delivered to the person to whom they are adjudged; or voluntary, in order to their being remitted to the persons they belong to, or sent to the places they are designed for. Consigned goods are supposed, in general, to be the property of him by whom they were consigned, but to be at the disposal of him to whom they are consigned.

CONSISTORY, a tribunal; every archbishop and bishop of every diocese hath a consistory court, held before his chancellor or commissary in his cathedral church, or other convenient place of his diocese, for ecclesiastical causes. From the bishop's court the appeal is to the archbishop; from the archbishop's court to the delegates.

CONSONANCE, in music, is ordinarily used in the same sense with concord, *viz.* for the union or agreement of two sounds produced at the same time, the one grave, and the other acute; which, mingling in the air in a certain proportion, occasion an accord agreeable to the ear.

CONSONANT, a letter that cannot be sounded without some single or double vowel before or after it.

Consonants are first divided into single and double; the double are *x* and *z*, the rest are all single: and these are again divided into mutes and liquids, eleven mutes, *b, c, d, f, v, g, j, k, p, q, t*; and four liquids, *l, m, n, r*. But the most natural division of consonants is that of the Hebrew grammarians, who have been imitated by the grammarians of other Oriental languages. These divide the consonants into five classes, with regard to the five principal organs of the voice, which all contribute, it is true, but one more notably than the rest, to certain modifications, which make five general kinds of consonants. Each class comprehends several consonants, which result from the different degrees of the same modification, or from the different motions of the same organs: these organs are, the throat, palate, tongue, teeth, lips, whence the five classes of consonants are denominated guttural, palatal, lingual, dental, and labial.

CONSPIRACY, in law, signifies an agreement between two or more, falsely to indict, or procure to be indicted, an innocent person of felony.

CONSPIRATORS are, by statute, defined to be such as bind themselves by oath, covenant, or other alliance, to assist one another, falsely and maliciously to indict persons, or falsely to maintain pleas.

From this and the former article it seems to follow, that not only those who actually cause an innocent man to be indicted, and also to be tried upon the indictment, whereupon he is lawfully acquitted, are properly conspirators; but that those also are guilty of this offence, who basely conspire to indict a man falsely and maliciously, whether they do any act in prosecution of such confederacy or not. For this offence the conspirators may be indicted at the suit of the king, and may be sentenced to fine, imprisonment, and pillory.

CONSTABLE. Lord high constable, an ancient officer of the crowns both of England and France, whose authority was so very extensive, that the office has been laid aside in both kingdoms, except upon particular occasions, such as the king's coronation.

The function of the constable of England consisted in the care of the common peace of the land, in deeds of arms and matters of war. By a law of Richard II. the constable of England has the determination of things concerning wars and blazonry of arms, which cannot be discussed by the common law. The first constable was created by the Conqueror: the office continued hereditary till the 13th of Henry VIII. when it was laid aside, as being so powerful as to become troublesome to the king. We have also constables denominated from particular places, as constable of the Tower, of Dover Castle, of Windsor Castle, of the castle of Caernarvon, and many other of the castles of Wales, whose office is the same with that of the castellani, or governors of castles.

From the Lord high constable are derived those inferior ones, since called the constables of hundreds or franchises, who were first ordained in the thirteenth of Edward I. by the statute of Winchester, which, for the conservation of peace and view of armour, appointed that two constables should be chosen in every hundred. These are what we now call high constables, on account that the increase of people and offences has made it necessary to appoint others under these, in every town, called petty constables, who are of the like nature, though of inferior authority to the other. The high constable over the whole hundred is usually chosen and sworn into his office by the justices of the peace in their sessions: and as to petty constables in towns, villages, &c. the right of choosing them belongs to the courtleet, though they may be elected by the parishioners. They are appointed yearly, and ought to be men of honesty, knowledge, and ability; and if they refuse to serve, or do not perform their duty, they may be bound over to the sessions, and there indicted and fined. Any constable, without a warrant from a justice, may take into his custody, any persons that he sees committing felony, or breaking the peace; but if it be out of his sight, as where a person is seized by another, he cannot do it without a warrant.

There are many persons exempted by law from serving the office of constable; these are, the ancient officers of any of the colleges in the two universities, counsellors, attornies, and all other officers, whose attendance is required in the courts of Westminster-hall, aldermen of London, the president and fellows of the fellowship of physic in London, surgeons and apothecaries in London, and within seven miles thereof, being free of the company of apothecaries, and licensed teachers or preachers in holy orders, in a congregation legally tolerated, shall be exempted from the office of a constable. The prosecutor of a felon to conviction, or the person to whom he shall assign the certificate thereof, shall be discharged from the office of constable.

But, generally speaking, every housekeeper, inhabitant of the parish, and of full age, is liable to fill the office of constable: he ought, however, to be of the abler sort of parishioners, as being more likely to perform his duty with probity and discretion.

CONSTELLATION, in astronomy, a system of several stars that are seen in the heavens near to one another. Astronomers not only mark out the stars, but, that they may better bring them into order, they distinguish them by their situation and position in respect to each other; and therefore they distribute them into asterisms, or constellations, allowing several stars to make up one constellation: and for the better distinguishing and observing them, they reduce the constellations to the forms of animals, as men, bulls, bears, &c. or to the images of some things known, as of a crown, a harp, a balance, &c. or give them the names of those, whose memories, in consideration of some notable exploit, they had a mind to transmit to future ages. See ASTRONOMY.

CONSTITUTION, in matters of policy, signifies the form of government established in any country or kingdom.

The constitution and government of a country frequently differ, though the latter should be founded on the former in every particular. The two terms are considered by some persons as synonymous, but accurate writers have ever made the necessary distinction between them. Lord Bolingbroke defines a constitution to be a general system of laws, institutions, and customs derived from the immutable principles of reason, and accepted by the people; and government, the particular tenor of conduct pursued by a chief and subordinate magistrate; he also asserts that the constitution of Great Britain may remain fixed for ever, that it is the basis on which her princes ought to act, and a true criterion by which their government must be appreciated; hence, according to the principles of the revolution, and the present settlement, the degree of submission may be regulated, particularly as the claim of descent is remote, and the choice of the community was purposely directed to preserve the constitution.

Men in the primitive ages might live voluntarily under or be compelled by conquest to bear a government without a constitution, but they soon (as Hooker remarks) rejected the yoke, or made it sit easy on their necks. Archdeacon Paley says, a constitution is so much of the laws of a country as marks the designation and form of its legislature, the rights and functions of the legislative body, and the nature and jurisdiction of the courts of justice; the constitution therefore is the principal section or title of the code of public laws, and the terms constitutional, and unconstitutional, signify in this case legal and illegal. The jurisprudence of England is composed of ancient usages, acts of parliament, and the decisions of the courts of law; those then are the sources whence the nature and limits of her constitution are to be deduced, and the authorities to which appeals must be made in all cases of doubt. An act of parliament can be considered unconstitutional, only when it militates against other laws which regulate the form of government. Those who consider the British constitution as a plan made by our ancestors at some distant æra are deceived; the great Charta, and the bill of Rights, were successful efforts to restrain the abuses of regal power, but they are partial modifications of the constitution, which, like others in Europe, originated from a variety of causes, and may be compared to an old mansion, repaired and altered at different periods, according to the abilities and taste of its possessors. Several approved historians conjecture, that the British constitution may have had its origin from the Anglo-Saxons; those alledge that the government of the northern nations, founded on the ruins of that of Rome, was free, and, though injured by succeeding princes, still retains a degree of legal administration, and an air of independence. The Saxons, who conquered Britain in the fifth century allowed their chiefs a very limited authority, and brought with them the same spirit of liberty which had distinguished their ancestors. The king therefore depended solely on his own abilities, and possessed no arbitrary power derivedfrom his station; the people, subject to little legal restraint, and less polished, paid great respect to the monarch and his family, yet were more regardless of regular descent, than present convenience, in filling the vacant throne. As their sovereignty was neither hereditary nor elective, the will of the king in the appointment of a successor was not always accepted, for the concurrence of the people was required, not only in this case, but in the usual mode of government: the states might establish a sovereign by suffrage, but they seldom exercised this privilege. The constitution may have differed in the different kingdoms of the Heptarchy, and have changed between the invasion and the Norman conquest, yet in all events they maintained a wittenagénot, or council, whose consent was necessary for making of laws and ratifying public acts; the preambles of all those from Ethelbert to Edward the Confessor, and even those of Canute, give undoubted proofs of the existence of a limited regal government, which was however very aristocratical, though the ancient democracy may, under the patronage of some distinguished lord, have given security and dignity to the gentry, and protection to the lower classes of people. The courts of the decennary, the hundred, and the county, were all calculated to defend general liberty, and restrain the power of the nobles, and the admission of all freeholders in the latter court was a great check upon the aristocracy. Some writers assert that the government of the Anglo-Saxon princes had little more affinity to the present constitution than in the relations between the king and nobility, common to those founded by the northern nations, and place the æra of its origin at the conquest, when William of Normandy overturned the ancient form of legislation, expelled the landholders, and gave their lands to his chiefs, whose government was tyrannical, different from the constitution, and a mixture of the customs of Normandy and the laws of Edward the Confessor; the latter he altered and confirmed in Parliament; and his statutes even declared, that all freemen should hold their possessions without unjust exaction and tollage, they rendering only their free service due to the crown; this was granted as a right by the common council of the kingdom, and has been justly called the first magna charta of the Normans, though equally conferred onthe English. Notwithstanding this, the monarch often assumed absolute power, and the constitution became gradually aristocratical and oppressive to the lower orders of freemen; nor were the nobles exempt from heavy exactions on their fiefs, and he even suppressed the most powerful baronies at pleasure. Self-preservation at length suggested opposition, and the barons were induced to grant the people some advantages, to secure their co-operations; as the latter soon began to feel their own importance, they ventured to make conditions for themselves, and insisted upon protection from the laws. In the reign of Henry I. the above causes produced their effects, in the resolution of the nation to give the crown to a prince, who should hold it under a compact with the people. Henry had sworn to grant a charter after his coronation, which he did, restoring the Saxon laws under Edward the Confessor, with the emendations made by his father and the advice of parliament, annulling evil customs and illegal sanctions; some of those were recited in the charter, and expressly repealed; the King also mitigated his feudal rights over his own tenants; those due from theirs, and their profits, were determined by a moderate rule of law.

Sir Henry Spellman was of opinion that this charter served as the basis of magna charta; those are mistaken, therefore, who consider the privileges obtained from King John as a set of innovations, as in fact they were mere restitutions of rights and just limitations of usurped power; Lord Lyttleton even thought this charter more important than that forced from John. Henry II. granted a charter of liberties, and confirmed that of his grandfather. Through the above causes, the constitution of England became the then best feudal system in the world. The same monarch established itinerant judges; and, to his everlasting honour, the trial by jury was extended to civil causes, which mode had been rarely used before the conquest. John, having ascended the throne, ruled with the utmost despotism; in consequence a powerful confederacy extorted from him the great charter, equally favourable to the clergy, the barons, and the people. This was confirmed by Henry III., who added certain articles to prevent injustice by sheriffs, and granted charter of forests. These still remain, with little alteration, and are universally considered the safeguards of British liberty, and the basis of the constitution, justly defining the limits of power and of subjection. Edward I. declared void, by his statute called *confirmatio chartarum*, all decisions contrary to the tenor of the great charter, which was to be considered as the common law, read twice annually to the people in every cathedral, and those were to be excommunicated who infringed it; and in the statute *de tallagio non concedendo* he decreed, that no tax or impost should be levied without the joint consent of Lords and Commons. In the reign of Edward II. the Commons ventured to annex petitions to their bills granting subsidies: and in that of Edward III. they declared, they would acknowledge no law to which they refused their assent: soon after they impeached and punished certain ministers of state, and refused the granting of subsidies, till their petitions to Henry IV. had been answered. In the interval from Edward I. to Henry IV. the fundamental principles of the constitution were confirmed by thirty-two statutes; those were followed by the petition of right agreed to by Charles I., the *habeas corpus* act, and other useful laws, in the reign of Charles II. and the bill of rights, confirmed 1 William and Mary. The revolution of that period was the third grand æra in the history of the constitution, from which auspicious time the nature and use of government has been justly appreciated, and the false doctrine of the divine right of Kings entirely exploded: four years afterward, the liberty of the press was established, and in the 12th and 13th of William aud Mary, the act of settlement, limiting the crown to the present royal family, took place, which also confirms our present invaluable birthrights in the law, religion, and liberty.

By the combination of three species of government, monarchy, aristocracy, and democracy, in King, Lords, and Commons, the best properties of each are brought into effect, at the same time each branch operates as a check upon the encroachments of either. The principal excellence of this venerable fabric is, that every citizen may become a senator, and when such, he possesses the right of proposing what laws he pleases to the legislature; and the right of taxation belonging to the Commons, affords every reason for patiently acquiescing in their enactments, particularly as the national disbursements are annually laid before the public. The nature and degrees of punishment being fixed by laws, neither the monarch nor the magistrate can vary them, nor can a man be imprisoned falsely with impunity, through the operation of the *habeas corpus* act, or unjustly condemned, when twelve impartial men of his own class decide upon his guilt or innocence. The power of framing laws vested in the two Houses of Parliament is restrained by the King's negative, and the abuse of that is prevented by their ability to refuse him supplies. In addition, all acts of the Crown are illegal without the subscription of its great officers; besides which, Parliament has the right of addressing the King, and punishing evil advisers. The appointment of obnoxious ministers may be resisted by the opposition of Parliament to their measures, and the prerogative of declaring war may he checked by the refusal of money to carry it on, and by the same means no improper use can be made of the regular army.

From this sketch of the free and enviable constitution of Great Britain we may justly infer, that no form of government ever did or can possess more inherent excellencies, and that it bears in its very nature ample means to alter and amend its few inperfections.

Constitution also denotes an ordinance, decision, regulation, or law, made by authority of any superior, ecclesiastical or civil. The constitutions of the Roman emperors make a part of the civil law, and the constitutions of the church make a part of the canon law.

Constitutions, *apostolical*, a collection of regulations attributed to the apostles, and supposed to have been collected by St. Clement, whose name they likewise bear. It is the general opinion, however, that they are spurious, and that St. Clement had no hand in them. They appeared first in the fourth age, but have been much changed and corrupted since that time. They are divided into eight books, consisting of a great number of rules and precepts relating to the duties of christians, and particularly the ceremonies and discipline of the church. Mr. Whiston, in opposition to the general opinion, asserts them to be a part of the sacred writings, dictated by the apostles in their meetings, and wrote down from their own mouth by St. Clement, and intended as a supplement to the New Testament, or rather as a system of Christian faith and polity. The reason why the constitutions are suspected by the orthodox, and perhaps the reason also why their genuineness is defended by Mr. Whiston, is, that they seem to favour Arianism.

CONSTRUCTION, in geometry, is the drawing such lines, such a figure, &c. as are previously necessary for the making any demonstration appear more plain and undeniable.

Construction *of equations*, in algebra, the method of drawing a geometrical figure, whose properties shall express the given equation, in order to demonstrate the truth of it geometrically. See Equations, *construction of*.

Construction, in grammar, the connecting the words of a sentence according to the rules of the language. Construction is either simple or figurative, according as the parts of the discourse are placed in their natural order, or recede from that simplicity, when shorter and more elegant expressions are used than the nature affords. The construction of words, called syntax, is distinguished into two parts, concord and regimen.

CONSUL, is an officer established by virtue of a commission from the king, and other princes, in all foreign countries of any considerable trade, to facilitate and dispatch business, and protect the merchants of the nation. The consuls are to keep up a correspondence with the ministers of England residing in the courts whereon their consulate depends. They are to support the commerce and the interest of the nation; to dispose of the sums given and the presents made to the lords and principals of places, to obtain their protection, and prevent the insults of the natives on the merchants of the nation. By the treaty of Utrecht, between Great Britain and Spain, the consul residing in the king of Spain's dominions shall take inventories of the estates of the English dying intestate in Spain; and these estates shall be intrusted with two or three merchants, for the security and benefit of the proprietors and creditors.

CONSULTATION, in law, a writ by which a cause, being removed from the spiritual court to the king's court, is returned thither again; and the reason is, that if the judges of the king's court, by comparing the libel with the suggestion of the party, find the suggestion false or not proved, and on that account the cause to be wrongfully called from the ecclesiastical court, then upon this consultation or deliberation they decree it to be returned. This writ is in the nature of a procedendo; yet properly a consultation ought not to be granted, only in case where a person cannot recover at the common law. In causes of which the ecclesiastical and spiritual courts have jurisdiction, and they are not mixed with any temporal thing, if suggestion is made for a prohibition, a consultation shall be awarded. See Prohibition.

CONSUMPTION. See Medicine.

CONTACT, is when one line, plane, or body, is made to touch another, and the parts that do thus touch are called the points or places of contact. The contact of two spherical bodies, and of a tangent with the circumference of a circle, is only in one point.

Contact, *angle of*, is the opening between a curve line and a tangent to it.

CONTAGION, in physic, the communicating a disease from one body to another. In some diseases it is only effected by an immediate contact, as in the syphilis; in others it is conveyed by infected clothes; and in others it seems capable of being transmitted through the air at a considerable distance. Though a very able writer in Dr. Rees's Cyclopedia produces a variety of facts, to prove that the most malignant contagions are never conveyed to any great distance through the atmosphere, but that they are in fact rendered inert and harmless by diffusion in the open air, and even in the air of a well ventilated apartment. Hence the same writer, who has given an article of great interest on this subject, infers that all pestilence is propagated by near approach to, or actual contact of, the disease, or by the conveyance of the contagious poison in articles impregnated with it. This noxious matter is in many cases readily distinguished by the peculiarly disagreeable smell which it communicates to the air. No doubt this matter differs according to the diseases which it communicates, and the substance from which it has originated. Morveau lately attempted to ascertain its nature; but he soon found the chemical tests hitherto discovered altogether insufficient for that purpose. He has put it beyond a doubt, however, that the noxious matter which rises from putrid bodies is of a compound nature; and that it is destroyed altogether by certain agents, particularly by those gaseous bodies which readily part with their oxygen. He exposed air infected by putrid bodies to the action of various substances; and he judged of the result by the effect which these bodies had in destroying the fetid smell of the air. The following is the result of his experiments; odorous bodies, such as benzoin, aromatic plants, &c. have no effect whatever: neither have the solutions of myrrh, benzoin, &c. in alcohol, though agitated in infected air. Pyrolignous acid is equally inert. Gunpowder, when fired in infected air, displaces a portion of it; but what remains still retains its fetid odour. Sulphuric acid has no effect; sulphurous acid weakens the odour, but does not destroy it. Vinegar diminishes the odour, but its action is slow and incomplete. Acetic acid acts instantly, and destroys the fetid odour of infected air completely. The fumes of nitric acid, first employed by Dr. Carmichael Smith, are equally efficacious. Muriatic acid gas, first pointed out as a proper agent by Morveau himself, is equally ineffectual. But the most powerful agent is oxymuriatic acid gas, first proposed by Mr. Cruickshanks, and now employed with the greatest success in the British navy and military hospitals.

We shall observe, that these gases are readily procured. Nitre, or, as it is called in the new chemistry, nitrate of potash, mixed with sulphuric acid, yields a very powerful gas, the acid combining with the potash, the base of the nitre, expels the nitrous acid gas in fumes. Muriatic acid gas is obtained in a similar manner by using common salt, the alkali combines with the acid, and the muriatic gas goes off in vapour. Prevention being, however, much better than the means of cure, we shall give some rules for the management of persons sick with contagious diseases. Cleanliness is essentially necessary: the chamber door should ever be kept open, and the windows as much as possible in the day; the bed curtains should not be drawn, except to ward off the direct light from the window: dirty clothes, utensils, &c. should be frequently changed, and washed very clean: all discharges from the patient should be instantly removed: visitors and attendants should avoid the patient's breath, and the vapour from his body, and from all evacuations; they should never go into an infected chamber with an empty stomach, and on coming from it they should blow their noses and expectorate freely.

During the prevalence of a contagious epidemic, great care should be taken to avoid all causes of debility, and to preserve an equal state of mind. The general alarm which prevails on such occasions contributes, not a little, to extend the evil.

CONTENT, in geometry, the area or quantity of matter or space included in certain bounds.

The content of a tun of round timber is 43 solid feet. A load of hewn timber contains 50 cubic feet; in a foot of timber are contained 1728 cubic or square inches; and as often as 1728 inches are contained in a piece of timber, be it round or square, so many feet of timber are contained in the piece. For the contents of cylindrical vessels, and vessels of other figures, see Gauging.

CONTIGUOUS *angles*, in geometry, are such as have one leg common to each angle, and are sometimes called adjoining angles, in contradistinction to those produced by continuing their legs through the point of contact, which are called opposite or vertical angles. The sum of any two contiguous angles is always equal to two right angles.

CONTINENT, in geography, a great extent of land not interrupted by seas, in contradistinction to island, peninsula, &c.

According to what relations we have of the disposition of the globe from late navigators, we may count four continents, of which there are but two well known. The first, called the ancient continent, comprehends Europe, Asia and Africa. The second is the new continent, called America. The third, which is called the northern or arctic continent, comprehends Greenland, the lands of Spitzberg, Nova Zembla, and the lands of Jesso. The fourth comprehends New Holland, &c.

CONTINGENT, something casual or uncertain. Hence future contingent, in logic, denotes a conditional event which may or may not happen, according as circumstances fall out.

CONTINGENT is also a term of relation for the quota that falls to any person upon a division. Thus each prince in Germany, in time of war, was formerly obliged to furnish so many men, so much money and ammunition, for his contingent.

CONTINGENT *use*, in law, is an use limited in a conveyance of lands which may or may not happen to vest, according to the contingency mentioned in the limitation of the use. And a contingent remainder is when an estate is limited to take place at a time to come, on an uncertain event.

CONTINGENT *legacy*, is a legacy which may or may not happen. If a legacy be left to one when he shall attain, or if he shall attain, the age of twenty-one years, this is a contingent legacy, and if the legatee die before that time, the legacy shall not vest. But a legacy to one, to be paid when he attains the age of twenty-one years, is a vested legacy; an interest which commences in *præsenti*, although it be *solvendum in futuro*: and if the legatee die before that age, his representatives shall receive it out of the testator's personal estate, at the same time that it would have become payable in case the legatee had lived.

CONTINUANCE *of a writ or action*, is its continuing in force from one term to another, where the sheriff has not returned a former writ issued out in the same action. With respect to continuances, the court of King's Bench is not to enter them on the roll till after issue or demurrer, and then they enter the continuance of all on the back, before judgment.

CONTINUED *proportion*, in arithmetic, is that where the consequent of the first ratio is the same with the antecedent of the second; as 4 : 8 : : 8 : 16, in contradistinction to discrete proportion.

CONTORTION, in medicine, has many significations. 1. It denotes the iliac passion. 2. An incomplete dislocation, when a bone is in part, but not entirely, forced from its articulation. 3. A dislocation of the vertebræ of the back sideways, or a crookedness of these vertebræ. And, 4. A disorder of the head, in which it is drawn towards one side, either by a spasmodic contraction of the muscles on the same side, or a palsy of the antagonist muscles on the other.

CONTORTÆ, in botany, twisted plants. The name of the thirteenth order in Linnæus's fragments of a natural method, consisting of plants which have a single petal that is twisted or bent toward one side. This order is divided into plants with twisted flowers, having five stamina and one style; and plants with twisted flowers, having five stamina and scarce any style; of the first, the genus Vinca, periwinkle, is an example; of the second, Apocynum, dog's-bane, is an example.

CONTORTED, in natural history, twisted, or incumbent on each other in an oblique direction.

CONTOUR, in painting, the out-line, or that which defines a figure.

CONTRABAND, in commerce, a prohibited commodity or merchandise, bought or sold, imported or exported, in prejudice to the laws and ordinances of a state, or the public prohibitions of the sovereign. Contraband goods are not only liable to confiscation themselves, but also subject all other allowed merchandise found with them in the same box, bale or parcel, together with the horses, waggons, &c. which conduct them. There are contrabands likewise, which, besides the forfeiture of the goods, are attended with several penalties and disabilities.

In this country, there are two principal contrabands for exportation, wools and live sheep, which all strangers are prohibited from carrying out of the country; the other, that of sheep skins and calf skins. See CUSTOMS.

CONTRACT, in a general sense, a mutual consent of two or more parties, who voluntarily promise and oblige themselves to do something, pay a certain sum, or the like. All donations, exchanges, leases, &c. are so many different contracts.

CONTRACT, in common law, an agreement or bargain between two or more persons, with a legal consideration or cause; as where a person sells goods, &c. to another for a sum of money; or covenants, in consideration of a certain sum, or an annual rent, to grant a lease of a messuage, &c. Contracts are two-fold, either express or implied. Express contracts are where the terms of the agreement are openly uttered, as, to pay a stated price for certain goods. Implied, are such as reason and justice dictate, and which, therefore, the law presumes that every man undertakes to perform: thus, if a man take up wares from a tradesman without any agreement of price, the law concludes that he contracted to pay their real value.

Contract, *usurious*, is an agreement to pay more interest for money than the laws allow.

CONTRACTION, in physics, the diminishing the extent or dimensions of a body, or the causing its parts to approach nearer to each other, in which sense it stands opposed to dilatation or expansion. See Expansion.

Water and all aqueous fluids are gradually contracted by a diminution of temperature, until they arrive at a certain point, which is about 8° above the freezing point; but below that point they begin to expand, and continue to do so according as the temperature is lowered. Similar effects have been observed with regard to some metals. Speaking of contraction, a remarkable phenomenon, of considerable importance in manufactures, obtrudes itself on our notice. It is the hardness which certain bodies acquire in consequence of a sudden contraction, and this is particularly the case with glass and some of the metals. Thus glass vessels, suddenly cooled after having been formed, are so very brittle, that they hardly bear to be touched with any hard body. The cause of this effect is thus properly explained by Dr. Young. "When glass in fusion is very suddenly cooled, its external parts become solid first, and determine the magnitude of the whole piece, while it still remains fluid within. The internal part, as it cools, is disposed to contract still further, but its contraction is prevented by the resistance of the external parts, which form an arch or vault round it, so that the whole is left in a state of constraint; and as soon as the equilibrium is disturbed in any one part, the whole aggregate is destroyed. Hence it becomes necessary to anneal all glass, by placing it in an oven, where it is left to cool slowly; for, without this precaution, a very slight cause would destroy it. The Bologna jars, sometimes called proofs, are small thick vessels, made for the purpose of exhibiting this effect; they are usually destroyed by the impulse of a small and sharp body; for instance, a single grain of sand, dropped into them; and a small body appears to be often more effectual than a larger one, perhaps because the larger one is more liable to strike the glass with an obtuse part of its surface."

CONTRA *harmonical proportion*, in arithmetic, is that relation of three terms, wherein the difference of the first and second is to the difference of the second and third as the third is to the first: thus, 3, 5, and 6, are numbers contra-harmonically proportional, for 2 : 1 :: 6 : 3.

CONTRAST, in architecture, is to avoid the repetition of the same thing, in order to please by variety.

CONTRATE *wheel*, in watch-work, that next to the crown, the teeth and hoop whereof lie contrary to those of the other wheels, from whence it takes its name.

CONTRAVALLATION, or *the line of contravallation*, in fortification, a trench guarded with a parapet, and usually cut round about a place by the besiegers, to secure themselves on that side, and to stop the sallies of the garrison. See Fortification.

CONTRAVENTION, in law, a man's failing to discharge his word, obligation, duty, or the laws or customs of the place. The penalties imposed in cases of contravention only pass for comminatory.

Contravention, in a more limited sense, signifies the non-execution of an ordinance or edict. It is supposed to be the effect of negligence or ignorance.

CONTRAYERVA. See Materia Medica.

CONTRE, in heraldry, an appellation given to several bearings, on account of their cutting the shield contrary and opposite ways: thus we meet with contre-bend, contre-chevron, contre-pale, &c. when there are two ordinaries of the same nature opposite to each other, so as colour may be opposed to metal, and metal to colour.

CONTRIBUTION, in a general sense, the payment of each person's quota, or the share he bears in some imposition or common expense. Contributions are either voluntary, as those of expenses for carrying on some undertaking for the public interest, or involuntary, as those of taxes and imposts.

Contribution, in a military sense, an imposition or tax paid by frontier countries to an enemy, to prevent their being plundered and ruined by him.

CONTROLLER, an officer appointed to control or oversee the accounts of other officers, and, on occasion, to certify whether or no things have been controlled or examined. In England we have several officers of this name, controller of the King's house, controller of the navy, controller of the customs, controller of the mint, &c.

CONTROLLER *of the hanaper*, an officer that attends the Lord Chancellor daily, in term and in seal-time, to take all things, sealed in leather bags, from the clerks of the hanaper, and to mark the number and effect thereof, and enter them in a book, with all the duties belonging to the King, and other officers, for the same, and so charge the clerk of the hanaper with them.

CONTROLLER *of the pipe*, an officer of the Exchequer, that makes out a summons twice every year, to levy the farms and debts of the pipe.

CONTROLLERS *of the pells*, two officers of the Exchequer, who are the Chamberlain's clerks, and keep a control of the pell of receipts, and goings out.

CONTUMACY, in law, a refusal to appear in court, when legally summoned; or the disobedience to the rules and orders of a court, having power to punish such offence.

CONTUSION. See MEDICINE and SURGERY.

CONVALLARIA, in botany, *lily of the valley*, a genus of the Hexandria Monogynia class and order. Natural order of Sarmentacæ. Asparagi, Jussieu. Essential character: corolla six-cleft; berry spotted, three-celled. There are eleven species, of which C. maialis, sweet-scented lily of the valley, has a perennial root, with numerous fibres transversely wrinkled, creeping horizontally, just below the surface, to a considerable distance. The whole plant is smooth, the base of the leaves and stalk are bound together, with four or five alternate purplish scales; flowers from six to eight, in a raceme, nodding; white and fragrant peduncles, bending, one-flowered, round filiform, corolla contracted at the mouth. Native of Europe, from Lapland to Italy. The lily of the valley claims our notice as an ornamental plant; few are held in greater estimation; indeed few flowers can boast such delicacy with so much fragrance. When dried they have a narcotic scent, and if reduced to powder excite sneezing. The genus has been divided into three, *viz.* Convallaria, Smilacina, and Maianthemum, by Desfontaines.

CONVENTICLE, a private assembly or meeting, for the exercise of religion. The word was first attributed as an appellation of reproach to the religious assemblies of Wickliffe in this nation, in the reigns of Edward III. and Richard II. and is now applied to illegal meetings of nonconformists. There were several statutes made in former reigns, for the suppression of conventicles; but by 1 Will. and Mary, it is ordered, that dissenters may assemble for the performance of religious worship, provided their doors be not locked, barred, or bolted. Conventicle, in strict propriety, denotes an unlawful assembly, and cannot, therefore, be justly applied to the legal assembling of persons in places of worship, certified or licensed according to the requisitions of law.

CONVENTION, a treaty, contract, or agreement, between two or more parties. Every convention among men, provided it be not contrary to honesty and good manners, produces a natural obligation, and makes the performance a point of conscience. Every convention has either a name and a cause of consideration, or it has none; in the first case it obliges civilly and naturally, in the latter only naturally.

CONVENTION is also a name given to an extraordinary assembly of parliament, or the states of the realm, held without the King's writ; as was the convention of estates, who, upon the retreat of James II. came to a conclusion that he had abdicated the throne, and that the right of succession devolved to King William and Queen Mary; whereupon their assembly expired as a convention, and was converted into a parliament.

CONVERGING, or CONVERGENT *lines*, in geometry, are such as continually approach nearer one another; or whose distance becomes still less and less. These are opposed to divergent lines, the distance of which become continually greater: those lines which converge one way diverge the other.

CONVERGING *hyperbola*, is one whose concave legs bend in towards one another, and run both the same way.

CONVERGING *rays*, in optics, those rays, that, issuing from divers points of an object, incline towards one another, till, at last, they meet and cross, and then become diverging rays. See OPTICS.

CONVERGING *series*. See SERIES.

CONVERSE, in mathematics. One proposition is called the converse of another, when, after a conclusion is drawn from something supposed in the converse proposition, that conclusion is supposed; and then that, which in the other was supposed, is now drawn as a conclusion from it: thus, when two sides of a triangle are equal, the angles under these sides are equal; and, on the converse, if these angles are equal, the two sides are equal.

CONVERSION *of equations*, in algebra, is when the quantity sought, or any part or degree thereof, being in fractions, the whole is reduced to one common denomination, and then omitting the denominators, the equation is continued in the numerators only. Thus suppose $a - b = \frac{aa + cc}{d} + h + b$; multiply all by d, and it will stand thus, $da - db = aa + cc + dh + db$.

CONVEX, an appellation given to the exterior surface of gibbous or globular bodies, in opposition to the hollow inner surface of such bodies, which is called concave: thus we say a convex lens, mirror, superficies, &c.

CONVEXITY, that configuration or shape of a body, on account of which it is denominated convex.

CONVEYANCE, in law, a deed or instrument that passes land, &c. from one person to another. The most common conveyances now in use are, deeds of gifts, bargain and sale, lease and release, fines and recoveries, settlements to uses, &c. A conveyance cannot be fraudulent in part, and good as to the rest; for if it be fradulent and void in part, it is void in all, and it cannot be divided. Fraudulent conveyances to deceive creditors, defraud purchasers, &c. are void by stat. 50 Edw. III. c. 6. 13 Eliz. c. 5—27. Eliz. c. 4.

CONVICT, in common law, a person that is found guilty of an offence by the verdict of a jury. The law implies that there must be a conviction before punishment for any offence, though it be not mentioned in any statute. On a joint indictment, or information, some of the defendants may be convicted and others acquitted.

CONVICT *recusant*, a person who has been legally presented, indicted, and convicted, for refusing to come to church to hear the common prayer, according to the statutes 1 and 23 Eliz. and 3 Jac. 1.

CONVOCATION, an assembly of the clergy of England, by their representatives, to consult of ecclesiastical matters. It is held during the session of parliament, and consists of an upper and a lower house. In the upper sit the bishops, and in the lower the inferior clergy, who are represented by their proctors, consisting of all the deans and archdeacons, of one proctor for every chapter, and two for the clergy of every diocese, in all one hundred and forty-three divines, *viz.* twenty-two deans, fifty-three archdeacons, twenty-four prebendaries, and forty-four proctors of the diocesan clergy. The lower house chooses its prolocutor, whose business it is to take care that the members attend, to collect their debates and votes, and to carry their resolutions to the upper house. The convocation is summoned by the King's writ, directed to the archbishop of each province, requiring him to summon all bishops, deans, archdeacons, &c.

The power of the convocation is limited by a statute of Henry VIII. They are not to make any canons or ecclesiastical laws without the Kings's licence; nor, when permitted to make any, can they put them in execution but under several restrictions. They have the examining and censuring all heretical and schismatical books and persons, &c. but there lies an appeal to the King in chancery, or to his delegates. The clergy in convocation, and their servants, have the same privileges as members of parliament. See PARLIAMENT.

CONVOLVULUS, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Campanaceæ, or bell-form flowers. Convolvuli, Jussieu. Essential character: corolla bell-shaped, plaited; stigmas two; capsules two-celled, with two seeds in each cell. There are 110 species of this very numerous genus; not more than thirteen species are natives of Europe; the others are mostly inhabitants of the warmer climates of Asia and America. Very few of them are cultivated in our gardens, except C. purpureus, purple bindweed; and C. tricolor, trailing bindweed, more commonly known by the names of convolvulus major and minor; the stems are herbaceous and milky, in the greater part twining, in a very few shrubby; leaves alternate; peduncles axillary or terminating, one flowered, with two bractes, or many flowered.

CONVOY, in marine affairs, one or more ships of war, employed to accompany and protect merchant-ships, and prevent their being insulted by pirates, or the enemies of the state, in time of war.

CONVOY, in military matters, a body of men that guard any supply of men, money, ammunition, or provisions, conveyed by land into a town, army, or the like, in time of war.

CONVULSION. See MEDICINE.

CONUS, in natural history, a genus of Vermes Testacea: animal a limax; shell univalve, convolute, turbinate; aperture effuse, longitudinal, linear, without teeth, entire at the base; pillar smooth. This genus is divided into five distinct families, *viz.* A. spire or turban nearly truncate. B. pyriform, with a rounded base: the cylinder half as long again as the spire. C. elongated and rounded at the base; the cylinder as long again as the spire. D. ventricose in the middle, and contracted at each end. E. thin, ventricose, and making a tinkling sound when thrown on its back upon a table or board. There are upwards of 70 species enumerated. Many of the conus tribe are beautiful shells, and bear a high price on account of their rarity. There is no species of this genus upon the English coast. Some very curious kinds have been discovered in a fossil state in England, chiefly in the chalk cliffs of Hampshire.

CONYZA, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx imbricate, roundish; corolla of the ray three-cleft; down simple; receptacle naked. There are forty-three species. The Conyzas or Fleabanes are either herbaceous or shrubby; in a few of them the leaves are decurrent; the flowers are of the compound kind without any ray, in corymbs or panicles at the top of the stem and branches.

COOKIÆ, in botany, a genus of the Decandria Monogynia class and order. Calyx five-cleft, inferior; corolla five-petalled, equal inferior; pome five-celled; the cells one seeded. One species found in China.

COOKERY, or *cooking*, the exercise of art in the preparation of food for human sustenance. It consists not only in the application of heat under various modifications and circumstances, but also in the due intermixture of condiments, calculated as well to please the palate as to promote nutrition. The exercise of this art is peculiar to man, and it has been deemed by naturalists one of his peculiar characteristics, that he is "a cooking animal." Dr Cullen says, that the cooking of vegetables by boiling renders them more soluble in the stomach, notwithstanding the degree of coagulation which their juices undergo. In the second place, the application of a boiling heat dissipates the volatile parts of vegetable substances, which are seldom of a nutritious nature, but, in many cases, have a tendency to prove noxious. In the third place, boiling helps to extricate a considerable quantity of air, that, in the natural state of vegetables, is always fixed in their substance; and it is probably in this way, especially, that heat contributes to the dividing and loosening the cohesion of their smaller parts. Thus they are rendered less liable to ferment, and to produce that flatulence which is so troublesome to weak stomachs.

In the cookery of animal substances, some practices, previous to the application of heat, are to be considered as affecting their solubility in the stomach; particularly salting and pickling. These processes are spoken of under the article CONDIMENTS.

The cookery of animal substances is of two kinds; as it is applied in a humid form, in boiling and stewing; or in a dry form, in roasting, broiling, and baking. By the joint application of heat and moisture to meat in boiling, the texture is certainly rendered more tender and more soluble in the stomach; and it is only in this way that the firmer parts, as the tendinous, ligamentous, and membranous parts, can be duly softened, and their gelatinous substance rendered subservient to nutrition. Yet these effects are different according to the degree of boiling. A moderate boiling may render their texture more tender, without much diminution of their nutritious quality; but if the boiling is extended to extract every thing soluble, the substance remaining is certainly less soluble in the stomach, and at the same time much less nutritious. But as boiling extracts, in the first place, the more soluble, and therefore the saline part, so what remains is, in proportion, less alkalescent, and less heating to the system.

Boiling in digesters, or vessels accurately closed, produces effects very different from boiling in open vessels. From meat cooked in the latter, there is no exhalation of volatile parts; the solution is made with great success, and if not carried very far, the meat may be rendered very tender, while it still retains its most sapid parts; and this is esteemed always the most desirable state of boiled meat. If a small quantity of water only is applied, and the heat continued long in a moderate degree, the process is called stewing, which has the effect of rendering the texture of meat more tender, without extracting much of the soluble parts. This, therefore, leaves the meat more sapid, and in a state perhaps the most nourishing of any form of cookery; as we learn from the admirable essays and experiments of Count Rumford, who found very unusual effects produced on meat by a low degree and long-continued action of heat, both in the dry and humid way.

The application of a dry heat in the cookery of meat is of two kinds, as it is carried on in close vessels, or as it is exposed to the air. The first of these which we shall consider is baking. In this practice meat has generally a covering of paste, by which any considerable exhalation is prevented, and the retention of the juices renders the meat more tender. In all cases, when the heat applied loosens, and in some measure extricates, the air, without exhaling it, the substance submitted to this process is rendered more tender than when an exhalation is allowed. In broiling, an exhalation takes place; but as the heat of a naked fire is more nearly applied, the outer surface is in some measure hardened before the heat penetrates the whole, and thereby a great exhalation is prevented, while the whole is rendered sufficiently tender; but this kind of cookery is suited to meats that are chosen to be eaten a little raw. Nearly a-kin to this is the practice of frying, in which the meat being cut into thin slices, and laid in a pan over the naked fire, the heat is applied more equally to the whole substance. But as the part of the meat lying next to the bottom of the vessel would be suddenly hardened by the heat, it is always necessary to interpose some fluid matter, usually of an oily quality, as butter. A strong heat applied to the latter renders it empyreumatic, or at least less miscible with the fluids of the stomach: so that all fried meats are less easily digested than those of any other preparation. Sometimes, indeed the same thing happens to baked meats, to which an oily matter, and that only, is added, to avoid the too drying heat of the oven. It is obvious that the preparations of stewing and frying may be frequently joined together; and according to there being more or less of the one or other, the effects may be imagined.

COOLER, among brewers, distillers, &c. a large vessel, wherein certain liquors are cooled after having been boiled.

COOMB, or Comb *of corn*, a dry measure, containing four bushels, or half a quarter.

COOPER, in the trades, an artificer who makes casks, tubs, barrels, and all kinds of wooden vessels which are bound together with hoops. This is unquestionably a very ancient trade, and is referred to 2000 years ago by the writers on rural economy in Rome. Their descriptions correspond in a good measure with the construction of casks in our day. It is not known when the business of a cooper was first introduced into this country, but it has been supposed it was derived from the French. Wood used for the purpose of cask-making should be old and thick; straight trees are the best; from these are hewn thin planks, which are formed into staves. In France, we are told, the wood is prepared in winter; the staves and bottoms are then formed, and they are put together in summer. Planing the staves, is one of the most difficult parts of the work, and it is at the same time one of the most important in the fabrication of casks. In the formation of the staves, it must be recollected that each is to constitute part of a double conoid. Each stave must therefore be broader at the middle, and gradually become narrower, but not in straight lines towards the extremities. The outside of the staves, across the wood, must be wrought into the segment of a circle; and it must be thickest near the middle, growing gradually thinner towards the ends. After the staves are dressed and ready to be arranged, the cooper, without attempting any great nicety in sloping them, so that the whole surface of the edge may touch in every point, brings the contiguous staves into contact only at the inner surface; and in this way, by driving the hoops hard, he can make a closer joint than could be done by sloping them from the outer to the inner side.

Cooper, on board a ship, he that looks to the casks and all other vessels for beer, water, or any other liquor. He has a mate under him.

COPAIFERA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Leguminosæ, Jussieu. Essential character; calyx none; petals five; legume ovate; seed one, with a berried aril. There is but one species, *viz.* C. officinalis, balsam of capevi tree. This is a lofty elegant tree, with a handsome head; the extreme branches at the axils are flexuose, with a brownish ash-coloured bark; leaves alternate, round, four inches long; racemes axillary, solitary, loosely divided into eight alternate, lateral common peduncles, an inch and a half in length, with white flowers sitting closely on them. Native of South America: from this tree is obtained in very considerable quantities, by perforating the trunk, fluid balsam or resin, which thickens by degrees;

and which is known in medicine by the title of balsam of copaiva. See Balsam.

COPAL This substance, which deserves particular attention from its importance as a varnish, and which, at first sight, seems to belong to a distinct class from the resins, is obtained from the rhus copallinum, a tree which is a native of North America: but the best sort of copal is said to come from Spanish America, and to be the produce of different trees.

Copal is a beautiful white resinous substance, with a slight tint of brown. It is sometimes opaque, and sometimes almost perfectly transparent. When heated it melts like other resins; but it differs from them in not being soluble in alcohol, nor in oil of turpentine without peculiar management. Neither does it dissolve in the fixed oils with the same ease as the other resins. It resembles gum animé a little in appearance, but is easily distinguished by the solubility of this last in alcohol, and by its being brittle between the teeth, whereas animé softens in the mouth. The specific gravity of copal varies from 1.045 to 1.139. Mr. Hatchett found it soluble in alkalies and nitric acid with the usual phenomena, so that in this respect it agrees with the other resins.

When copal is dissolved in any volatile liquid, and spread thin upon wood, metal, paper, &c. so that the volatile menstruum may evaporate, the copal remains perfectly transparent, and forms one of the most beautiful and perfect varnishes that can well be conceived. The varnish thus formed is called copal varnish, from the chief ingredient in it. Copal varnish used by the English japanners is made as follows. Four parts by weight of copal in powder are put into a glass matrass and melted. The liquid is kept boiling till the fumes, condensed upon the point of a tube thrust into the matrass, drop to the bottom of the liquid without occasioning any hissing noise, as water does. This is a proof that all the water is dissipated, and the copal has been long enough melted. One part of boiling hot linseed oil (previously boiled in a retort without any litharge) is now poured into it, and well mixed. The matrass is then taken off the fire, and the liquid, while still hot, is mixed with about its own weight of oil of turpentine. The varnish thus made is transparent, but it has a tint of yellow, which the japanners endeavour to conceal, by giving the white ground on which they apply it a shade of blue. It is with this varnish that the dial plates of clocks are covered after having been painted white.

Mr. Sheldrake has lately favoured the public with another and easier method of dissolving copal. This method is as follows: "Provide a strong vessel made of tin or other metal; it should be shaped like a wine bottle, and capable of holding two quarts; it will be convenient to have a handle strongly rivetted to the neck; the neck should be long, and have a cork fitted to the mouth, but a notch or small hole should be made in the cork, that, when the spirit is expanded by heat, a small portion may force its way through the hole, and thus prevent the vessel from bursting. Dissolve half an ounce of camphor in a quart of spirit of turpentine, and put it into the vessel; take a piece of copal the size of a large walnut, reduce it to a coarse powder or very small pieces, put them into the tin bottle, fasten the cork down with a wire, and set it, as quick as possible, upon a fire so brisk as to make the spirit boil almost immediately; then keep it boiling very gently for about an hour, when so much of the copal will be dissolved as will make a very good varnish; or, if the operation has been properly begun, but enough of copal has not been dissolved, it may be again put on the fire, and by boiling it slowly for a longer time, it may be at last brought to the consistence desired.

COPARCENARY, an estate held in coparcenary, is where lands of inheritance descend from the ancestor to two or more persons. It arises either by common law, or particular custom. By common law, as where a person seized in fee-simple, or fee-tail, dies, and his next heirs are two or more females, his daughters, sisters, aunts, cousins, or their representatives; in this case they shall all inherit. And these co-heirs are then called coparceners, or, for brevity sake, parceners. Parceners, by particular custom, are where lands descend, as in gavel-kind, to all the males in equal degree, as sons, brothers, uncles, or other kindred; and in either of these cases, all the parceners put together make but one heir, and have but one estate among them.

COPERNICAN *system*, or Hypothesis, that system of the world, wherein the Sun is supposed at rest in the centre, and the planets, with the Earth, to move in ellipses round him. The Sun and stars are here supposed at rest, and that diurnal motion which they appear to have, from east to west, is imputed to the Earth's motion from west to east, round its axis. This system was received of old by Philolaus, Aristarchus, and Pythagoras, from which last it had the name of the Pythagoric system: it was also held by Archimedes; but after him it became neglected, and even forgotten for many ages, till it was revived by Copernicus, about the year 1500, and from him named the Copernican system. According to this hypothesis, the Sun is supposed very nearly the centre of gravity of the whole system, and in the common focus of every one of the planetary orbits: next to him Mercury performs his revolution around him; next Mercury is the orbit of Venus; then the Earth, with its attendant or secondary, the Moon, performing a joint course, and in their revolution measuring out the annual period. Next the Earth is Mars, the first of the superior planets; next him Jupiter, then Saturn, and lastly, the Herschel planet. Between Mars and Jupiter have been discovered four very small bodies, called Asteroides; which see.

These and the comets are the constituent parts of the solar system, which is now received and approved as the only true one. See Astronomy.

COPERNICUS (Nicholas) in biography, was born at Thorn, in Prussia, in 1472. Having acquired, during the course of his education at Cracow, a fondness for mathematical studies, and particularly for astronomy, he went to Bologna, to prosecute these studies under an eminent astronomer of that university. Here he obtained such distinction, that he was appointed professor of mathematics at Rome. Returning after some years to his native country, he obtained a canonry in the cathedral church of Frauenburg, and in the leisure which this situation afforded him pursued his astronomical speculations. Perceiving the Ptolemaic system (which supposes the Earth to be fixed in the centre, and the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn, to revolve about it in concentric circles) to be inconsistent with the phenomena, and encumbered with many absurdities, he had recourse to the Pythagorean hypothesis, which places the Sun in the centre of the system, and makes the Earth a planet, revolving annually with the rest about the Sun, and daily about its own axis. Upon this system, compared with the observations which had been made by others and himself, he proceeded to ascertain the periodical revolutions of the planets, and wrote his treatise, "De Orbium Cœlestium Revolutionibus"—"On the Revolutions of the Heavenly Bodies," in which he demonstrated them geometrically.

A doctrine which explained the celestial phenomena with so much simplicity could not fail to engage the attention and admiration of astronomers and philosophers. But, on account of its inconsistency with some passages of scripture, it was rejected by many divines, and censured in an express decree of the Romish Church. Nevertheless the doctrine daily gained ground, and is now universally received. Copernicus died in 1543.

COPPEL, Copel, or Cuppel, a chemical vessel made of earth, pretty thick, and of the form of a platter or dish. See Laboratory.

COPPER, in the arts, seems to have been known in the remotest periods of antiquity. It is among the first metals which was employed by the early nations of the world; it is not one of the scarce metals, is easily extracted from its ores, and not difficult to work. The Egyptians applied it to a great variety of uses, as it appears from the earliest period of their history. The Greeks were acquainted with the mode of working copper, and employed it in many of the arts. It was the basis of the celebrated Corinthian metal. The Romans knew the uses of this metal, and it is generally supposed that of it they fabricated the greatest number of their utensils. The alloys which they made with copper, after the example of the Egyptians and Greeks, were very numerous, and applied to a great variety of uses. Copper exists in considerable abundance in nature; it is found native, alloyed with other metals, combined with sulphur, in the state of oxide, and in that of salt. It is not unfrequently met with in the native state, sometimes crystallized in an arborescent form, and sometimes in more regular figures. Copper exists native, alloyed with gold and silver. The most abundant ores of copper are the sulphurets, and of these there is a considerable variety, exhibiting various colours and various forms of crystals. In the state of oxide it has been found in Peru, of a greenish colour, mixed with white sand. In the state of salt, copper is combined with the sulphuric and carbonic acids, forming native sulphates and carbonates of copper. The latter present many varieties, but may chiefly be referred to the blue and green carbonates. The extraction of the ores of copper is to be conducted according to the nature of the combination in which they exist. The following process is recommended for the treatment of the sulphurets of copper. The ore is first reduced to powder, and then boiled with five parts of concentrated sulphuric acid. The solution is evaporated to dryness, and the residuum well washed with warm water, to remove all soluble matters. The solution being sufficiently diluted, a plate of copper is immersed in it, which precipitates the silver, and afterwards a plate of iron to precipitate the copper. It is boiled with the plate of iron till no farther precipitate takes place. The copper which is thus obtained is dried with a gentle heat, so that it may not undergo oxidation. It is supposed that the copper is mixed with iron; the whole may be dissolved in nitric acid; and the process is again repeated by introducing the plate of iron. In this way it is easy to discover the quantity of copper in the sulphurets of this metal.

Copper is a very brilliant metal, of a fine red colour, differing from every other metallic substance. The specific gravity of copper is 8.58. When it is hammered it acquires a greater density. It possesses a considerable degree of hardness and some elasticity. It is extremely malleable, and may be reduced to leaves so fine, that they may be carried about by the wind. It has also a considerable degree of ductility, intermediate, according to Guyton, between tin and lead. The tenacity of copper is also very great. A wire .078 of an inch in diameter will support a weight, without breaking, equal to more than 300*lbs.* avoirdupois. Copper has a peculiarly astringent and disagreeable taste. It is extremely deleterious, when taken internally, to the animal economy, and indeed may be considered as a poison. It is distinguished by a peculiarly disagreeable odour, which it communicates to the hands by the slightest friction. Copper does not melt till the temperature is elevated to a red heat, which is about 27° Wedgwood, or by estimation 1450° Fahrenheit. When it is rapidly cooled after fusion, it assumes a granulated and porous texture; but if it be cooled slowly, it affords crystals in quadrangular pyramids, or in octahedrons, which proceed from the cube, its primitive form. When the temperature is raised beyond what is necessary for its fusion, it is sublimed in the form of visible fumes. When copper is exposed to the air, especially if it be humid, it is soon deprived of its lustre. It tarnishes, becomes of a dull brown colour, which gradually deepens till it is converted into that of the antique bronze, and at last is covered with a shining green crust, which is well known under the name of verdigris. This process is the oxydation of the metal by the absorption of oxygen from the atmosphere; and it is promoted and accelerated, either by being moistened with water, or by the water which exists in the atmosphere. As this oxide is formed, the carbonic acid of the atmosphere combines with it, so that it is to be considered as a mixture of oxide and carbonate of copper. But when copper is subjected to a strong heat, the oxidation proceeds more rapidly. If a plate of copper be made red hot in the open air, it loses its brilliancy, becomes of a deep brown colour, and the external layer, which is of this colour, may be detached from the metal. This is the brown oxide of copper. This oxide may be obtained by immersing a plate of red-hot copper into cold water. The scales which are formed on the surface fall off by the sudden contraction of the heated copper. This may be repeated till the whole is converted into this oxide. The copper in this state is in the highest degree of oxidation. The component parts of this oxide are,

Oxygen	25
Copper	75
	100

There are, however, different oxides; copper combines with a smaller proportion of oxygen, forming an oxide of an orange colour. This is the oxide of copper with the smaller proportion of oxygen. The component parts of this oxide, according to Mr. Chenevix, are,

Oxygen . . .	11.5
Copper . . .	88.5
	100.0

This oxide changes colour the moment it is exposed to the air, by the absorption of oxygen, for which it has a very strong affinity. There is no action between azote, hydrogen, or carbon, and copper. Phosphorus readily combines with copper, and forms with it a phosphuret, which is prepared by fusing equal parts of copper and phosphoric gas, with $\frac{1}{6}$th of the whole of charcoal in powder Copper combines with sulphur by different processes. If sulphur in powder and filings of copper are mixed together, and formed into a paste with a little water, when they are exposed to the air, the mass swells up, becomes hot, and is converted into a brown matter, which effloresces slowly in the air, and is converted into sulphate of copper.

Copper combined with sulphur is one of the most common ores of this metal. According to the experiments of Proust, the natural production, known by the name of copper pyrites, is a sulphuret of copper combined with an additional portion of sulphur. It is distinguished by its brittleness, metallic lustre, and yellow colour.

The alloys of copper (that is, those in which this metal predominates) are more numerous and more important in the arts than those of any other metal. Many of them are perfectly well known, and have been in use from very ancient times; of many, the exact composition, and particularly the mode of preparing, are kept as secret as possible; for even when the precise composition of an alloy is found by chemical analysis, it may often be extremely difficult to produce a mixture by common methods, which shall have exactly the same shade of colour, the same malleability, texture, susceptibility of polish, or some other excellence, which, perhaps, a mere accident has discovered to the possessor.

The principal objects of alloying copper appears to be, to render it less liable to tarnish, and especially to be acted on by common animal or vegetable substances, to make it more fusible, and harder, and able to take a higher polish, and to alter its colour either to a golden yellow or silvery white. All these objects are attainable by different alloys. Copper, alloyed with gold, silver, and platina, is seldom, if ever, used in the proportions in which it would be reckoned as alloy of copper, being much too costly for any purpose of manufacture; with this exception, however, that a very small portion of silver much improves the composition of the alloy of copper and tin, when used as bell-metal or speculum-metal. Copper is used largely as an alloy of gold and silver, and it is often plated with one or the other.

Tutenag is a white alloy of copper, zinc, and iron, according to Keir, which is very hard, tough, and sufficiently ductile to be wrought into various articles of furniture, such as candlesticks, &c. which take a high polish, and when made of the better sort of tutenag are hardly distinguishable from silver. The inferior kinds are still white, but with a brassy yellow. The Chinese petong is another fine, white, malleable alloy of copper, the composition of which is not exactly known, but it contains a small portion of silver. Copper unites with lead very intimately by fusion, but when a mass of this alloy is exposed to a heat less than that at which the whole melts, the lead alone sweats out, leaving almost all the copper in a porous or honey-combed state. When the copper holds a small portion of silver, the lead carries the latter out with it, and this is the principle of the old processs of eliquation, formerly much used in the extracting of silver from copper ores. Copper, with about a fourth of its weight of lead, forms pot-metal, used by the ancients for their coins.

Copper, nearly saturated with zinc, forms brass, the most important of all the alloys of this metal See Brass. With a much less proportion of zinc, the colour of the alloy approaches very nearly to that of gold, and the malleability increases. Mixtures chiefly of these two metals are used to form a variety of yellow or gold-coloured alloys, known by the names of tombac, Manheim, or Dutch gold, tinsel, similar, Prince Rupert's metal, Pinchbeck, &c.; but the precise composition varies according to the fancy or the experience of different manufacturers. The Dutch gold may be beaten out into extremely fine leaves, which, when fresh, have nearly the brilliance of gold-leaf, and are used as a cheap imitation of it; but they tarnish very soon. The mixture may be made, either by directly melting copper and zinc, or by mixing brass and copper. In either case the copper should be melted first, and the zinc added afterwards, the whole stirred together with wood, covering it with a little charcoal, and poured out immediately, to prevent the loss by the burning off the zinc. A kind of tombac is the material of which a large proportion of the Roman coins was composed: Klaproth, on analyzing several struck during the first century of the emperors, found them all to consist either of pure copper, or of copper and zinc, in which the latter metal made generally from a fifth to a sixth of the mass: A little tin and lead were found in some; but in such small proportion as to appear only an accidental impurity.

The alloys of copper and tin are extremely important in the arts, and curious as chemical mixtures. They form, in different proportions, mixtures, which have a distinct and appropriate use. Tin added to copper makes it more fusible; much less liable to rust or corrosion by common substances; harder, denser, and more sonorous. In these respects the alloy has a real advantage over unmixed copper; but this is in many cases more than counterbalanced by the extreme brittleness which even a moderate portion of tin imparts, and which is a singular circumstance, considering how very malleable both metals are before mixture, and the remarkable softness and ductility of tin.

Copper, or sometimes copper with a little zinc, alloyed with as much tin as will make from about one-tenth to about one-fifth of the whole, forms an alloy, which is the principal, and often the only composition for bells, brass cannon (so called,) bronze statues, and several smaller purposes, and hence it is called bronze, or bell-metal; and it is excellently fitted for these purposes, by its hardness, density, sonorousness, and fusibility, whereby the minute parts of hollow moulds may be readily filled before it fixes in cooling. For cannon, a lower portion of tin seems to be used. Bronze cannon are much less liable to rust than those of iron; but in large pieces of ordnance, by very rapid firing, the touch-hole is apt to melt down, and spoil the piece: of which there is a remarkable instance at the Tower of London, of a mortar of the largest calibre thus spoiled at the siege of Namur. On account of the sonorousness of bronze, these cannon give a much sharper report than those of iron, which for a time impairs the hearing of the people that work them. A common alloy for bell-metal is about 80 of copper to 20 of tin; or where copper, brass, and tin are used, the copper is from 70 to 80 per cent. including the portion contained in the brass, and the remainder is tin and zinc. The zinc certainly makes it more sonorous. Antimony is also often found in small quantity in bell-metal. Some of the finer kinds used for small articles contain also a little silver, which much improves the sound. When the tin is nearly one-third of the alloy, it is then most beautifully white, with a lustre almost like that of mercury, extremely hard, very close-grained, and perfectly brittle. In this state it takes a most beautiful polish, and is admirably fitted for the reflection of light for all optical purposes. It is then called speculum metal, which, however, for the extreme perfection required in modern astronomical instruments, is better mixed with a very small proportion of other metals, particularly arsenic, brass, and silver.

When more tin is added than amounts to half the weight of the copper, the alloy begins to lose that splendid whiteness, for which it is so valuable as a mirror, and becomes more of a blue-grey. As the tin increases, the texture becomes rough-grained, and as it were rotten, and totally unfit for manufacture. The speculum metal is therefore in the highest proportion of alloy of tin that copper will admit, for any useful purpose. See Aikin's Dictionary of Chemistry.

COPPERAS is the sulphate of iron, and is commonly called green vitriol. If sulphuric acid be diluted with water, and be poured upon iron, much effervescence will be seen: the metal will be dissolved, and the solution, when evaporated, will exhibit the sulphate of iron, or common copperas, which is a neutral salt in a very impure state. Copperas is the basis of many dyes: it gives a fine black, though it rather subjects the material to decay, unless used with extreme caution, the least excess occasioning the cloth, &c. to rot very soon. It seems that wool is more affected by it than felt, as is obvious from the greater duration of hats beyond what broad cloths, &c. exhibit when dyed black. Ink owes its rich blackness principally to the copperas it contains; and our fine black leathers are equally indebted to its powerful qualities, which so firmly fix the colour on all occasions. Many servants are in the habit of cleansing their copper kitchen utensils with green vitriol, which is extremely dangerous: the copperas is highly corrosive, and disengages a very large portion of the copper, which cannot be always removed, even when much pains are taken, the salt being buried under projecting rims, rivets, &c. We are apt to believe that many most painful and dangerous complaints have resulted from this, though probably they may have been assigned to other supposed causes.

Mr. Murdoch, of Cornwall, obtained a patent for extracting copperas from mundic, and other ores containing sulphur, zinc, or arsenic. He washed the calcined mundic, &c. and by evaporating the liquid produces chrystals of copperas. It is probably owing in a great degree to the quantity of green vitriol it contains, that ink is so efficacious in the cure of burns where the skin is not off; but it should be applied without delay. Where copperas comes in contact with metals, it occasions an oxide to be formed, which is highly prejudicial to linens, &c. as well as to health. When it acts upon iron, it produces a stain called iron-mould, which may, however, be easily removed, if attended to in due time, by the use of vegetable acids; especially the salt of lemons, and partially by cream of tartar, which is often sold by those itinerant knaves, who impose it on the ignorant throughout the country for the concentrated salt of that fruit.

COPROSMA, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Stellatæ. Rubiaceæ, Jussieu. Essential character: calyx one-leafed, five toothed; corolla five or six cleft; stamina five, six, or seven. Herm. styles two, long; berry containing two flattish seeds. There are two species, *viz.* C. foetidissima, and C. lucida, both shrubs: leaves opposite, with a stipule interposing; peduncles axillary, one, or many-flowered; flowers male and hermaphrodite; corolla differently divided, and the number of stamens uncertain, from five to seven. These were discovered in Queen Charlotte's Sound, New-Zealand.

COPULA, in logic, the verb that connects any two terms in an affirmative or negative; as "riches make a man happy." where *make* is the copula: "no weakness is a virtue;" where *is* is the copula.

COPULATIVE *propositions*, in logic, those where the subject and predicate are so linked together, by copulative conjunctions, that they may be all severally affirmed or denied one of another. Example, "Riches and honours are apt to elate the mind, and increase the number of our desires."

COPY, in a law sense, signifies the transcript of any original writing, as the copy of a patent, charter, deed, &c. A common deed cannot be proved by a copy or counterpart, where the original may be procured. But if the deed be inrolled, certifying an attested copy is proof of the inrollment, and such copy may be given in evidence.

Copy is also used for the imitation of an original work, more particularly in painting, draught, figure, &c.

Copy, among printers, denotes the manuscript, or original of a book, given to be printed.

Copy is used for an imitation of any original work, particularly a painting, drawing, figure, &c. Of late years many methods have been invented for taking copies of letters, or other MS. for the convenience of merchants, &c. Mr. Watt, of Birmingham, obtained a patent for a copying machine, which acts as a rolling press: the ink made use of is of a particular quality, which prevents its drying too quickly, and the paper on which the copy is to be taken is unsized, and in other respects prepared for the purpose. There have been other contrivances of polygraphs, for making two or more copies at the same time of any writing. But the most simple method, where the practice is not much called for, consists in putting a little sugar in common writing ink, and with this the writing is made on common paper; and when a copy is required, unsized paper is taken, and lightly moistened with a sponge. The wet paper is then applied to the writing, and a flat iron of a moderate heat being lightly passed over the unsized paper, the copy is immediately produced. The use of the sugar is to preven the ink from drying too soon.

Copy-*hold*, a tenure, for which a tenant has nothing to shew but the copy of the rolls made by the steward of the lord's court.

The customs of manors differ as much as the humour and temper of the respective ancient lords; so a copyholder, by custom, may be tenant in fee-simple, in fee-tail, for life, by the courtesy, in dower, for years, at sufferance, or on condition; subject, however, to be deprived of these estates upon the concurrence of those circumstances, which the will of the lords, promulged by immemorial custom, hath declared to be a forfeiture or absolute determination of those interests; as in some manors the want of issue, in others the want of issue male, in others the cutting down timber, in others the non-payment of rent or fine. Yet none of these interests amount to freehold; for the freehold of the whole manor abides always with the lord only, who hath granted out the use of occupation, but not the corporeal seizin, or true possession of certain parts or parcels thereof, to these his customary tenants at will.

If a person would devise a copyhold estate, he cannot do it by his will, but he must surrender to the use of his last will and testament, and in his will declare his intent; and here the lands do not pass by the will, but by the surrender thus made.

Copyhold inheritances have no collateral qualities, which do not concern the descent, as to make them assets to bind the heir, or whereof the wife may be endowed, &c. They are not extendible in execution, but are within the acts against bankrupts, and the statutes of limitation.

Copy-*holder*, one who is admitted tenant of lands, or tenements within a manor, which, time out of mind, by use and custom of the manor, have been demisable, and demised to such as will take them in fee-simple, or fee-tail, for life, years, or at will, according to the custom of the manor by copy of court-roll. But is generally where the tenant has such estate either in fee or for three lives.

Copy-*right*, the right which an author may be supposed to have in his own original literary compositions; so that no other person, without his leave, may publish or make profit of the copies. When a man, by the exertion of his rational powers, has produced an original work, he has clearly a right to dispose of that identical work as he pleases; and any attempt to take it from him, or vary the disposition he has made of it, is an invasion of his right of property. Now the identity of a literary composition consists entirely in the sentiment and the language; the same conceptions, clothed in the same words, must necessarily be the same composition: and whatever method be taken of conveying that composition to the ear, or to the eye of another, by recital, by writing, or by printing, in any number of copies, or at any period of time, it is always the identical work of the author which is so conveyed: and no other man (it hath been thought) can have a right to convey or transfer it, without his consent either tacitly or expressly given. This consent may, perhaps, be tacitly given, when an author permits his work to be published without any reserve of right, and without stamping on it any marks of ownership; it is then a present to the public, like the building of a church, or the laying out a new highway: but in case of a bargain for a single impression, or a total sale or gift of the copy-right; in the one case the reversion hath been thought to continue in the original proprietor; in the other, the whole property, with its exclusive rights, to be perpetually transferred to the grantee. On the other hand it is urged, that though the exclusive right of the manuscript, and all which it contains, belongs undoubtedly to the owner before it is printed or published, yet from the instant of publication the exclusive right of an author, or his assigns, to the sole communication of his ideas, immediately vanishes and evaporates, as being a right of too subtle and unsubstantial a nature to become the subject of property at the common law, and only capable of being guarded by positive statute and special provisions of the magistrate.

COR *Caroli*, in astronomy, an extra-constellated star in the northern hemisphere, situated between the Coma Berenices and Ursa Major, so called by Dr. Halley in honour of King Charles.

Cor *Hydræ*, a fixed star of the first magnitude, in the constellation of Hydra.

Cor *Leonis*, or *Regulus*, in astronomy, a fixed star of the first magnitude, in the constellation Leo.

CORACIAS, the *roller*, in natural history, a genus of birds of the order Picæ. Generic character: bill straight, bending towards the tip, sharp edged, the base naked of feathers; tongue cartilaginous and bifid; legs short; feet formed for walking, three toes before and one behind, divided throughout. There are, according to Gmelin, twenty-five species; though Latham enumerates but sixteen. The following is the principal. C. garrulus, or the common roller. These birds are about the size of a jay, and abound in several parts of Europe. They are found in the latitudes between Denmark and Africa; and in Sicily and Malta, as well as in Germany, are sold in the shops and markets for food. Being birds of passage, they are supposed to spend the winter in Africa, as they are stated to be seen at Senegal not unfrequently in flocks. They build in trees, though sometimes in holes in the ground, and feed on insects, worms, frogs, nuts, and corn. Their flesh has very much the taste of a turtle. Its name is derived from a noise made by it similar to chattering.

CORAL. By this designation we generally understand that substance of which a variety of ornaments are made, considering it as a concrete substance, and supposing it to be a marine plant. This was the opinion entertained for centuries, from the time even of Pliny to the beginning of the seventeenth century, when various circumstances gave rise to doubts as to the formation of coral. Monsieur de Peyssonel of Marseilles observed, that the ramifications were inhabited by a numerous tribe of insects; and that what appeared to be the flowers of the coral, and which receded into small apertures on its being withdrawn from the salt water, were those insects, which, on re-immersion, again protruded themselves. Added to this, the softness of the terminations of all the points, and their being filled with a milky fluid, gives just reason to conclude, that nature has not been deficient in providing these insects with both the means of forming their abodes, and with the means of subsistence. What that subsistence may be, or to what purpose, or how the milky fluid is formed, naturalists have not yet discovered. It should seem that the main channels in the principal branches are gradually formed, and that the lateral ramifications are produced by the expulsion of supernumeraries in the family, which attach themselves to the exterior, and form new galleries. This is the more probable, because pieces of coral, broken off from the main branches, in a few days are found to be again cemented to such parts as they may happen to light upon. By this we may also infer, that a state of rest is necessary to the existence of the coral insect, and that it has very powerful means of attaching itself to rocks, &c. Coral is generally found covered with a rugged incrustation, and on being left to dry in the sun, soon appears discoloured, and emits a very fœtid smell, arising from the corruption of the polypi, or insects, that have died for want of their natural element, and of food. The incrustation being decoriated, the coral presents itself; mostly of a beautiful blood red colour; some are white, and a few pieces are black. The latter is much valued, but the red only is used in medicine as an astringent. Vegetable distilled oils dissolve coral; the red kind yields, by distillation in a retort, a volatile vitreous spirit, that effervesces with acids, turns syrup of violets green, and causes the solution of corrosive sublimate to assume a milky appearance. Calcined in a gentle heat it becomes white, and it imparts to all the menstrua a red colour, which itself gradually loses. The white coral is little valued, and is generally made into lime of the finest quality, where it grows in abundance between high and low water mark. Fisheries for red and black coral are established in many parts of the world, principally in the Levant, in the Red Sea, Peruvian Gulf, Chinese Seas, and among many of the numerous clusters of islands in the Eastern and Pacific Oceans. The largest, brightest, and heaviest, is accounted the best. The women of Asia wear necklaces and bracelets made of one or more rows of red coral; there called moongah. Although obtained in their own quarter of the world, the beads are very dear; those of about the size of a large marrow-fat pea being usually sold for four or five rupees per tolah of half an ounce; which is equal to sixteen or twenty pounds sterling for a pound avoirdupois. The natives of Hindostan have a mode of imitating coral by means of the butts of large conch-shells, which they colour very artfully. Coral is sometimes found in a fossil state, but invariably of a white or yellowish colour; these, from some remaining red spots in their interior, appear to have been formerly entirely of that colour, but to have lost it by absorption, or by the action of acids: and the colour of coral is by no means fixed: if a pound of red coral (the isis nobilis of Linnæus) be boiled in a strong syrup, in which a pound of wax is mixed, both being previously dissolved in spirits of wine, the whole colouring matter of the coral may be extracted. Artificial coral is made of levigated cinnabar, or of minium; but these are easily detected: they will not effervesce with acids, nor do they afford an alkaline earth, as real coral invariably does.

CORALLINA, *Coralline*, in natural history, a genus of the Vermes Zoophyta: Animal growing in the form of a plant; stem fixed, with calcareous subdivided branches, mostly jointed. C. officinalis is common on almost every shore, growing in clustered tufts from two to five inches long, about the thickness of a large thread; white, greenish, yellowish, purple or reddish, and frequently a mixture of all the colours. This is the species sometimes used in powder as an absorbent and vermifuge. C. flabellum inhabits the West Indies, of various colours, from a greenish-brown to milk-white; sometimes of a flat kidney-shaped form, and about an inch high; sometimes expanding to a large subdivided lobed and undulated mass, from one to five inches high, and as many broad: stem terminated by a tuft of fine radical tubes.

CORCHORUS, in botany, a genus of the Polyandria Monogynia class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character: corolla five-petalled; calyx five-leaved, deciduous; capsule many valved, many seeded. There are sixteen species. Natives of both Indies.

CORCULUM, in botany, a term used by Linnæus for the heart, or, more properly, embryo of a seed, alluding to its shape, which, in the walnut, and many other seeds, resembles the animal heart in miniature. It is the most important, and even essential part of a perfect seed, to which all the rest are subservient, being the point whence the future plant originates. In unimpregnated seeds it is deficient, or rather abortive; in fertile ones it is closely connected with the cotyledons, on which it depends for the first supplies of nutriment, and other exciting causes of its evolution. The corculum consists of the radicle, which descends to become a root, and the plumula or feather, which ascends and becomes the stem and leaves.

CORD, *magical*, an instrument in great use among the Laplanders, and supposed to possess considerable virtues in certain magical rites and ceremonies. When properly prepared with knots, it is supposed to have power over the winds; and by means of it they will sell a favourable wind to any one that has faith enough to become a purchaser. If they untie only one of these knots, a moderate gale is to succeed; if two, it is much stronger; and if three, there is to be a storm.

Cord *of wood*, a certain quantity of wood for burning, so called, because formerly measured with a cord. The dimensions of a statute cord of wood are eight feet long, four feet high, and four feet broad.

CORDAGE, a term used, in general, for all sorts of cord, whether small, middling, or great, made use of in the rigging of ships. Cordage, cable-laid, as the seamen term it, is made with nine strands, *i. e.* the first three strands are laid slack, and then three of them, being closed together, make a cable, or cablet. See Cable, Rope, &c.

CORDATE, a term used in Natural History, signifying heart-shaped.

CORDIA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: corolla funnel-form; style dichotomous; drupe with two-celled nuts. There are twelve species, of which one is C. myxa, smooth leaved cordia, sebesten, or Assyrian plum. The leaves of this tree are about three inches long, opposite, flat, entire, on a round petiole, half an inch in length; peduncles panicled, terminating, subcorymbed; petals white, revolute; fruit inferior, red, nearly an inch in diameter. The timber of this tree is tough and solid; it is used for procuring fire by friction. A native of Arabia and the East Indies.

CORDIAL, in medicine, whatever raises the spirits, and gives them a sudden strength and cheerfulness.

CORDON, in fortification, a row of stones, made round on the outside, and set between the wall of the fortress, which lies aslope, and the parapet, which stands perpendicular, after such a manner, that this difference may not be offensive to the eye: whence the cordons serve only as an ornament, ranging round about the place, being only used in fortification of stone-work. For in those made with earth, the void space is filled up with pointed stakes.

CORDWAINERS, a term whereby shoemakers are denominated in statutes. By a statute of Jac. I. the master and wardens of the cordwainers company, &c. are to appoint searchers and triers of leather; and no leather is to be sold, before searched, sealed, &c.

CORDYLOCARPUS, in botany, a genus of the Tetradynamia Siliquosa class and order. Silique cylindrical, swelling into knobs, jointed, the uppermost joint distinct; calyx closed. Two species found in the Archipelago.

COREOPSIS, in botany, a genus of the Syngenesia Polygamia Frustranea class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx erect, many-leaved, surrounded at the basc with spreading rays; down two-horned; receptacle chaffy. There are twenty species.

CORIACEOUS, a term used in Natural History, of a leather-like consistence.

CORIANDRUM, in botany, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ. Essential character: corolla rayed; petal inflex emarginate; involucre universal, one-leafed; partial halved; fruit spherical. There are two species, *viz.* C. sativum, common or great coriander, has an annual root, the stem about a foot and a half in height; universal involucre, one-leafed or none, the three leaflets of the partial involucre small, filiform; petals white or reddish. It flowers in June or July in corn fields. C. testiculatum, small or twin-fruited coriander; root annual; stem angular; umbel usually simple, very seldom compound; universal involucre one-leafed; partial none; petals not rayed; anthers purplish. The leaves of this sort, as well as the former, have a strong disagreeable scent. The seeds are grateful to the taste, and, incrusted with sugar, are sold by the confectioners. The first sort, though found wild in Essex, where it has been long cultivated, is not a native of this country. They are both brought from the South of Europe, China, and Cochin China.

CORIARIA, in botany, a genus of the Dioecia Decandria class and order. Essential character: calyx five-leaved; corolla five petalled, very like the calyx. Male, anthers two parted: female, styles five; seeds five, covered with succulent berried petals. There are three species.

CORIS, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Lysimachiæ, Jussieu. Essential character: corolla one-petalled, irregular; calyx spinous; capsule five-valved superior. There is but one species, *viz.* C. monspeliensis, Montpelier coris. This plant is seldom more than six inches high, and spreads near the surface of the ground like heath. It flowers in June, and makes a very pretty appearance. There are two varieties of this plant, one with a red, and the other with a white flower. Native of the South of France.

CORISPERMUM, in botany, a genus of the Monandria Digynia class and order. Natural order of Oleraceæ. Atriplices, Jussieu. Essential character: calyx none; petals two: seed one, oval, naked. There are two species, *viz.* C. hyssopifolium, hyssop-leaved tickseed, and C. squarrosum, rough spiked tickseed. These plants having little beauty are seldom cultivated, except in botanic gardens. They are natives of Russia.

CORK, is a substance analogous to wood, it is the exterior bark of a tree belonging to the genus oak, which grows wild in the southern parts of Europe. When the tree is fourteen or fifteen years old it is fit to be barked, and may be done successively for several years. The bark always grows up again, and its quality improves as the age of the tree increases. If the bark is not taken off in due time, it splits and peels off by itself, being pushed away by the second growth. The best bark comes from Spain and Portugal: it is taken off in sheets, care being used in keeping them as large as possible. After it is detached from the tree the Portuguese burn or char it, laying the convex side of the bark to the fire in order to straighten and swell it. It is then piled in stacks ready for sale.

Cork is formed into soles for shoes, into corks and bungs for stopping bottles, &c. into a floatage for the nets of fishermen; it is employed generally, though perhaps with a considerable degree of error, in teaching the art of swimming; it is also ingeniously used, on account of its lightness, when an amputation of the human leg has been necessary, to supply the deficiency; the Spaniards line stone walls with it, which not only renders their houses very warm, but corrects the moisture of the air; the Egyptians made coffins of it, which, being covered in the inside with a resinous composition, preserved their dead bodies. It is burnt to make that light black substance called Spanish black, from its having been first made in Spain.

Cork bark has not only been applied as above, but also in the preservation of life when endangered by shipwreck; the most conspicuous exhibition of its advantages is in the application of it in the construction of the "life boat," or "cork boat," as it was originally called. See Boat, *life*.

A cork jacket too has been revived from an old German discovery, by Mr. Dubourg, to preserve the lives of persons in danger of drowning, which is constructed as follows: pieces of cork about three inches long by two wide, and the usual thickness of the bark, are inclosed between two pieces of strong cloth or canvass, and formed like a jacket without sleeves; the pieces of cloth are sewed together round each piece of cord, to keep them in their proper situations; the lower part of the jacket, about the hips, is made like the same part of womens' stays, to give freedom to the thighs in swimming: it is made sufficiently large to fit a robust man, and is secured to the body by two or three strong tapes sewed far back on each side, and tied before; the strings are thus placed, to enable any wearer to tighten it to his own convenience. Cork in its action has the elasticity of a spring, and when pressed into any aperture, its exerts a force acting outwardly on all sides from the centre. It is this quality that makes it valuable in shutting out the external air from liquors and elastic fluids; and it is fitted for this purpose in a degree proportioned to the impermeability of its pores. The elasticity of cork has also been employed for many other purposes in the arts; it forms the spring of the lifter in ordinary candlesticks, and where the frame is not heavy, it can be made into a good substitute for the pulleys and weights of the sashes of windows.

Cork *cutting*, or the manufacturing of corks. This business, though it is thought one of the most dirty, is not one of the least profitable; it is likewise easy in the acquirement. The cork, after being pressed into square pieces, is received by the cork cutters, and if not sufficiently flat for their purpose, they "lay" it again over a fire in their "burning-yard," turning the convex part to the flame; the heat, by twisting the edges of the bark, counteracts the natural bend, and compels it to receive a flat form. During this operation, a considerable degree of attention is paid to smoothing it, and particularly again to cover its defects. It is next cut into slips, narrow or wide, according to the intended cork, bung, or tap, for such are the names of the general divisions in this business. The use of the two former is well known, the latter is used for stopping the tap-holes of barrels, as the name implies. These slips are again cut into squares, of a length proportioned to the use they are intended for. This operation is performed by one man, from whom they are handed forward to several others. A further division of corks takes place of three different sorts, according to their lengths, and are denominated "short," "short long," and "full long." The cork-maker places himself before the table or plank, on which is fastened a board about three inches thick, four broad, and twelve long: immediately on a line with his left hand is a piece of wood rising about four inches from the board, and fixed about the middle of it, on which the cork is laid after being cut as above. This wood not only supports the cork, and is as a guide to the workman, but by its elevation above the board gives room for the knife to cut a part of the cork in a smooth and circular manner, without striking on the table below. The piece is then turned to where the last cut ceased, and this is continued until the knife has gone completely round; the top and bottom are then pared level, and the cork thrown into a box or basket with the rest of the same length. As the bark is not of the same quality throughout each piece, the corks are sorted by a boy into four kinds, "superfine," "fine," "common," and "coarse," and are sold accordingly. The only tool employed by the cork-cutter is a knife about three inches broad in the blade, and about six inches long, very thin and sharp, and equal in breadth from the handle nearly to the end, which is finished by a gentle curve. This knife he sharpens upon the board where the guard is placed, by one whet or stroke on each side, after every cut, and now and then upon a common whetstone.

From the foregoing review, it is evident that the art of a cork-cutter is principally to obtain a regular, round, and quick turn of the wrist, in guiding the knife so as to complete a pretty correct circle, and to make a smooth surface; it is on this account that the knife must be particularly sharp, to enable the workman to turn it with ease. Cork received into the stomach, in its crude state, is very deleterious: but after it has undergone certain processes, it is used in medicine. It contains a small quantity of very powerful acid, called suberic acid. This acid may be obtained in a solid form, but is not crystallizable: it is either pulverulent when it has been precipitated, or when obtained by evaporation is in thin irregular pellicles. Its taste is slightly bitter and acid: dissolved in a small quantity of boiling water, it is irritating to the throat, and excites coughing. It reddens the vegetable colours, and it attracts a little humidity from the air, especially when it is not perfectly pure. Exposed to heat, it is volatilized, and forms crystalline flakes on the sides of the vessel. Heated by the blow-pipe, it first liquifies, then becomes pulverulent, and lastly is sublimed, exhaling an odour of sebacic acid. It becomes brown from exposure to light. At the temperature of 60°, an ounce of water dissolves ten grains of the concrete acid, but if it is very pure, not more than four grains. Boiling water dissolves half its weight. It is not altered by oxygen gas. The mineral, or the other vegetable acids, have little action on it, and do not completely dissolve it, especially when it is not quite pure. Alcohol developes in it an aromatic odour.

Suberic acid unites easily with the alkalies and earths. Its salts are named suberates. The mineral acids in general precipitate the suberic acid from their solutions; and they are decomposed by solutions of almost all the metallic salts. Suberic acid has no action on platina, gold, or nickle; but it forms salts with the greater number of the other metals. In general, these salts do not crystallize, and they have a tendency to form with an excess of acid. Its action on some metallic solutions give some appearances which may serve to distinguish it. It decomposes acetite and nitrate of lead, and nitrates of mercury and silver: with nitrate of copper it forms no precipitate, but the blue colour of the solution passes to green, as does also that of sulphate of copper: the solution of sulphate of iron becomes of a deep yellow, and that of sulphate of zinc of a clear golden yellow. A character peculiar to it is, that when a few drops of it are added to a solution of indigo in sulphuric acid, it causes the blue colour to pass to a green.

The characters by which it is distinguished from the known vegetable acids are, 1. from the citric, by not crystallizing; 2. from the gallic, by not precipitating iron back; 3. from the mallic, by being obtained in a concrete form; 4. from the tartaric, by its volatility; 5. from the oxalic, by not precipitating the solution of sulphate of copper, and by yielding to it lime. From these, and the various phenomena presented in its combinations, it is considered as different from all the other acids.

CORN, in country affairs, the grain or seeds of plants, separated from the ear, and used for making bread. See AGRICULTURE.

CORN *trade*. It is evidently desirable in every nation, that there should be plenty of the principal articles of food; and likewise that the money price of it should be as low as possible. The policy of every country, with regard to corn, should be directed to these two capital objects.

It is found by universal experience, that there is no method of favouring the production of any article so safe and advantageous, as the securing of a good price to the producer; and this end is answered in England by permitting the exportation of corn when it is cheap; and enabling the producer, by means of a bounty that usually is at least equal to the expense of carriage, to sell his corn in other countries as cheaply as the farmers of those countries. With this view, the bounty on the exportation of corn was originally granted, and this end it is supposed to have answered.

The general objection to all bounties has already been stated. See BOUNTY. With regard to the bounty on the exportation of corn, it may be observed, that in consequence of it, the money price of corn has probably been higher, than, *cæt. par.*, it otherwise would have been: but the money price of corn regulates the money price of labour, and, consequently, the money price of all the productions of labour must be enhanced, by whatever enhances the money price of corn. The bounty, therefore, has probably rendered the money price of all articles of British industry rather higher than it otherwise would have been. Now this bad effect could not arise from a bounty on production, to be paid to the grower whenever the market price was below a certain sum; or to be paid regularly for every bushel of wheat grown. If a bounty, therefore, be necessary, it seems more desirable that it should be given for production than for exportation.

But as the quantity of corn produced depends not merely on the diligence and skill of the farmer, but on the nature of the seasons, some degree of uncertainty will necessarily exist with regard to the supply for any particular year. The proportion between the supply and the demand will vary, and the price consequently will fluctuate. Popular prejudice always ascribes scarcities to the farmer, the miller, or the corn dealer; but an enlightened policy must regard all of these, whose capitals enable them to keep a large stock, and especially the last, as most beneficially employed. It is their interest to watch the market, to ascertain the quantity produced, and to suit the supply to the demand. They purchase when they find the market overstocked; they sell when it is understocked; they keep a quantity in reserve when a scarcity is apprehended, and all their activity and property is perpetually exerted to prevent the dreadful extremity of a famine.

CORN, in medicine and surgery, a hard tubercle like a flat wart, growing in several parts of the feet, especially upon the joints of the toes. This disorder is attributed to the wearing of too strait or narrow-toed shoes, which never fail to produce these tubercles, especially if the person is obliged to stand or walk much, and in the summer time. Various are the methods used for removing these callosities of the skin and cuticle; some by knife, and others by application of emollient and caustic or eroding medicines.

As few things are more troublesome than corns in the feet to those who have much walking, we may observe, that the pressure may be prevented in the following manner: Take a piece of linen, spread with any emollient plaster; lay one piece over another, eight or ten, or more times, and cut a hole in the middle of them, exactly the same size and circumference as the corn, then apply it in such a way that the corn enters the hole in the plaster, and is thus defended against the contact of shoes and stockings. Such a plaster, properly applied, the corn will frequently, in a few weeks, disappear without any other remedy. If the corn is at the bottom of the foot, a hole cut in a felt sole, so as to fit the corn is sufficient. When this method is found inefficient, rub the corn with the volatile liniment two or three times, in the twenty-four hours, keeping it covered in the intervals with an emollient plaster. Every morning and evening the foot must be kept in warm water for half an hour, and the corn well rubbed with soap. When softened with the water, it should be scraped with a blunt knife till the soft part is removed, and till the operation begins to give pain. This treatment is to be continued till the corn is entirely extirpated.

CORNEA *tunica*, in anatomy, the second coat of the eye, so called from its substance, which resembles the horn of a lanthorn. See Eye.

CORNET, in the military art of the ancients, an instrument much in the nature of a trumpet, which when it only sounded, the ensigns were to march alone, without the soldiers; whereas, when the trumpet only sounded, the soldiers were to move without the ensigns. The cornets and buccinæ sounded the charge and retreat, and the cornets and trumpets sounded during the course of the battle.

Cornet, in the military art of the moderns, the third commission officer in a troop of horse or dragoons. This is a very honourable post: he commands in the lieutenant's absence; his principal duty being to carry the standard, near the middle of the first rank of the squadron.

CORNEUS, the name by which Linnæus calls a kind of tin ore, found in black columns, with irregular sides, and terminating in prisms. See Tin.

CORNICE. That part of the entablature which rests upon the frize. See Architecture.

CORNUCOPIA, *or horn of plenty*, among painters, &c. is represented under the figure of a large horn, out of which issue fruits, flowers, &c. Upon medals the cornucopia is given to all deities, genii, and heroes, to mark the felicity and abundance of all the wealth procured by the goodness of the former, or the care and valour of the latter.

Cornucopiæ, in botany, so called from the manner in which the flowers grow within their involucre, like a cornucopia, or horn of plenty, a genus of the Triandria Digynia class and order. Natural order of Graminæ or Grasses. Essential character: involucre one-leafed, funnelform, crenate, many flowered; calyx two-valved; corolla one-valved. There are two species, of which is C. cucullatum, hooded cornucopiæ, the root of this is annual, fibrous, and branched; culms numerous, ascending, jointed, smooth, branched, leafy, dark purple at the joints; flowers several, arising from the sheaths of the upper leaves; calyx and corolla striated, obtuse; filaments projecting very far; style connected at the base, spreading in the upper part, twisted, the length of the stamens. Native of the vales about Smyrna, whence it was sent to England.

CORNUS, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Stellatæ. Caprifoliæ, Jussieu. Essential character: involucre generally four-leaved; petals four superior; drupe with a two-celled nut. There are twelve species, of which C. florida, great flowered dogwood, seldom rises above seven or eight feet, and is generally furnished with large leaves. It does not flower here very plentifully, nor does it produce berries in England, though it is very hardy. This tree attains the height of twenty-five and thirty feet in the United States, and is one of the most ornamental of our forest trees. The bark of the C. florida, and that of Cornus sericea, are possessed of tonic powers. They have been used as substitutes for Peruvian bark. See Dr. Walker's inaugural dissertation.

CORNUTIA, in botany, a genus of the Didynamia Gymnospermia class and order. Natural order of Personatæ. Vitices, Jussieu. Essential character: calyx five-toothed; stamina longer than the corolla; style very long; berry one-seeded. There are two species, *viz.* C. pyramidata, hoary-leaved cornutia; and C. quinata; the former is a native of the West Indies, Campeachy, and la Vera Cruz, the latter of China, in the woods near Canton.

COROLLA, among botanists, the most conspicuous part of a flower, surrounding the organs of generation, and composed of one or more flower-leaves, most commonly called petals, to distinguish them from the leaves of the plant; according as there is one, two, or three of these petals, the corolla is said to be monopetalous, dipetalous, tripetalous, &c.

COROLLARY is an useful consequence drawn from something already advanced or demonstrated: thus it being demonstrated that a triangle, which has two equal sides, has also two angles equal, this corollary will follow, that a triangle which has three sides equal, has also its three angles equal.

CORONA, in architecture, the principal crowning member of a cornice, being the most prominent vertical face in the entablature.

CORONARIÆ, in botany, the tenth order of plants in Linnæus' Fragments of a Natural Method. Under this name Linnæus gives a great number of genera, most of which furnish very beautiful flowers, as the hyacinthus, agave, polyanthus, &c.

CORONATION, the public and solemn confirming the title, and acknowledging the right of governing to a king or queen; at which time the prince swears reciprocally to the people, to observe the laws, customs, and privileges of the kingdom, and to act and do all things conformable thereto.

CORONER, an ancient officer of this kingdom, so called because he is wholly employed for the king and crown. The office of coroners especially concerns the pleas of the crown; and they are conservators of the peace in the county where elected, being usually two for each county. Their authority is judicial and ministerial: judicial where a person comes to a violent death; to take and enter appeals of murder, pronounce judgment on outlawries, &c and to enquire into the lands, goods, and escape of murderers, treasure-trove, wreck of the sea, deodands, &c. The ministerial power is when coroners execute the king's writs, on exception taken to the sheriff, as being party in a suit, of kin to either of the parties, or on the default of the sheriff, &c. The authority of the coroner does not terminate on the demise of the king. On default of sheriffs, coroners are to impannel juries, and to return issues on juries not appearing, &c.

The coroner shall have for his fee, upon every inquisition taken upon the view of the body slain, 13*s*. 4*d*. of the goods and chattels of him that is the slayer and murderer, if he have any goods; and if he have no goods, of such amercement, as any township should happen to be amerced for the escape of the murderer. 3. Hen. VII. But as the said fee of 13*s*. 4*d*. is not an adequate reward for the general execution of the said office, therefore, for every inquisition not taken upon view of a body dying in gaol, the coroner shall have 20*s*. and also 9*d*. for every mile he shall be compelled to travel from his usual place of abode to take such inquisition; to be paid by order of the justices in sessions, out of the county rates. 25 Geo. II. c. 29. s. 1.

CORONILLA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: calyx two-lipped; the upper teeth connate; standard scarcely longer than the wings; legume contracted between the seeds. There are fourteen species, mostly natives of the south of France, Switzerland, Italy, and Geneva.

CORPORAL, an inferior officer, under a sergeant, in a company of foot, who has charge over one of the divisions, places and relieves centinels, and keeps good order in the corps de garde; he also receives the word from the inferior rounds, which passes by his corps de garde. This officer carries a fusee, and is commonly an old soldier: there are generally three corporals in each company.

Corporal *of a ship*, an officer who has the charge of setting and relieving the watches and centries, and who sees that the soldiers and sailors keep their arms neat and clean: he teaches them how to use their arms, and has a mate under him.

CORPORATION, a body politic, or incorporate, so called, because the persons or members are joined into one body, and are qualified to take and grant, &c. Corporations are either spiritual or temporal: spiritual, as bishops, deans, arch-deacons, parsons, vicars, &c. Temporal, as mayor, commonalty, bailiff, burgesses, &c. And some corporations are of a mixed nature, composed of spiritual and temporal persons, such as heads of colleges and hospitals, &c. All corporations are said to be ecclesiastical or lay: ecclesiastical are either regular, as abbies, priories, chapters, &c. or secular, as bishoprics, deaneries, archdeaconries, &c. lay, as those of cities, towns, companies, or communities of commerce, &c.

Corporations may be established three different ways, *viz.* by prescription, letters patent, or act of parliament; but are most commonly established by patent or charter. London is a corporation by prescription: but though corporations may be by prescription, yet it shall be intended, that it did originally derive its authority by a grant from the king.

A corporation may be dissolved; for it is created upon a trust, and if it be broken, it is forfeited. No person shall bear office in any corporation but such as have received the sacrament, taken oaths, &c. and none are to execute in a corporation for more than a year. A corporation cannot sue or appear in person, but by an attorney.

Ordinances made by corporations, to be observed on pain of imprisonment, forfeiture of goods, &c. are contrary to Magna Charta. Actions arising in any corporation may be tried in the corporation courts; but if they try actions not within their jurisdictions, and encroach upon the common law, they are liable to be punished for it. The corporation of the city of London is to answer for all particular misdemeanors committed in any of the courts of justice within the city, and for all other general misdemeanors committed in the city.

CORPUSCULAR *philosophy*, that way of philosophising, which endeavours to explain things, and to account for the phenomena of nature by the motion, figure, rest, position, &c. of the corpuscles, or the minute particles of matter.

Boyle reduces the principles of the corpuscular philosophy to the four following heads.

1. That there is but one universal kind of matter, which is an extended, impenetrable, and divisible substance, common to all bodies, and capable of all forms. On this head, Newton remarks thus: "All things considered, it appears probable to me, that God in the beginning created matter in solid, hard, impenetrable, moveable particles; of such sizes and figures, and with such other properties, as most conduced to the end for which he formed them; and that these primitive particles, being solids, are incomparably harder than any of the sensible porous bodies compounded of them; even so hard as never to wear or break in pieces; no other power being able to divide what God made one in the first creation. While these corpuscles remain entire, they may compose bodies of one and the same nature and texture in all ages; but should they wear away, or break in pieces, the nature of things depending on them would be changed; water and earth, composed of old worn particles, of fragments of particles, would not be of the same nature and texture now, with water and earth composed of entire particles at the beginning. And therefore, that nature may be lasting, the changes of corporeal things are to be placed only in the various separations, and new associations of these permanent corpuscles."

2. That this matter, in order to form the vast variety of natural bodies must have motion in some or all its assignable parts; and that this motion was given to matter by God, the creator of all things; and has all manner of directions and tendencies. "These corpuscles, says Newton, have not only a vis inertiæ, accompanied with such passive laws of motion as naturally result from that force; but also are moved by certain active principles: such as that of gravity, and that which causes fermentation, and the cohesion of bodies."

3. That matter must also be actually divided into parts: and each of these primitive particles, fragments, or atoms of matter, must have its proper magnitude, figure and shape.

4. That these differently sized and shaped particles have different orders, positions, situations, and postures, from whence all the variety of compound bodies arises. See Atomic Philosophy: Attraction.

CORREA, in botany, a genus of the Octandria Monogynia class and order: calyx campanulate, four-toothed; petals four, reflected at the ends; capsule four-celled, four-valved, with a single seed in each. One species, the alba, a shrub, is a native of Port Jackson.

CORRECTION, in printing, the pointing out or discovering the faults in a printed sheets, in order to be amended by the compositor, before it be printed off. See Printers, *marks of*.

CORRIGIOLA, in botany, a genus of the Pentandria Trigynia class and order. Natural order of Holoraceæ. Portulaceæ, Jussieu. Essential character; calyx five-leaved; petals five; seed one, three-sided. There is but one species, *viz.* C. litoralis. bastard knot grass, a native of France, Germany, Switzerland, and Piedmont, in sandy soils, usually near the sea or rivers.

CORRIRA, the *courier*, in natural history, a genus of birds of the order Grallæ. Generic character: bill short and straight, and without teeth; legs long; thighs longer than the body; feet palmated, with a back toe. This bird, for there is only one species, is a native of Italy, and is remarkable for the extreme length of its neck as well as legs; it runs with peculiar speed, and derives, unquestionably, from this circumstance its popular designation of courier. It seems to be extremely rare, as Latham remarks that Aldrovandus was the only naturalist who had seen it, and that on his description all subsequent writers had depended.

CORROSIVE *sublimate,* an old name for the oxymuriate of mercury, or, as it is called in the shops, muriated mercury. If muriatic acid be added to the yellow sulphate of mercury, or to the nitrate of mercury, muriate of mercury is formed, which is soluble in water, and which, on account of its properties, was formerly called corrosive sublimate, or corrosive muriate of mercury.

To obtain it, in the large way, the following process is mentioned by Mr. Murray: mix together equal parts of dry oxynitrate of mercury, decrepitated common salt, and calcined sulphate of iron. One-third of a matrass is filled with this mixture; the vessel is placed in a sand-bath, and gradually heated to redness. When the apparatus is cold, oxymuriate of mercury is found sublimed in the upper part of the matrass.

Oxymuriate of mercury, when obtained by sublimation, is in the form of a beautiful white semi-transparent mass, composed of very small prismatic needles. By evaporation, it yields cubes or rhomboidal prisms, or more commonly quadrangular prisms, with their sides alternately narrower, and terminated by dihedral summits; its specific gravity is 51; its taste is excessively acrid and caustic, and it leaves, for a long time a very disagreeable styptic metallic impression on the tongue. When swallowed, it is one of the most virulent poisons known, producing violent pain, nausea, and vomiting, and corroding in a very short time the stomach and intestines. It is soluble in about 20 parts of cold water. Boiling water, according to Macquer, dissolves half its weight of it. According to Wenzel, water, when boiled over this salt, dissolves very nearly one-third of its weight of it. Alcohol, according to Macquer, at the temperature of 70°, dissolves three-eighths of its weight, and 100 parts of boiling alcohol dissolves 88 parts of it. It is not altered by exposure to the air. When heated, it sublimes very readily; and while in the state of vapour, it is exceedingly dangerous to those who are obliged to breath it.

It is soluble in sulphuric, nitric, and muriatic acids; and may be obtained again by evaporation unaltered. It is decomposed by the fixed alkalies, and its oxide precipitated of a yellow colour, which soon becomes brick red. This decomposition renders oxymuriate of mercury a useful test for ascertaining the presence of fixed alkalies in solution. If liquid oxymuriate of mercury be dropt into a solution containing the smallest portion of alkali, the brick-red precipitate appears. Ammonia forms with it a triple salt. The component parts of this salt are, according to Chenevix,

Oxide of mercury . .	82
Acid	18
	100

Externally, this substance is employed as an escarotic for destroying fungous flesh.

CORROSIVES, in surgery, are medicines which corrode whatever part of the body they are applied to: such are, burnt alum, white precipitate of mercury, white vitriol, red precipitate of mercury, butter of antimony, lapis infernalis, &c.

CORRUPTION, the destruction of the proper mode of existence of any natural body.

CORRUPTION *of blood,* in law, on infection accruing to a man's estate attainted of felony and treason, and to his issue; for as he loses all to the prince, &c. his issue cannot be heirs to him, or to any other ancestor by him; and if he were noble, his heirs are rendered ignoble.

CORSELET, a little cuirass, or, according to others, an armour or coat made to cover the whole body, anciently worn by the pike-men, usually placed in the front and flanks of the battle, for the better resisting the enemy's assaults, and guarding the soldiers placed behind them.

CORTULA, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ, or compound radiated flowers. Corymbiferæ, Jussieu. Essential character: receptacle almost naked; down margined; corollules of the disk four cleft; in the ray scarcely any. There are fifteen species, mostly natives of the Cape.

CORTUSA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Preciæ. Lysimachiæ, Jussieu. Essential character: corolla wheel-shaped, the throat having an elevated ring; capsule one-celled, oval, five-valved at the end. There are two species, C. mathioli, sends out many oblong smooth leaves, a little indented on the edges, forming a sort of head like the auricula; the peduncles come out in the centre of the leaves, rising about four inches high, which support an umbel of flowers, each on a slender short pedicle; they are of a flesh colour, and spread open like those of the auricula. Native of the Alps, Austria, Silesia, and Siberia, flowering in April and May. C. gmelini resembles the first, though the flowers are much smaller and the calyxes larger; this is a native of Siberia.

CORVUS, the *crow*, in natural history, a genus of birds of the order Picæ. Generic character: bill strong, convex, sharp edged; nostrils covered with bristly feathers turned back over them; tongue cartilaginous and divided; toes three forward and one backward, the middle one joined to the outer as far as the first joint. The greater number of this tribe of birds are to be found in almost every country, and they are distinguishable by being gregarious, noisy, and prolific; by being in general promiscuous feeders upon animal and vegetable substances, and by laying six eggs in nests built in trees. Some naturalists reckon 41 species; Gmelin, however, specifies 48. Those most entitled to attention are the following.

C. corax, the raven. This is the largest species of the genus, and weighs three pounds, and measures in length two feet, and in breadth four. It inhabits, in the old continent, from Greenland to the Cape of Good Hope, and in the new, from Canada to Mexico. It will destroy many animals, such as chickens, ducks, and rabbits, and sometimes even lambs, for subsistence, but appears to delight more in the putrid remains of carcases, which are to be almost every where met with on a globe perpetually changing its inhabitants. It may, in this point of view, be regarded as highly serviceable, preventing the contagion of disease in a great degree, as well as the annoyance of the senses. Its smell is particularly acute, enabling it to discriminate its favourite repast, though at a great distance. Its caution is also extraordinary, as it will rarely venture within the reach of a gun, which it appears to distinguish with particular sagacity. It is long lived, having been stated on respectable authority to live from 40 to 60 years. It is easily familiarized, but is much addicted to concealing, in holes and bye places, things of no possible advantage to itself, and which the owner is much embarrassed by the want of. It may be taught to speak. In America it builds in trees; in some other countries it builds in the holes of rocks; the duty of incubation is performed by the male during the day, and by the female in the night. The Greenlanders make use of it for food, and use its skin in the manufacture of garments, and its wings for brushes. Its feathers are split by them, and twisted into fishing lines. The raven is the only species of its genus at present existing in Greenland, which may be considered as an evidence of its robust and hardy constitution. In times of superstition, this was a bird of most important augury, whose sounds were studied with the most profound attention, and frequently overwhelmed even the hero himself with terror. See Aves, Plate IV. fig. 4.

C. corone, the carrion crow, is very similar to the raven in habits and colour; it is the bird so universally known in the United States by the name of crow.

C. frugilegus, the rook. Rooks are, in France and some parts of Germany, birds of passage, but in England they are stationary. They live upon various worms and the erucæ of insects, particularly those of the chafer, the extirpation of which is of extreme service to the farmer, and far more than compensates for the depredations committed by those birds themselves on the corn, which they thus usefully preserve from far more destructive plunder. Rooks are gregarious birds, and, unless when breeding, regularly repair, sometimes in immense flocks, from the place where they roosted to whatever spot of ground they may fix upon as their grand refectory, returning as the day closes in the same formidable body to their former lodging. In February they begin to build their nests, which they do in large societies of many hundreds on the tops of high trees, particularly elms. To the curious observer this process is a scene of considerable interest, exhibiting perpetual bustle and assiduity, incessant struggle and contention, stratagem and violence. Cunning and oppression are in perpetual conflict, art is often successfully substituted for strength, and more frequently power for right. It is a circumstance within the recollection of several persons at Newcastle, England, that a pair of rooks, who had been interrupted in various efforts to build in a neighbouring rookery, at length actually established their nest on the weather-vane of the spire of the exchange, and produced their young to perfection, notwithstanding all the persecutions of their enemies, all the clamorous admiration of the populace, and the movements which they experienced from every shifting breeze of wind. So tenacious were they of this situation, that they returned to it for ten successive years.

C. monedula, the jackdaw. These birds are about the size of a small pigeon, though not quite so thick. In England they are stationary; in France, Austria, and Denmark, in different degrees, migratory. They rarely build their nests in trees, preferring the ruins of human habitations, or of churches and towers, where their eggs and young are more beyond the reach of depredating school-boys. They sometimes lay in rabbit holes. They are domesticated with great facility, and may be taught to utter a considerable number of words. They are, like the raven, much addicted to concealment and pilfering, hiding not only their food, but a variety of toys and trinkets, a circumstance which has not unfrequently brought suspicion and disgrace upon the most honest and faithful domestics. See Aves, Plate IV. fig. 5.

C. glandarius, the jay. The jay weighs about seven ounces, and is about thirteen inches long. Its colours are beautifully arranged, and it attracts by its appearance that favourable and delighted attention, which is somewhat counteracted by its harsh and chattering sounds. It is regarded by the sportsman with no little aversion, as its vigilance is ever upon the alert, and on the first sight of an enemy it utters those screaming sounds of alarm, which warn all within its reach of danger, and defeat the hopes and aims of their adversary. Its nest is built of sticks, roots, and tender twigs, in the woods, and the young continue with their parents till the following season, when they withdraw and form establishments of their own. Jays feed on almost all sorts of seeds and fruits, on nuts and acorns, and occasionally on eggs, and even chickens. They are sometimes kept in a cage, but almost uniformly lose in this confinement all the beauty of their plumage. They will imitate with great ease and accuracy a variety of sounds, and articulate a considerable number of words; and, by this acquired talent, have sometimes produced considerable mischief, setting on dogs to worry cattle, calling the dogs by their names, in imitation of the shepherd's voice; and they appear greatly to enjoy the spectacle of confusion and distress which they thus produce. This jay is not found in the south, beyond Greece or Italy, and is unknown in Ireland and America. See Aves, Plate IV. fig. 6.

C. pica, the magpie. This bird is extremely common in England, and is found in most countries between Sweden and Italy in Europe. In America it has not been long known, but was discovered in considerable numbers by Lewis and Clarke on the Missouri, and by Pike; and by the testimony of these travellers it does not appear to be migratory, as the latter met with them when the degree of cold was excessive; where this bird abounds, the blue jay (C. cristatus) is not found. Though its colours consist only of black and white, yet these are attended with such extraordinary bloom and radiance, that the plumage of one seen in a perfect state of nature will excite a very high sensation of beauty. It may easily be brought up in a state of domestication, and will speak with great ease many phrases with all the readiness of the parrot, though not with his distinct and accurate enunciation. It feeds much like the crow on promiscuous substances. It constructs its nest with peculiar dexterity, not only covering the bottom with materials of a soft and downy texture, for the comfort of its young, but fixing the entrance at the side, and wattling, of appropriate substances, a complete roof for its habitation, which is thus rendered warm, dry, and secure.

C. graculus, the red-legged crow, is common on the coasts of Devonshire and Cornwall, England; in Kent, Wales, and Scotland also, it is to be found. It is a turbulent, bold, and clamorous bird, builds every where in rocky situations, is voracious, and often seen snatching from its companions locusts or juniper berries, which constitute its favourite food. It flies in circles, and resembles the jackdaw in some particulars of its manners, being equally prone to pilfer and hide. It is fond of glare, and has been known to snatch up burning sticks from the hearth, and place them in situations, where, if unobserved, they must have produced destructive conflagrations.

CORUNDUM, in mineralogy. Though corundum appears to have been known to Dr. Woodward, it may be said to have been first distinguished from other minerals by Dr. Black. In 1768, Mr. Berry, a lapidary in Edinburgh, received a box of it from Dr. Anderson of Madras. Dr. Black ascertained that these specimens differed from all the stones known to Europeans; and, in consequence of its hardness, it obtained the name of adamantine spar. It is found in Hindostan, not far from the river Cavery, which is south of

Madras, in a rocky matrix of considerable hardness, partaking of the nature of the stone itself. It occurs also in China, and in Ceylon, Ava, &c. The Count de Bournon pointed out the resemblance between this mineral and the sapphire, in a dissertation published by him and Mr. Greville in the Philosophical Transactions for 1798, and suggested it as probable, that corundum may be only a variety of the sapphire; and that the seeming difference in their ingredients is owing to the impurity of those specimens of corundum, which have hitherto been brought to Europe. This conjecture has been since confirmed by a subsequent dissertation of Bournon, and the chemical analysis of Chenevix. Werner subdivides it into two species, namely, corundum, and adamantine spar; but, in reality, they seem to be only varieties, or, at most, subspecies of the same species. The chief difference exists in the colours.

Corundum has been found in India, in the Carnatic, and on the coast of Malabar. It occurs massive, in rolled pieces, and crystallized; crystals the same as in sapphire; colour greenish-white, passing into greenish-grey, and asparagus-green, sometimes pearl grey, which passes into flesh-red; surface rough; fracture foliated; specific gravity 3.7 to 4.2.

Mr. Chenevix obtained the following constituents from the specimens of the corundums, which he subjected to chemical analysis.

IMPERFECT CORUNDUM.

	From the Carnatic.	From Malabar.	From China.	From Ava.
Silica	5.0	7.0	5.25	6.5
Alumina	91.0	86.5	86.50	87.0
Iron	1.5	4.0	6.50	4.5
	97.5	97.5	98.25	98.0
Loss	2.5	2.5	1.75	2.0
	100	100	100	100

PERFECT CORUNDUM.

	Blue, or Sapphire.	Red, or Oriental Ruby.
Silica	5.25	7.0
Alumina	92.00	90.0
Iron	1.00	1.2
	97.25	98.2
Loss	1.75	1.8
	100	100

CORUSCATION, a glittering, or gleam of light issuing from any thing. It is chiefly used for a flash of lightning darting from the clouds in time of thunder. See METEOROLOGY.

CORYLUS, in botany, English *hasel*, or nut-tree, a genus of the Monoecia Polyandria class and order. Natural order of Amentaceæ. Essential character: male calyx one-leaved, three-cleft, scale-form, one-flowered; corolla none; stamens eight. Female calyx two-leaved, lacerated; corolla none; styles two; nut ovate. There are three species, with many varieties; C. avellana, common hasel nut tree, is properly a shrub, the trunk of which is covered with a whitish cloven bark, which is smooth on the branches, frequently of a bay colour, spotted with white; the shoots are sometimes hairy, ash-coloured, and green, with white tubercles. The male catkins appear in autumn, and wait for the expansion of the female germs in spring; the styles are of a bright red colour, long, and cetaceous; the flowering branches, especially those which bear the fertile flowers, are set with short fine hairs, terminating in globules; the catkins are in pairs, and of a yellowish-green colour.

CORYMBIUM, in botany, a genus of the Syngesia Monogamia class and order. Natural order of Compositæ Discoideæ. Cinarocephalæ, Jussieu. Essential character: calyx two-leaved, one-flowered, prismatic; corolla one-petalled, regular; seed one, below the corolla woolly. There are four species, all natives of the Cape of Good Hope.

CORYNOCARPUS, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Berberides, Jussieu. Essential character: nectaries five, petal-shaped, alternate with the petals, glandulous at the base. One species, found at New Zealand.

CORYPHA, in botany, *appendix palmæ*. Natural order of Palms. Essential character; flowers hermaphrodite, six-stamened: spathe many-leaved; corolla three-petalled; pistil one; berry globose, superior, one-seeded; seed bony, globose. There are two species, *viz.* C. umbraculifera, great fan palm, and C. minor; the former of which we shall give a short description of. It scarcely flowers till it is between 30 and 40 years old. Knox describes the great fan palm under the name of tallipot; he says it is as large as a ship's mast, and very straight. The leaves are of great use, one being so broad and large that it will cover 15 or 20 men;

being dried, it is very strong and limber, yet it will fold close like a fan, being then about the size of a man's arm. The whole leaf spread is round, but is cut into triangular pieces for use. Soldiers all carry them upon their heads, not only to shade them from the sun, and to keep them dry in case of rain on their march, but to make their tents for them to lie under. These leaves all grow on the top of the tree. It bears no fruit until the last year of its life; the yellow blossoms, which are very beautiful, come out on the top, spreading abroad in great branches; these come to a round, hard fruit, the size of our largest cherries, and in such abundance, that one tree will yield seed enough for a country; but they are not fit for food. The flowers smell so strong, that the trees are cut down where they are near houses. It is a native of Malabar, the island of Ceylon, the Marquesas, and Friendly Islands. The trunk within is only a pith, which they beat in a mortar to flour, and make cakes of it, which taste much like white bread. The leaves also serve for covering their houses, and for writing on with an iron style. Most of the books which are shown in Europe for the Egyptian papyrus are made from the leaves of this palm.

CORYPHÆNA, the *Coryphene*, in natural history, a genus of fishes of the order Thoracici. Generic character: head sloping suddenly downwards, gill-membrane with five rays; dorsal fin as long as the back. There are 19 species, of which the principal is C. hippuris, the common coryphene. These fishes are commonly known by the name of dolphin, and appear in the Indian and Atlantic seas in immense numbers, frequently following in the wake of ships, and seizing with extreme rapacity whatever is thrown from them at all applicable for food. Indeed, occasionally, on their being opened, their stomachs have been found to contain hard and indigestible substances. They are endowed with extraordinary strength and vigour, swim with extreme swiftness, and are perpetually in the pursuit of smaller fish, particularly the flying-fish, which has not a more mortal enemy throughout the ocean. They are of particularly rapid growth, and they are often taken both by the line and net, on account of their estimation for the table. They are about the length of three feet, and display in the water the most dazzling splendour and the most exquisite combination of colours, particularly azure, green and gold. All these vanish a short time after the dolphin is taken from the water, exhibiting, however, incessant changes during the conflict between life and death, one moment restored to their original lustre, the next fading beyond observation, till at length bloom and vitality are both finally extinguished. During the monotony of an Indian voyage, the death of the dolphin is considered by sailors as furnishing an agreeable variety, and is, indeed, watched with singular attention and interest.

CO-SECANT, in geometry, the secant of an arch which is the complement of another to 90°.

CO-SINE, in trigonometry, the sine of an arch, which is the complement of another to 90°. See SINE and TRIGONOMETRY.

COSMEA, in botany, a genus of the Syngenesia Frustranea class and order. Receptacle chaffy; seeds four-sided, with a two or four-awned crown; calyx double, each of them of one eight-parted leaf.

COSMETIC, in physic, any medicine or preparation which renders the skin soft and white, or helps to beautify and improve the complexion, as lip-salves, cold creams, ceruss, &c.

COSMICAL, a term in astronomy, expressing one of the poetical risings of a star: thus, a star is said to rise cosmically, when it rises with the sun, or with that point of the ecliptic in which the sun is at that time: and the cosmical setting is when a star sets in the west at the same time that the sun rises in the east.

COSMOGONY, a word frequently used to denote the science of the formation of the universe.

COSMOGRAPHY, a description of the several parts of the visible world, or the art of delineating the several bodies, according to their magnitudes, motions, relations, &c.

COSMOPOLITE, a term denoting a citizen of the world, or one who has no fixed residence any where.

COSSIGNEA, in botany, a genus of the Hexandria Monogynia class and order. Calyx inferior, five-parted; corolla four or five-petalled; capsule three-celled, opening at top; the cells about three-seeded. There are two species noticed by Lamarck, found in Bourbon and Mauritius.

COSTIVENESS. See MEDICINE.

COSTUME, a term among painters: thus, a painter must observe the costume;

that is, he must make every person and thing sustain its proper character, and not only observe the story, but the circumstances, the scene of action, the country or place, and make the habits, arms, manners, proportions, and the like, to correspond.

COSTUS, in botany, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character: corolla inner, inflated, ringent, the lower lip trifid. There are four species, all natives of the East and West Indies.

CO-TANGENT, the tangent of an arch, which is the complement of another to 90°.

COT, in naval affairs, a particular sort of bed frame, suspended from the beams of a ship, for the officers to sleep in. It is made of canvass, sewed in the form of a chest, about six feet long, one foot deep, and two or three wide, and is extended by a square wooden frame with a canvass bottom, on which the bed or mattrass is laid. It is reckoned much more convenient at sea than either the hammocks or fixed cabins.

COTTON it the produce of the gossypium, a plant about the size of a currant bush, a native of the torrid zone, though it is produced in parts of Turkey, so far as 44 or 45 degrees from the equator. The finest cotton is known by the name of cat's-claw, from its singular appearance when it breaks the pod. This kind was accidentally discovered at the island of Bourbon, and was supposed to have been introduced among some seed sent from South America to the Mauritius. The soil should be extremely well prepared, and of the best quality, for the reception of cotton seed, which is uusually sown in November or December, after the periodical rains in tropical climates, and ripens in May or June, when the numerous pods, which are about the size of large gooseberries, break, and display their downy contents. These are picked, and after the husks have been disengaged, the cotton is put to a small mill, consisting of two bright steel rollers, each about an inch in diameter, set parallel within the distance of about the twentieth part of an inch. These rollers move different ways, and draw the cotton through between them, while the seeds are forced out of the respective little balls of down in which they are enclosed, and drop into a bag. The generality of cotton is white; but some is of a nankeen colour, and is invaluable in the manufacture of that article, as it fades very little, even with long use and frequent washing. The elasticity of cotton is inconceivable! It may be pressed into a fiftieth part of the space into which the strongest packers can reduce it by personal exertion: large screws are erected at many sea-ports where cotton is shipped, for the purpose of bringing the bales into the smallest compass, so as to save freight. Cotton can only be imported as a raw material, in which form it comes to us from the Levant, the West Indies, South America, and the East Indies. In the last quarter there are some kinds indigenous, but some are exotics. The name is obviously derived from the Arabic appellation *kuter*, which leads us to suppose the cultivation may have originated in Arabia. The amazing export of cotton fabrics from our settlements in the East created for some time a necessity for the manufacturer to import the raw material, and in a few instances the thread, from the country where cotton is cultivated to an immense extent, and where a very fine sort is produced, far superior to what the Levant or the West Indies furnish. Of late years, however, the great demand for this material has excited a strong spirit of enterprize, and enabled the British colonies to raise nearly as much as the looms of the country, and the demand of the mother country, generally require. It is a highly dangerous cargo, being very subject to take fire if at all damp when packed, or if the smallest spark should reach it; in either case it will burn very slowly for weeks; but when the hold is opened and air supplied, bursts forth with inconceivable fury. There is a species of silky down produced in pods, (similar to those of the cotton plant) on a very large tree, called the seemul. It is only fit to fill beds. Specimens of it have passed through various hands; but this kind of cotton is so peculiarly glossy, and the fibre is so short, that it could neither be carded nor spun. When mixed with rabbit's fur, &c. to make hats, it always separated. It also failed in paper-making; otherwise its abundance and cheapness would have rendered it highly valuable.

COTTON, *carding of*, as a preparation for spinning, used formerly to be performed by the hand, with a single pair of cards upon the knee; but this being a tedious method, ill suited to the rapid operations of the new spinning machines, other methods were contrived for affording a quicker and more adequate supply. The first improvement for this purpose was likewise made by Mr. Hargrave, and consisted in applying two or three cards to the same board, and fixing them to a stool or stock; whence they obtained the name of stock-cards. With these one woman could perform two or three times as much work as she could do before in the common way. A still more expeditious method of carding, however, by what are commonly called cylinder cards, was soon afterwards invented, and is that which is now most commonly practised.

Cotton *spinning*, the art or process of reducing cotton-wool into yarn or thread. The most simple method for this purpose, and the only one in use for a long time in this country, was by the hand, upon the well-known domestic machine, called a one-thread wheel. But as the demand for cotton goods began to increase, other inventions were thought of for expediting this part of the manufacture. About fifty years ago an engine was contrived, for a more easy and expeditious method of spinning cotton, and a patent was obtained; but the undertaking did not prove successful. Some years after, various machines were constructed by different persons for facilitating the spinning of cotton, but without producing any very material or lasting advantage. At length, about 1767, Mr. James Hargrave, a weaver in the neighbourhood of Blackburn, in Lancashire, constructed a machine, by which a great number of threads (from 20 to 80) might be spun at once, and for which he obtained his Majesty's letters patent. This machine is called a jenny, and is the best contrivance for spinning woof, or shute, that has hitherto appeared. It is now commonly constructed for 84 threads, and with it one person can spin 100 English hanks in the day, each hank containing 840 yards.

The next and most capital improvements which this branch of manufacture received were from Mr. Arkwright, afterward Sir Richard Arkwright, of Cromford, in Derbyshire. He first brought forward his new method of spinning cotton in 1768, for which he obtained a patent in 1769. In 1775 he obtained another patent, for engines which he had constructed to prepare the materials for spinning; though one of these patents, being challenged at law, was set aside some years before it expired. The result of Mr. Arkwright's different inventions and improvements is a combination of machinery, by which cotton is carded, roved and spun, with the utmost exactness and equality; and such a degree of perfection attained in spinning warp, as is not to be equalled in any other part of the the world. To these improvements this country is entirely indebted for the great extent of its cotton manufactures, large buildings having been erected for that branch both in England and Scotland, many of which contain several thousands of spindles, each driven by one or more large water wheels; and some of such extent, as to spin at the rate of one thousand yards of twist or warp yarn in the minute. Other machines have been invented at different times, and a variety of improvements made by different mechanics and manufacturers, one of which in particular we must not omit to mention. It is called a mule, being a kind of mixture of machinery between the warp-machine of Mr. Arkwright, and the woof machine, or hand jenny, of Mr. Hargrave, and was also invented in Lancashire.

Cotton *mills* are large buildings, with peculiar machinery for carding, roving, and spinning cotton. These were entirely unknown in this country before the different inventions and improvements of Messrs. Arkwright and Hargrave; since which time great numbers have been erected in England, many in Scotland, and some in Ireland. See Manufacture *of cotton*.

COTTUS, the *bull-head*, in natural history, a genus of fishes of the order Thoracici. Generic character: head broader than the body, spiny; eyes vertical and supplied with a nictitating membrane; gill membrane of six rays: body round, without scales, tapering towards the tail; dorsal fins generally two. There are ten species, of which the principal is C. gobio, the river bull-head. This is about five inches long when full grown, is found in almost every part of Europe in clear streams, and conceals itself under a stone or in the gravel. Its food consists of worms, aquatic insects, and extremely young fish. It is reported to deposit its spawn in a hole in the gravel, formed by it for the purpose, and which nothing but necessity will induce it to leave. It is capable of swimming very vigorously and rapidly, but is far more stationary than active in its habit. It is used as food, but almost exclusively by the poor. The mailed bull-head, or C. cætaphractus, is found in abundance in the seas of Europe. For a representation of it, see Pisces, Plate III. fig. 2.

COTYLEDON. A seed consists of three parts: *viz.* the cotyledons, the radicle, and the plumula, which are usually inclosed in a cover. If we take a garden bean, we may perceive each of these three parts with great ease; for this seed is of so large a size, that all its organs are exceedingly distinct. When we strip off the external coats of the bean, which are two, and of different degrees of thickness in different parts, we find that it easily divides into two lobes, pretty nearly of the same size and figure. Each of these lobes is called a cotyledon. The cotyledons of the bean, then, are two in number. See GERMINATION.

COTYLEDON, in botany, a genus of the Decandria Pentagynia class and order. Natural order of Succulentæ. Sempervivæ, Jussieu. Essential character: calyx five-cleft; corolla one-petalled, with five nectareous scales at the base of the germ; capsules five. There are nineteen species, almost all of them natives of the Cape.

COUCHANT, in heraldry, is understood of a lion, or other beast, when lying down, but with his head raised, which distinguishes the posture of couchant from dormant, wherein he is supposed quite stretched out and asleep.

COUCHE, in heraldry, denotes any thing lying along: thus, chevron couché, is a chevron lying sideways, with the two ends on one side of the shield, which should properly rest on the base.

COUCHING, in surgery, one of the two chief methods of curing a cataract, by couching with the needle.

COVENANT, in law, the agreement or consent of two or more by deed in writing, sealed and delivered, whereby either or one of the parties promises to the other that something is already done, or shall be hereafter done: he that makes the covenant is called the covenantor, and he to whom it is made is denominated the covenantee.

A covenant is either in fact or in law. A covenant in fact, is that which is expressly agreed on between the parties. In law, it is that covenant which the law intends and implies, though it be not expressed in terms: as where a person grants a lease of a house, &c. for a certain term, the law will intend a covenant on the lessor's part, that the lessee shall quietly enjoy the premises during the term against all incumbrances.

There is also a covenant real, and a covenant merely personal. A covenant real, is when a person binds himself to pass some real things, as lands or tenements, or to levy a fine of lands, &c. A covenant personal, is when the same is altogether personal; as if a person, by deed, covenants with another to build him a house, or to do him some other service, &c.

COVENANT *to stand seized to use,* is where a man who has a wife, children, brother, sister, or other kindred, does by deed in writing, under hand and seal, covenant and agree, that, for their provision or preferment, he and his heirs shall stand seized of the land to their use, either in fee simple, fee tail, or for life.

COVERT, in law. See COVERTURE.

COVERT *way,* or *Corridor,* in fortification, a space of ground level with the field on the edge of the ditch, three or four fathoms broad, ranging quite round the half moons, and other works toward the country. It has a parapet raised on a level, together with its banquets and glacis. The greatest effort, in sieges, is to make a lodgment on the covert-way, because the besieged usually pallisade it along the middle, and undermine it on all sides.

COVERTURE, in law, is applied to the state and condition of a married woman, who is under the power of her husband, and therefore called feme covert; and disabled to contract with any person, to the detriment either of herself or husband, without his consent and privity, or allowance and confirmation thereof.

COUGH. See MEDICINE.

COULTER, in husbandry, an iron instrument fixed in the beam of a plough, and serving to cut the edge of each furrow. See PLOUGH.

COUNCIL, or COUNSEL, in a general sense, an assembly of divers considerable persons, to concert measures relating to the state.

COUNCIL. In this country the law, in order to assist the King in the discharge of his duties, the maintenance of his dignity, and the exertion of his prerogative, hath assigned him a diversity of councils to advise with.

1. The first of these is the high court of parliament. See PARLIAMENT.

2. The peers of the realm are by their birth hereditary counsellors of the crown, and may be called together by the King, to impart their advice in all matters of importance to the realm, either in time of parliament, or, which hath been their principal use, when there is no parliament in being. Accordingly, Bracton, speaking of the nobility of his time, says

they might properly be called "consules à consulendo; reges enim tales sibi associant ad consulendum." And in the law-books it is laid down, that the peers are created for two reasons: 1. Ad consulendum; 2. Ad defendendum regem; for which reasons the laws give them certain great and high privileges; such as freedom from arrests, &c. even when no parliament is sitting; because the law intends, that they are always assisting the King with their counsel for the commonwealth, or keeping the realm in safety by their prowess and valour.

Instances of conventions of the peers, to advise the King, have been in former times very frequent, though now fallen into disuse, by reason of the more regular meetings of parliament. Sir Edward Coke gives us an extract of a record, 5 Henry IV. concerning an exchange of lands between the King and the Earl of Northumberland. Many other instances of this kind of meeting are to be found under our ancient kings; though the formal method of convoking them had been so long left off, that when Charles, I. in 1640, issued out writs under the great seal, to call a council of all the peers of England to meet and attend his Majesty at York, previous to the meeting of the long parliament, the Earl of Clarendon mentions it as a new invention, not before heard of; that is, as he explains himself, so old, that it had not been practised in some hundreds of years. But though there had not for a long time before been an instance, nor has there been any since, of assembling them in so solemn a manner, yet in cases of emergency, our princes have at several times thought proper to call for, and consult as many of the nobility as could easily be brought together; as was particularly the case with James II after the landing of the Prince of Orange; and with the Prince of Orange himself, before he called the convention parliament, which afterwards called him to the throne. Besides this general meeting, it is usually looked upon to be the right of each particular peer of the realm to demand an audience of the King, and to lay before him, with decency and respect, such matters as he shall judge of importance to the public weal.

3. A third council belonging to the King are, according to Sir Edward Coke, his judges of the courts of law, for law-matters. And this appears frequently in the English statutes, particularly 14 Edward III. c. 5. and in other books of law. So that when the King's council is mentioned generally, it must be defined, particularized, and understood, according to the snbject matter; and if the subject be of a legal nature, then by the King's council is understood his council for matters of law; namely, his judges.

4. But the principal council belonging to the King is his privy council, which is generally, by way of eminence, called The Council. For an account of its constitution and powers, see Council, *Privy*.

Council, *Privy*, the primum mobile of the civil government of Great Britain, bearing part of that great weight in the government, which otherwise would be too heavy upon the King.

It is composed of eminent persons, the number of whom is at the Sovereign's pleasure, who are bound by oath to advise the King to the best of their judgment, with all the fidelity and secrecy that becomes their station. The King may declare to, or conceal from, his privy council whatever he thinks fit, and has a select council out of their number, commonly called the cabinet council, with whom his Majesty determines such matters as are most important, and require the utmost secrecy. All proclamations from the King and the Privy Council ought to be grounded on law, otherwise they are not binding to the subject. Privy counsellors, though but gentlemen, have precedence of all the knights and younger sons of barons and viscounts, and are styled right honourable.

Council, *Common*, in the city of London, is a court, wherein are made all bye-laws wich bind the citizens. It consists, like the parliament, of two houses; an upper, composed of the Lord Mayor and aldermen; and a lower, of a number of common council men chosen by the several wards, as representatives of the body of the citizens.

Council, *of war*, an assembly of the principal officers of an army or fleet, occasionally called by the general or admiral, to concert measures for their conduct with regard to sieges, retreats, engagements, &c.

Council, in church history, an assembly of prelates and doctors, met for the regulating matters relating to the doctrine or discipline of the church.

COUNSELLOR *at law*, a person retained by a client to plead his cause in a public court of judicature. There are two degrees of council, *viz.* barristers and sergeants. Barristers are called to the bar after a certain period of standing in the inns of court. See Barrister. After 16 years standing they may be called to the degree of sergeant. The judges of the courts of Westminster are always admitted sergeants before they are advanced to the bench. From both sergeants and barristers the king's council are usually selected, the two principal of whom are called his attorney and solicitor general. Counsel are supposed to plead gratis, and can maintain no action for their fees; and to encourage in them a freedom of speech in the lawful defence of their clients, a counsellor is not answerable for any matter by him spoken, though it should prove groundless, and reflect on the reputation of another; provided it relates to the cause which he espouses, and is suggested in his client's instructions. And notwithstanding counsellors have a special privilege to practise the law, yet they are punishable for misbehaviour by attachment. No counsel is allowed to a prisoner upon a general issue of indictment of felony, unless some point of law arise; for the court is the prisoner's only counsel.

COUNT, a nobleman who possesses a domain erected into a county. The dignity is a medium between that of a duke and a baron. See Earl. Counts were originally lords of the court, or of the emperor's retinue, and had their name comites *a comitando*. Eusebius tells us, that Constantine divided them into three classes; of the two first the senate was composed: those of the third had no place in the senate, but enjoyed several other privileges of senators. There were counts that served on land, others at sea; some in a civil, and some in a legal capacity. The quality of count is now no more than a title, which a king grants upon erecting a territory into a county, with a reserve of jurisdiction and sovereignty to himself. A count has a right to bear on his arms a coronet adorned with three precious stones, and surmounted with three large pearls, whereof those in the middle and extremities of the coronet advance above the rest. See Crown.

Count, in law, signifies the original declaration of complaint in a real action, as a declaration is in a personal one.

Count *wheel*, in the striking part of a clock, a wheel which moves round once in 12 or 24 hours. It is sometimes called the locking-wheel. See Clock.

COUNTER *barry*, or Contre *barre*, in heraldry, is the same as our bendy sinister per bend counterchanged.

Counter *bond*, a bond of indemnification, given to one who has given his bond as a security for another's payment of a debt, or the faithful discharge of his office or trust.

Counter *changed*, in heraldry, is when any field or charge is divided or parted by any line or lines of partition, consisting all interchangeably of the same tinctures.

Counter *deed*, a secret writing, either before a notary or under a private seal, which destroys, invalidates, or alters a public one.

Counter *ermine*, in heraldry, is the contrary to ermine, being a black field with white spots.

COUNTERFEITS, in our law, are persons that obtain any money or goods by counterfeit letters or false tokens, who, being convicted before justices of assize, or of the peace, &c. are to suffer such punishment as shall be thought fit to be inflicted, under death, as imprisonment, pillory, &c.

Counter *march*, in military affairs, a change of the face or wings of a battalion, by which means those that were in the front come to be in the rear. It also signifies returning, or marching back again.

Counter *mark*, a mark put upon goods that have been marked before. It is also used for the several marks put upon goods belonging to several persons, to shew that they must not be opened but in the presence of them all, or their agents.

In goldsmith's work, the counter-mark is the mark punched upon the work at the hall, to shew that the metal is standard. With horse-jockies, the counter-mark is an artful hole made in the teeth of old horses, to make them pass for horses of six years old. Counter-mark of a medal is a mark added to it a long time after its being struck. It is sometimes an emperor's head, sometimes a cornucopia, &c. Counter-marks are distinguished from the monograms in this, that, being struck after the medal, they are indented: whereas the monograms, being struck at the same time with the medals, have a little relievo.

Counter *paled*, in heraldry, is when the escutcheon is divided into twelve pales parted *per fesse*, the two colours being counter-changed; so that the upper are of one colour, and the lower of another.

Counter *part*, in music, denotes one part to be applied to another. Thus the bass is said to be a counter-part to the treble. In law, it is the duplicate or copy of any indenture or deed.

Counter *passant*, is when two lions are in a coat of arms, and the one seems to go quite the contrary way from the other.

Counter *plea*, in law, a cross or contrary plea, particularly such as the demandant alleges against a tenant in courtesy, or dower, who prays the King's aid, &c. for his defence.

Counter *point*, in music, the art of composing harmony, or of disposing several parts in such a manner as to make an agreeable whole, or a concert. In general, every harmonious composition, or composition of many parts, is called counter-point. It took its name from hence: before notes of different meaures were invented, the manner of composing was to set pricks or points one against another, to denote the several concords.

Counter *pointed*, in heraldry, is when two chevrons in one escutcheon meet in the points, the one rising as usual from the base, and the other inverted falling from the chief; so that they are counter to one another in the points. They may also be counter-pointed, when they are founded upon the sides of the shield, and the points meet that way, called counter-pointed in fesse.

Counter *poise*, is a piece of metal, called by some the pear, on account of its figure, and the mass, by reason of its weight, which, sliding along the beam, determines the weight of bodies weighed by the statera romana.

Counter *salient*, is when two beasts are borne in a coat leaping from each other directly the contrary way.

Counter *scarp*, in fortification, is properly the exterior talus or slope of the ditch; but it is often taken for the covered way and the glacis. In this sense we say, the enemy have lodged themselves on the counter-scarp.

COUNTERMAND, in the English law, is where a thing, before executed, is by some act or ceremony afterwards made void by the party that did it. A countermand may be either actual or implied: actual, where a power to execute any authority is, by a formal writing or deed for that purpose, put off for a time, or made void: implied, when a person makes his last will and testament, whereby he devises his land to such an one, and afterwards conveys the same land to another by feoffment.

COUNTY, in geography, originally signified the territory of a count or earl, but now it is used in the same sense with shire. See Shire.

England, for the better government thereof, and the more easy administration of justice, is divided into 52 counties, each whereof is subdivided into rapes, lathes, wapentakes, hundreds; and these again into tythings. For the execution of the laws in the several counties, excepting Cumberland, Westmoreland, and Durham, every Michaelmas term officers are appointed, called sheriffs; other officers of the several counties are, lord lieutenants, custodes rotulorum, justices of the peace, bailiffs, high constables, coroner, clerks of the market, &c. Of the 52 counties in England and Wales, there are four termed counties palatine, *viz.* Lancaster; Chester, Durham, and Ely. These counties are reckoned among the superior courts, and are privileged as to pleas, so that no inhabitant of such counties shall be compelled by any writ to appear, or answer the same except for error, and in cases of treason, &c. The counties-palatine of Durham and Chester are by prescription, where the king's writs ought not to come, but under the seal of the counties palatine, unless it be a writ of proclamation. There is a court of chancery in the counties-palatine of Lancaster and Durham, over which there are chancellors. Scotland is divided into 33 counties, the government of which is committed to sheriffs.

County *corporate*, a title given to several cities, on which the English monarchs have thought proper to bestow extraordinary privileges, annexing to them a particular territory of land, or jurisdiction, as the county of Middlesex annexed to the city of London, the county of the city of York, the county of the city of Bristol, &c.

County *court*, a court of justice, held every month in each county, by the sheriff or his deputy. See Court.

COUP *de bride*, in the manege, the same with ebrillade. See Ebrillade.

COUPED, in heraldry, is used to express the head or any limb of an animal, cut off from the trunk smooth; distinguishing it from that which is called erassed; that is, forcibly torn off, and therefore ragged and uneven.

Couped is also used to signify such crosses, bars, bends, chevrons, &c. as do not touch the sides of the escutcheon, but are, as it were, cut off from them.

COUPLE *closs*, in heraldry, the fourth part of a chevron, never borne but in pairs, except there be a chevron between them, saith Guillim, though Bloom gives an instance to the contrary.

COURSE, in navigation, that point of the compass or horizon, on which the ship steers; or the angle between the rhomb-line and the meridian. See NAVIGATION.

COURSE, in architecture, a continued range of stones, level, or of the same height throughout the whole length of a building, without being interrupted by any aperture.

COURSES, in a ship, the mainsail and foresail: when the ship sails under them only, without lacing on any bonnets, she is then said to go under a pair of courses. To sail under a main course and bonnets, is to sail under a mainsail and bonnet.

COURSING, among sportsmen, is of three sorts, *viz.* at the deer, at the hare, and at the fox. These coursings are with greyhounds; for the deer there are two sorts of coursings, the one with the paddock, the other either in the forest or purlieu.

The best method of coursing the hare is, to go out and find a hare sitting, which is easily done in the summer by walking across the lands, either stubble, fallow, or corn grounds, and casting the eye up and down; for in summer they frequent those places for fear of the ticks, which are common in the woods at that season; and in autumn the rains falling from the trees offend them. The rest of the year there is more trouble required; as the bushes and thickets must be beat to rouse them, and oftentimes they will lie so close, that they will not stir till the pole almost touches them; the sportsmen are always pleased with this, as it promises a good course. If a hare lies near any close or covert, and with her head that way, it is always to be expected that she will take to that immediately on being put up; all the company are therefore to ride up, and put themselves between her and the covert before she is put up, that she may take the other way, and run upon open ground. When a hare is put up, it is always proper to give her ground, or law, as it is called: that is, to let her run twelve-score yards, or thereabouts, before the greyhounds are slipped at her; otherwise she is killed too soon, the greater part of the sport is thrown away, and the pleasure of observing the several turnings and windings that the creature will make, to get away, is all lost. A good sportsman had rather see a hare save himself after a fair course, than see her murdered by the greyhounds as soon as she is up.

In coursing the fox no other art is required, than standing close and in a clear wind, on the outside of some grove where it is expected he will come out; and when he is come out, he must have head enough allowed him, otherwise he will return back to the covert. The slowest greyhound will be able to overtake him, after all the odds of distance necessary; and the only danger is the spoiling the dog by the fox, which too frequently happens. For this reason, no greyhound of any value should be run at this course; but the strong, hard, bitter dogs, that will seize any thing.

COURT, in a law sense, the place where judges distribute justice, or exercise jurisdiction; also the assembly of judges, jury, &c. in that place.

Courts are divided into superior and inferior, and into courts of record and base courts: again, courts are either such as are held in the King's name, as all the ordinary courts, or where the precepts are issued in the name of the judge, as the admiral's court.

The superior courts are, those of the King's Bench, the Common Pleas, the Exchequer, and the Court of Chancery. A court of record is that which has a power to hold plea, according to the course of the common law, of real, personal, and mixed actions; where the debt or damage is forty shillings or above, as the court of King's Bench.

A base court, or a court not of record, is where it cannot hold plea of debt, or damage amounting to forty shillings, or where the proceedings are not according to the course of the common law, nor inrolled; such as the county-court, courts of hundreds, court-baron, &c.

The rolls of the superior courts of record are of such authority, as not to admit of any proof against them, they being only triable by themselves; but the proceedings of base courts may be denied, and tried by a jury. Some of the courts may fine, but not imprison, a person, such as the leet; and some can neither fine nor inflict punishment, and can only amerce, as the county-court, court-baron, &c. But the courts of record at Westminster Hall have power to fine, imprison, and amerce; and in those courts the plantiff need not show, in his declaration, that the cause of action arises within their jurisdiction, being general; though, in inferior courts, it must be showed at large, on account they have particular jurisdictions.

COURT-BARON, a court that every lord

of a manor has within his own precints. This court must be held by prescription, and is of two kinds, *viz.* by common law, and by custom; the former is where the barons or freeholders, being suitors, are the judges; the other is, that where the lord or his steward is the judge.

Court *of chivalry*, or the *marshal's court*, that whereof the judges are the lord high constable and the earl marshal of England. This court is the fountain of martial law, and the earl marshal is not only one of the judges, but is to see execution done. See Chivalry.

Court *of conscience*, a court in the cities of London, Westminster, and some other places, that determines matters in all cases, where the debt or damage is under forty shillings.

Court *of delegates*, a court where delegates are appointed by the King's commission, under the great seal, upon an appeal to him from the sentence of an archbishop, &c. in ecclesiastical causes, or of the court of admiralty, in any marine cause.

Court *of hustings*, a court of record held at Guildhall, for the city of London, before the Lord Mayor and Aldermen, Sheriffs, and Recorder, where all pleas, real, personal, and mixed, are determined; where all lands, tenements, &c. within the said city, or its bounds, are pleadable in two hustings; the one called the hustings of plea of lands, and the other the hustings of common pleas. The court of hustings is the highest court within the city, in which writs of exigent may be taken out, and outlawries awarded, wherein judgment is given by the Recorder. To the Lord Mayor and city of London belong several other courts, as the court of Common Council, consisting of two houses, the one for the Lord Mayor and Aldermen, and the other for the commoners; in which court are made all bye-laws which bind the citizens. The Chamberlain's court relates to the rents and revenues of the city, to the affairs of servants, &c.

To the Lord Mayor belongs the court of coroner and escheator; another court for the conservation of the river of Thames; another of gaol delivery, held eight times a year at the Old Bailey, for the trial of criminals, where the Lord Mayor himself is the chief judge. There are also other courts, called wardmotes, or meetings of the wards; and courts of halymote, or assemblies of the guilds and fraternities.

Court-leet, a court ordained for the punishment of offences under high treason against the crown.

Court-martial, a court appointed for the punishing offences in officers, soldiers, and sailors, the powers of which are regulated by the Mutiny Bill.

Court *of Requests*, was a court of equity, of the same nature with the chancery, but inferior to it. It was chiefly instituted for the relief of such petitioners, as in conscionable cases addressed themselves to his Majesty; the Lord Privy Seal was the chief judge of this court,

COURTESY, or Curtesy *of England*, a certain tenure, whereby a man, marrying an heiress seized of lands of fee simple, or fee tail general, or seized as heir of the tail special, and hath a child by her that cometh alive into the world, though both it and his wife die forthwith, yet, if she were in possession, he shall keep the land during his life, and is called tenant per legem Angliæ, or tenant by the courtesy of England; because this privilege is not allowed in any country except Scotland, where it is called curialitas Scotiæ.

COUSIN, a term of relation between the children of brothers and sisters, who, in the first generation, are called cousin-germans; in the second generation, second cousins, &c.

Before the time of Theodosius, there was no law, ecclesiastical or civil, to prohibit the marriage of cousin-germans: under the reign of that emperor they were forbidden, but allowed again in the next reign, and under Justinian, who fixed the allowance in the body of his laws; but still the canons continued the prohibition, and extended it to a greater degree.

COUSU, in heraldry, signifies a piece of another colour or metal placed on the ordinary, as if it were sewed on, as the word imports. This is generally of colour upon colour, or metal upon metal, contrary to the general rule of heraldry.

COVERT, in heraldry, denotes something like a piece of hanging, or a pavilion falling over the top of a chief or other ordinary, so as not to hide, but only to be a covering to it.

COW, in zoology, the female of the ox-kind. See Bos.

CRAB'S *claws*. See Materia Medica.

CRAB'S *eyes*. See Pharmacy.

Crab, an engine of wood, with three claws, placed on the ground like a capstan, and used at launching, or heaving ships into the dock.

CRADLE, in surgery, a case in which a broken leg is laid after being set.

CRADLE, among shipwrights, a timber frame made along the outside of a ship by the bilge, for the convenience of launching her with ease and safety.

CRAFT, in the sea language, signifies all manner of nets, lines, hooks, &c. used in fishing. Hence all such little vessels as ketches, hoys, and smacks, &c. used in the fishing trade, are called small craft.

CRAMBE, in botany, a genus of the Tetradynamia Siliquosa class and order. Natural order of Siliquosæ Cruciformes. Essential character: filaments, the four longer two-cleft at the end, one only of the tips bearing an anther: berry dry, globose, deciduous. There are six species, of which one is C. maritima, sea-colewort; the roots of this plant creep under ground, whereby it propagates very fast. The whole plant is smooth, glaucous, and sometimes tinged with purple; several stalks arise, about two feet high, spreading, much branched, bearing sessile leaves. The flowers or long peduncles are white. The fruit at first ovate, terminated by the blunt stigma, afterwards nearly spherical, the size of large peas. The young leaves, covered up with sand, and blanched, are boiled and eaten as a great delicacy. It is found on the sandy and beachy coasts of Sweden and Denmark; it is also common in many parts of England, particularly in the west.

CRAMP, in medicine, a convulsive contraction of a muscular part of the body, being either natural, as in convulsive constitutions, or accidental, from living in cold places, under ground, &c. It affects all parts indifferently, but the ham, calves, feet, and toes, oftener than the arms and hands.

An effectual preventative for cramp in the calves of the legs, which is a most grievous pain, is to stretch out the heel of the leg as far as possible, at the same time drawing up the toes to the body. This will frequently stop the progress of a fit of the cramp after it has commenced; and a person will, after a few times, be able in general to prevent the fit coming on, though its approach be between sleeping and waking.

CRANE. See GRUS.

CRANE, in mechanics, a machine for raising goods into loft, or from vessels to wharfs, or for lowering them from heights, &c. in a safe manner, and by the application of a comparatively small power. Numberless contrivances have been resorted to for these purposes; the first of them appears to have been the great drum-wheel, in which one or more men, an ass, &c. being made to walk, a rotary motion followed, whereby a rope fastened to the axis of the wheel was wound up, and with it whatever weight the power thus created was capable of lifting. But it was found that various fatal accidents attended this piece of machinery; for when the man slipped, the wheel would obtain a reverse motion, and by its accumulated velocity would dash him to pieces. On the other hand, if the rope suspending the weight gave way, the motion of the wheel, it being released from opposition, became so accelerated as to produce the same fatal effects.

An improvement upon this was the inclined plane, (seen in fig. 1, Pl. IV. Miscel.) which having ribs, or battens, all pointing to its centre, is moved by a man walking either nearer to or further from the axis, according to the weight to be raised, his greatest power being near the edge; the rope *x*, sustaining the weight *o*, passing through the pully *y*, and winding on the axis *p*, as it revolves in consequence of the man's pressure. To prevent accidents, the man has hold of the arm *n*, projecting from the post *z*; so that, in case of a slip, he might save himself by bearing thereon.

But though this plan is certainly a great improvement, yet it cannot be considered as altogether safe, and it takes up so much space, that it is very rarely in use. The windlass, worked by various different powers, and those variously applied, has in general superseded all other practices. It is to be lamented that some are too complex and expensive, which would otherwise prove highly serviceable. We give that in fig. 2, as being cheap and effective. It consists merely of a barrel, *e*, to which three concentric iron wheels, *a*, *b*, *c*, all graduated with equidistant teeth, and laying in one plane, secured also by cross bars, are affixed. The small wheel D, having teeth fitting to those on either wheel, may be brought forward to work in either *a*, *b*, or *c*, at pleasure. Now D being one foot in diameter, and *a* being two feet, the latter will revolve once, while the former revolves twice: this power is suited to light weights. When the resistance is greater, the power must be increased by removing D farther from the centre of the windlass *e*, and applying it to the second wheel *b*, which being three times the diameter of D, will turn only once while the latter makes three revolutions: again, when the weight is very great, D must be made to work upon the largest wheel *e*, which being four times its diameter, will cause D to turn four times while *c* turns but once. The figure is not exactly in the above proportions; but the explanation will suffice to render that minutia of less importance. D is turned by a crank-handle, or winch, and is made to fit into three different sockets, where its axis is keyed down, opposite to whichever wheel is to be acted upon. It should have a small ratchet, or pall, to prevent its retrocession, in case the weight should overpower the operator.

Some cranes are made to weigh goods as they are raised; but this can seldom be done with accuracy, though the general estimate may be correct enough for ordinary occasions. It is done by allowing the jib, or projection *m*, (fig. 2.) to play on a joint at *n*, and by having a moveable weight at the other end of the beam *s*, of which the jib forms a part, with an index on the principle of the steel-yard. But this cannot answer where very heavy articles, such as cannon, &c. are to be raised, as the joints would soon give way. Whatever may be the construction of cranes, power and safety ought to be the principal objects.

We shall proceed to describe some other cranes that are much in use in the present day. Fig. 1. Plate Cranes, is an elevation of a crane sideways, and fig. 2. is a plan; A B is a stout beam, turning in a cast iron collar at B, affixed to beams in the floor of the wharf; it goes down about twelve feet below this, and has a steel pivot in the lower end, which works in a brass collar, so that the beam A B can turn round freely without shake; C D are the two beams of the jib, with a pully at E, over which the chain for hoisting the goods works; the other end of this chain is wound round a roll, *e*,1 foot diameter; a cog wheel, marked 100, of 100 teeth, turned by a pinion of 7 leaves, on the same axle with another wheel 31, of 31 teeth: this is turned by a pinion, 14, of 14 teeth. If great power is required, the winch handle is applied to a square on the end of the spindle of the last pinion, and for less weight the winch is put on the axle of 31: when this is the case, the pinion 14 must be disengaged from its wheel, by sliding its axle lengthways. G is a clip, to keep the pinion in or out of gear, as it has been placed by the attendant. A plan of it is also shewn in fig. 2: the two semicircular bands in it fit into grooves turned in the spindles, and the weight *a* at the end keeps them in this prevents them moving endways; when the weight *a* is raised, it releases them both; and when they are moved, the clip fits into another groove turned in them, so as to prevent their return. The frame containing the wheels is formed by two cast iron crosses, bolted to the main beam A B by the ends of their vertical arms, the two other arms forming the bearing for the wheels.

Cranes of this kind are now coming into very general use in London, as they require no expensive framing over them, and they can be turned all round. A further advantage they possess, in common with several other kinds, is, the chain not being bent suddenly round the small pullies over the jib when they are swinging overland, as in the common kind, and fig. 4.

A crane of this kind, which we saw at Woolwich Warren, had an apparatus (shewn in fig 3.) attached to it for lowering with safety great weights without any exertion of the workmen. It consists of a cylinder, *b d e*, of cast iron, smoothly bored through; *f g* is a passage connecting the top and bottom of the cylinder, and *h* a cock by which this passage can be closed; *i* is a piston fitting the cylinder, and *k* the rod affixed to it, moving through a stuffing box in the lid of the cylinder; the axis of the wheel 31 (fig 1 and 2.) or one in the place of it, has a crank on it working the piston rod of the cylinder (fig. 3.) which is bolted fast to the back of the beam A B, with the usage sliding motion to render its motion parallel. The cylinder is filled full of oil, and as the handle of the crane is turned, the piston is moved up and down in the cylinder: now if the cock *h* is open, the oil flows freely from one part of the cylinder to the other, without obstructing the motion of the crane; but if it is closed, the oil, finding no other passage, and being an incompressible fluid, stops the piston, and the descent of the goods suspended by the crane. By opening the cock partially, the friction (or, as it is technically termed, the wire-drawing) of the oil impedes the motion of the wheels, so as to lower the greatest weights with any velocity required. A portion of the circle *m* is fastened to the cock, with fine teeth cut in it; a click takes into these teeth, to hold the cock at any opening it may be set to. This contrivance is described in Gregory's Mechanics, published in 1806, applied to a different kind of crane, but the invention is ascribed to Mr. David

Hardie. We consider it a contrivance of great utility, and likely to prove extremely useful.

Fig. 4, is an elevation of a crane at Queenhithe wharf, London. A B is a very strong upright beam, firmly bolted to beams running inland, and further secured by curved stays D: *a d e* is a cast-iron frame, bolted to the beam at one end and the stays D at the other. This forms the frame for the wheelwork, which is the same as fig. 1; the chain, after going round the roll, goes over a large wheel *f*, and passes through the beam to the jib. E is a cast-iron frame, bolted to the top of the beam A B, to receive the upper pivot of the jib; *g* is one of the small pulleys, round which the chain bends when the jib is turned overland to raise or lower goods. F is another cast-iron frame, to support the lower pivot of the jib, and G is a pile bolted to it, to assist. A few boards nailed over the two stays D forms a cover for the whole machinery, and defends the wheel-work. The jib and its iron-work will be understood by inspection of the figure. All cranes where chains are used for hoisting the goods should have barrels, with a spiral groove cut in them, and the lower half of the chain lay in the groove, as in fig. 5. This was applied, in 1789, by Mr. John Smeaton, to a crane designed by him, and executed in the Wool-quay, Custom-house, and found to be of great advantage. In 1805, Mr. Gilbert Gilpin received the silver medal of the Society of Arts for the same invention, without perhaps knowing it had been used before. The pulleys should also be grooved, to receive the lower half of the links of the chain in the same manner.

CRANICHIS, in botany, a genus of the Gynandria Diandria class and order. Natural order of Orchideæ. Essential character: nectary guleated. There are five species, all natives of Jamaica.

CRANIOLARIA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Bignoniæ, Jussieu. Essential character: calyx double of the flower; perianth four-leaved; spathe one-leaved; corolla tube very long; capsule of martynia. There is but one species, *viz.* C. annua, found in the neighbourhood of Carthagena in New Spain.

CRANIUM. See Anatomy.

CRANK, a contrivance in machines, in manner of an elbow, only of a square from, projecting from a spindle, and serving, by its rotation, to raise and fall the pistons of engines.

Crank likewise denotes the iron support for a lantern, or the like; also the iron made fast to a stock of a bell for ringing it.

In the sea language, a ship is said to be crank-sided when she can bear but small sail, for fear of oversetting; and when a ship cannot be brought on the ground without danger, she is said to be crank by the ground.

CRANZIA, in botany, a genus of the Pentandria Monogynia class and order. Essential character: calyx five-parted; petals five; nectary none; berried capsule. There is but one species, *viz.* C. aculeata, a prickly shrub; leaves ternate, with pellucid dots; fruit dotted like the orange. A native of the East Indies.

CRAPE, in commerce, a kind of stuff made in the manner of gauze, with raw silk gummed and twisted on the mill.

CRASPEDIA, in botany, a genus of the Syngenesia Polygamia Segregata. Essential character: calycle none; calyx imbricate; florets in depressed bundles, all hermaphrodite, tubular; down feathered; receptacle chaffy. One species, viz. C. uniflora, a native of New Zealand.

CRASSULA, in botany, a genus of the Pentandria Pentagynia class and order. Natural order of Succulentæ. Sempervivæ, Jussieu. Essential character: calyx one leafed, five-cleft; petals five; nectareous scales five at the base of the germ; capsule five, many seeded. There are sixty-four species.

CRATÆGUS, in botany, a genus of the Icosandria Digynia class and order. Natural order of Pomaceæ. Rosaceæ, Jussieu. Essential character: calyx five-cleft; petals five; berry inferior, two-seeded. There are twenty-three species. This genus consists chiefly of shrubs or trees, hardy, and deciduous; leaves simple, undivided, or lobed; peduncles in most species many flowered; corymbed terminating, and solitary from the axils; corollas white, appearing in May and June, and succeeded by red berries in autumn.

CRATER, in astronomy, a constellation of the southern hemisphere. See Astronomy.

CRATEVA, in botany, a genus of the Dodecandria Monogynia class and order. Natural order of Putamineæ. Capparides, Jussieu. Essential character: calyx four-cleft; corolla three-petalled; berry one-celled, many seeded. There are five species. These are trees with ternate leaves, and the flowers in terminating panicles. Natives of both Indies.

CRAX, the curassow, in natural history, a genus of birds of the order Gallinæ. Generic character: bill strong, convex, and thick, the base of each mandible covered with a cere; nostrils small, and fixed in the cere; feathers which cover the head often curling at the ends; tail large and straight. Latham mentions four species, and Gmelin notices five. We shall select the C. alector, or the peacock pheasant of Guiana. These birds abound in the woods of Guiana, and are about the size of a small turkey, which they also extremely resemble in taste. They are destroyed by the Indians of the country in vast numbers, and sold to the planters, who are particularly fond of them, and with whom, as they are so plentiful, they constitute a frequent and almost daily article of food. They are easily domesticated, and found in this state, in great abundance, in the settlements of Berbice and Demerara, and in others of the West India islands. See Aves, Plate IV. fig. 7.

CRAYON, a name for all coloured stones, earths, or other minerals, used in designing or painting in pastel. See Painting.

CREAM. See Milk.

Cream *of tartar*, the common name of supertartrate of potash; it is also denominated crystals of tartar. In this salt there is an excess of the Tartaric acid, which see.

CREDIT, in political economy, is the trust which an individual places in another individual, or in the state, in pecuniary transactions. This trust arises from a confidence in the creditor, that the debtor will fulfil the engagement into which he enters.

The foundation of credit is a knowledge of the circumstances of the debtor, or of his character for industry, ability, and probity. The degree of confidence is increased by experience of his punctuality in making good his engagements, and diminished by all circumstances which diminish the safety, or even interrupt the regular course of mercantile transactions.

The money price of goods sold upon credit must be higher than that of goods paid for immediately, and this in proportion to the length of credit given and the risk. The advantage of giving credit to men of large capitals is, that they get higher prices, the difference between the money price and the credit price being greater than the legal interest of the money price for the time. Hence it is a principle with some traders to give very long credit at proportionate prices. The advantage to purchasers of small capital is, that these credits are so much addition to their capital for the time

Some men of large property, but whose concerns admit of indefinite extension, will take all the credit they can get, either on pecuniary loans, or in purchases, being able to make a larger profit on any capital they can procure by either of these methods than it costs them. They are exposed, however, 1, to the risk of having great demands made upon them, when it may be inconvenient to satisfy them; and, 2, to the very common misfortune of forgetting how much of their capital belongs to other people; Dr. Franklin's observation being too true, that most men think their debts and their sins less than they really are. A person on whom credit is placed, and to whom it is advantageous, should be religiously punctual. Nothing will so much confirm his credit. He, however, is in a safer condition, who can give credit without taking any; who sells on credit, but buys for money. And this should in general be the object of every young tradesman.

The degree of credit among private persons is considerably affected by the laws. If they tend to enforce the fulfilment of engagements, they strengthen credit; if they facilitate fraud, they enfeeble it.

The confidence placed in governments, on the public credit, depends exactly on the same causes as the credit of individuals, on the punctuality with which they fulfil their engagements. Hence, in free states, *i. e.* states in which the creditors have a controul over the government, credit is extensive; but in absolute monarchies it is little or nothing. It is an alarming circumstance for all creditors of the state, that wherein a great national debt has been contracted, the issue has been a national bankruptcy. The republics of Italy, and that of the United Provinces, as well as the monarchs of France, have ultimately discharged their debts in this unhappy manner. This has been caused, indeed, by the pressure of inevitable circumstances, but it is not the less alarming on that account.

CREEPER, at sea, a sort of grapnel, but without flooks, used for recovering things that may be lost overboard.

CRENATE, in Natural History, scolloped or notched at the margin.

CRENGLES, among seamen, small ropes spliced into the bolt-ropes of the sails of the main-mast and fore-mast, into which the bowling bridles are made fast.

CREPIS, in botany, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Semiflosculosæ. Sichoraceæ, Jussieu. Essential character: calyx calycled, with deciduous scales, down hairy, stipitate; receptacle naked. There are twenty species.

CREPITATION, in chemistry, the noise which some salts make over the fire during calcination, called also DECRIPITATION; which see.

CREPUSCULUM, *twilight*, the time from the first dawn or appearance of the morning to the rising of the sun; and again, between the setting of the sun and the last remains of day.

The crepusculum, or twilight, it is supposed, usually begins and ends when the sun is about 18 degrees below the horizon; for then the stars of the 6th magnitude disappear in the morning, and appear in the evening. It is of longer duration in the solstices than in the equinoxes, and longer in an oblique sphere than in a right one; because, in those cases, the sun, by the obliquity of his path, is longer in ascending through 18 degrees of latitude.

Twilight is occasioned by the sun's rays refracted in our atmosphere, and reflected from the particles of it to the eye. Kepler indeed assigned a different cause of the crepusculum, *viz.* the luminous matter about the sun. This may lengthen the duration of the twilight, by illuminating the air, when the sun is too low to reach it with his own light, but is not the principal cause of it: which is unquestionably the refraction of the atmosphere.

The depth of the sun below the horizon, at the beginning of the morning, or end of the evening twilight, is determined in the same manner as the arch of vision; *viz.* by observing the moment when the air first begins to shine in the morning, or ceases to shine in the evening; then finding the sun's place for that moment, and thence the time till his rising in the horizon, or from his setting in it in the evening. It is now generally agreed that this depth is about 18 degrees upon an average. Alhazen found it to be 19°; Tycho, 17°; Rothman, 24°; Stevenius, 18°; Cassini, 15°; Riccioli, in the equinox in the morning 16°, in the evening 20° 30′; in the summer solstice in the morning 21° 25′, in the winter solstice in the morning 17° 25′.

This difference among the determinations of astronomers is not to be wondered at, the cause of the crepusculum being inconstant; for, if the exhalations in the atmosphere be either more copious or higher than ordinary, the morning twilight will begin sooner, and the evening hold longer, than ordinary; for the more copious the exhalations are, the more rays will they reflect, consequently the more will they shine; and the higher they are, the sooner will they be illuminated by the sun. On this account, too, the evening twilight is longer than the morning, at the same time of the year, in the same place. To this it may be added, that in a denser air the refraction is greater; and that not only the brightness of the atmosphere is variable, but also its height from the earth: and therefore the twilight is longer in hot weather than in cold, in summer than in winter, and also in hot countries than in cold, other circumstances being the same. But the chief differences are owing to the different situations of places upon the earth, or to the difference of the sun's place in the heavens. Thus, the twilight is longest in a parallel sphere, and shortest in a right sphere, and longer to places in an oblique sphere, in proportion as they are nearer to one of the poles; a circumstance which affords relief to the inhabitants of the more northern countries, in their long winter nights. And the twilights are longest in all places of north latitude, when the sun is in the tropic of cancer; and to those in south latitudes, when he is in the tropic of capricorn. The time of the shortest twilight is also different in different latitudes: in England, it is about the beginning of October and of March, when the sun is in the signs Libra and Pisces.

CRESCENT, in heraldry, a bearing in form of a new moon. It is used either as an honourable bearing, or as the difference to distinguish between elder and younger families; this being generally assigned to the second son, and those that descend from him. The figure of the crescent in the Turkish symbol, with its points looking towards the top of the chief, which is its most ordinary representation, called crescent montant. Crescents are said to be adossed, when their backs are turned towards each other; a crescent is said to be inverted, when its points look towards the bottom; turned crescents have their points looking to the dexter-side of the shield; cornuted crescents to the sinister side; and affronted crescents, contrary to the adossed, have their points turned to each other.

CRESCENTIA, in botany, English calabash-tree, a genus of the Didynamia Angiospermia class and order. Natural order of Putamineæ. Solaneæ, Jussieu. Essential character: calyx two-parted, equal; corolla gibbous; berry pedicelled, one celled, many seeded: seeds two-celled. There are two species, *viz.* C. cujete, narrow leaved calabash-tree, and C. cucurbitina, broad leaved calabash-tree. These are small trees, with large leaves, either singly alternate, or in alternate bundles. Flowers on the trunk or branches sub-solitary; they are both natives of the West-Indies.

CRESSA, in botany, a genus of the Pentandria Digynia class and order. Dubii, Linnæus. Convolvuli, Jussieu. Essential character: calyx five-leaved; corolla salver form; filaments sitting on the tube; capsule two-valved, one-seeded. There are two species, natives of the East Indies, in salt marshes.

CREST, in armoury, the top part of the armour for the head, mounting over the helmet, in manner of a comb, or tuft of a cock, deriving its name from crista, a cock's comb. The crest was for the most part made of feathers, or the hair of horses' tails or manes. The soldiers took great pride in adorning them. In most of the old monuments, we find the crest represented not much unlike those on the tops of our modern head-pieces: but whatever the common soldiers had, those of the officers were usually wrought in gold or silver, and the plumes of a larger size, quite across the helmet; and some wore two, three, or four together, of these plumes.

Crest, in heraldry, the uppermost part of an armoury, or that part of the cask or helmet next to the mantle. Guillim says the crest, or cognizance, claims the highest place, being seated on the most eminent part of the helmet; yet so as to admit of an interposition of some escrol, wreath, chapeau, crown, &c. The crest is esteemed a greater mark of nobility than the armoury, being borne at tournaments, to which none were admitted till such time as they had given proof of their nobility; sometimes it serves to distinguish the several branches of a family, and it has served, on occasion, as a distinguishing badge of factions: sometimes the crest is taken for the device; but more usually is formed of some piece of the arms. Families that exchange arms do not change their crest.

CREW, the company of sailors belonging to a ship, boat, or other vessel. The sailors that are to work and manage a ship are regulated by the number of lasts it may carry, each last making two tun.

CRIBBAGE, a game at cards, wherein no cards are to be thrown out, and the set to make sixty-one: and as it is an advantage to deal, by reason of the crib, it is proper to lift for it, and he that has the least card deals.

There are only two players at this game, wherein the cards are dealt out one by one, the first to the dealer's antagonist, and the next to himself; and so on, till each have five: the rest being set down in view on the table.

This done, the dealer lays down the two best cards he can for his crib; and his antagonist lays down the other two, the very worst in his hand, by reason the crib is the property of the dealer. They next turn up a card from the parcel left after dealing, and then count their game thus: any fifteen upon the cards is two; as king and five, ten and five, nine and six, eight and seven, &c. A pair is also two; a pair royal, or three aces, kings, &c. six; a double pair royal, or four aces, &c. twelve. Sequences of three cards, as four, five, and six, is three; sequences of four, four; five, five, &c. and the same holds of a flush. Knave noddy, or of the suit turned up, is one in hand, and two to the dealer. If, after the cards for the crib are laid out, you have in your hand a nine and two sixes, that makes six; because there is two fifteens, and a pair: and if a six chance to be turned up, then you have twelve in your hand, *viz.* the pair royal, and three fifteens. These are to be marked with pegs, counters, or otherwise. If you happen to have sequences, as of four, five, and six, in your hand, and six be the turned up card, they are counted thus: first, the sequences in your hand make three; and the sequences of the four and five in your hand, added to the six turned up, make other three: there is likewise two fifteens, counting first with the six in your hand, and then with that turned up.

This done, the antagonist to the dealer plays first, suppose a six; and if the dealer can make it fifteen, by playing nine, he gains two; and he that reaches thirty-one exactly gains two, or comes nearest under it gains one. Here too, in playing of the cards, you may make pairs, pairs-royal, flushes, &c. which are all counted as above.

As to the crib, it is the dealer's, who may make as many as he can out of them, together with the card turned up; counting as above: if he can make none, he is said to be bilked.

Thus they play and deal by turns, till the game of sixty-one is up; and if either of the gamesters reach this before the other is forty-five, this last is said to be lurched, and the other gains a double game.

CRIBRARIA, in botany, a genus of the Cryptogamia Fungi: case furnished with a double membrane, the outer one thin and fugacious, inner one reticulate; seeds without filaments, ejected through the foramina. One species, *viz.* the pallida.

CRICKET, the name of an exercise or game with bats and balls. The laws of this game, as settled by the cricket club in 1744, and played at the Artillery Ground, London, are as follow. The pitching the first wicket is to be determined by the cast of a piece of money. When the first wicket is pitched, and the popping-crease cut, which must be exactly three feet ten inches from the wicket, the other wicket is to be pitched directly opposite, at twenty-two yards distance, and the other popping-crease cut three feet ten inches before it. The bowling-creases must be cut in a direct line from each stump. The stumps must be twenty-two inches long, and the bail six inches. The ball must weigh between five and six ounces. When the wickets are both pitched, and all the creases cut, the party that wins the toss up may order which side shall go in first, at his option.

The laws for the bowlers. Four balls and over.—The bowler must deliver the ball with one foot behind the crease even with the wicket, and when he has bowled one ball, or more, shall bowl to the number four before he changes wickets; and he shall change but once in the same innings. He may order the player that is in at his wicket to stand on which side of it he pleases, at a reasonable distance. If he delivers the ball with his hinder foot over the bowling-crease, the umpire shall call no ball, though she be struck, or the player is bowled out, which he shall do without being asked, and no person shall have any right to ask him.

Laws for the strikers, or those that are in.—If the wicket is bowled down, it is out. If he strikes or treads down, or he falls himself upon the wicket in striking, but not in over-running, it is out. A stroke or nip over or under his bat, or upon his hands, but not arms, if the ball be held before she touches ground, though she be hugged to the body, it is out. If in striking, both his feet are over the popping-crease, and his wicket put down, except his bat is down within, it is out. If he runs out of his ground to hinder a catch, it is out. If a ball is nipped up, and he strikes her again wilfully before she come to the wicket, it is out. If the players have crossed each other, he that runs for the wicket that is put down is out: if they are not crossed, he that returns is out. If in running a notch, the wicket is struck down by a throw before his foot, hand, or bat, is over the popping-crease, or a stump hit by the ball, though the ball was down, it is out. But if the bail is down before, he that catches the ball must strike a stump out of the ground-ball in hand, then it is out. If the striker touches or takes up the ball before she is lain quite still, unless asked by the bowler or wicket-keeper, it is out.

Bat, foot, or hand over the crease.—When the ball has been in hand by one of the keepers or stoppers, and the player has been at home, he may go where he pleases till the next ball is bowled. If either of the strikers is crossed in his running ground designedly, which design must be determined by the umpires, the umpires may order that notch to be scored. When the ball is hit up, either of the strikers may hinder the catch in his running ground, or if she is hit directly across the wickets, the other player may place his body any where within the swing of the bat, so as to hinder the bowler from catching her: but he must neither strike at her, nor touch her with his hands. If a striker nips a ball up just before him, he may fall before his wicket, or pop down his bat before she comes to it, to save it. The bail hanging on one stump, though the ball hit the wicket, it is not out.

Laws for the wicket-keepers.—The wicket-keeper shall stand at a reasonable distance behind the wicket, and shall not move till the ball is out of the bowler's hand, and shall not by any noise incommode the striker; and if his hands, knees, foot, or head, be over or before the wicket, though the ball hit it, it shall not be out.

Laws for the umpires.—To allow two minutes for each man to come in when one is out, and ten minutes between each hand. To mark the ball, that it may not be changed. They are sole judges of all outs and ins, of all fair or unfair play, of all frivolous delays, of all hurts, whether real or pretended, and are discretionally to allow what time they think proper before the game goes on again. In case of a real hurt to a striker, they are to allow another to remain, and the person hurt to come in again; but are not to allow a fresh man to play on either side on any account. They are sole judges of all hinderances, crossing the players in running, and standing unfair to strike; and in case of hinderance, may order a notch to be scored. They are not to order any man out, unless appealed to by one of the players. Those laws are to the umpires jointly.

Each umpire is the sole judge of all nips and catches, ins and outs, good or bad runs, at his own wicket, and his determination shall be absolute, and he shall not be changed for another umpire without the consent of both sides. When the four balls are bowled, he is to call over. These laws are separately.

When both umpires call play three times, it is at the peril of giving the game from them that refuse to play.

CRIME, the transgression of the law, either natural or divine, civil or ecclesiastic.

Civilians distinguish between crimen and delictum. By the first, they mean capital offences injurious to the whole community, as murder, perjury, &c. the prosecution of which was permitted to all persons, though no ways immediately interested. By the latter, they understand private offences committed against individuals, as theft, &c. By the laws, no body was allowed to prosecute in these, except those interested.

With us crimes are distinguished into capital, as treason, murder, robbery, &c. and common, as perjuries, &c. Again, some crimes are cognizable by the King's judges, as the above mentioned; and others are only cognizable in the spiritual courts, as simple fornication.

CRIMNOIDES, or CRIMOIDES, among physicians, a term sometimes used for the sediment of urine resembling bran.

CRIMSON, one of the seven red colours of the dyers. See DYEING.

CRINODENDRUM, in botany, a genus of the Monadelphia Decandria class and order. Essential character: calyx none: corolla bell-shaped, six-petalled; capsule one-celled, gaping elastically at top. There is but one species, *viz.* C. patagua, a beautiful evergreen branchy tree, with a body seven feet in diameter. It is a native of Chili.

CRINUM, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Spathaceæ. Narcissi, Jussieu. Essential character; corolla funnel-form, monopetalous, six-parted, three alternate segments unciate; germ at the bottom of the corolla, covered; stamina, distant. There are six species.

CRITHMUM, in botany, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ. Essential character: fruit oval, compressed; florets equal. There are three species.

CRITICISM, from the Greek word κρινω, signifies, in general, the art of judging; but in its more restrained and usual sense, denotes the art of judging with propriety concerning the nature of literary compositions.

Notwithstanding the ignorance and insolence which have occasionally disgraced the writings of professed critics of minor rank, and notwithstanding the sneers of one of the wittiest of English authors against what he denominates the "cant of criticism," and his memorable eulogium of those, "who are pleased they know not why, and care not wherefore," the art of criticism is founded in nature, and every man of thinking mind is led to the practice of that art. The merits or demerits of literary works are a perpetual subject of comment, and the intelligent reader is not contented with referring to his own immediate feelings as the grounds of his verdict, but appeals to certain principles, which he regards as established, and which he quotes as the guides of opinion. When, after we have perused a poem, or attended at the representation of a play, we call to mind what has pleased and what has displeased us in the whole, or in the parts of it, we exercise criticism in its simplest form; but when, at the call of a laudable curiosity, or in order to enable ourselves to detail the reasons of our admiration or of our disappointment, we attentively examine those reasons, we rise into the regions of philosophy; and the principles which are founded on the basis of philosophy can alone constitute the standard of true taste.

If these principles be the rules by which the intelligent reader forms his decision upon the character of an author's writings, it is evident that the writer, who would wish to please the intelligent, must conform himself to the laws which are established by their sanction. It is true, indeed, that the promulgation of the rules of criticism did not precede the production of some of the greatest monuments of human genius. On the contrary, the circulation of works of transcendent merit affords the models, from the contemplation of which were derived the rules of criticism. It was from the study of Homer, of Eschylus, of Sophocles, and Euripides, that Aristotle deduced those laws of composition, which have been universally received by the enlightened part of the world as the dictates of sound judgment and elegant discrimination. But it must not on that account be imagined, that the authors of those models did not form and shape them by rule. Though they were not guided by any *lex scripta*, it may truly be asserted, that "they were a law unto themselves:" they were guided by an intuitive sense

"Of decent and sublime, with quick disgust
Of things deform'd, or disarrang'd, or gross
In species———."

But as this immediate perception of what is fitting and what is unbecoming, in works of art, seems to be communicated only to a chosen few, it must be regarded as a law of our nature, that mankind in general must be content to learn, by study, what they do not derive from intuition, and on this circumstance are founded the utility and the dignity of the elements of criticism.

The truth of this observation will be the more apparent, if we examine the writings of those, who either enjoyed no opportunity of becoming acquainted with those elements, or from the heights of their vain imaginations looked down upon them with contempt. These have universally been betrayed into the most glaring improprieties, which, though they may in some instances have been, by the applause of the injudicious, rendered popular for a short period, have never stood the test of time, but in consequence of the operation of good sense have been finally condemned by the unanimous suffrage of the public. The conceits of Cowley had their admirers for a few years, but they are now buried in oblivion, or are only quoted as lessons of warning to the youthful poet. It is the opinion of true judges, which rectifies the impressions of the multitude when they are led astray by haste, by ignorance, or by the pursuit of false ornament, that at length bestows the meed of lasting renown.

Let it not be said, in opposition to this recommendation of the study of the rules of criticism, that certain writings, which have grossly violated their precepts, have nevertheless descended with high applause to future times, and are still read with unabating avidity. This may be true: and indeed, in the deserved popularity of the plays of Shakspeare, we have in our vernacular language a most striking case in point. But it has been justly observed, that these plays "have gained the public admiration, not by their being irregular, not by their transgressions of the rules of art, but in spite of such transgressions. They possess other beauties, which are conformable to just rules; and the force of these beauties has been so great as to overpower all censure, and to give the public a degree of satisfaction superior to the disgust arising from their blemishes." If the mixed metaphors, the low puns, and far-fetched allusions, which abound in Shakspeare's writings, had not been redeemed by such truly empassioned and high-wrought scenes as the closet interview between Hamlet and his mother, or the terrific phantom of the "air-drawn dagger," his works would have been left to moulder in the dust of public libraries, or would have been doomed by their rare occurrence to acquire a factitious value, by being stored up on the shelves of the curious collector.

If rightly considered, indeed, the instance of Shakspeare eminently evinces the necessity of an acquaintance with the rules of criticism, to the attainment of perfection in the art of composition. Had that child of fancy possessed taste in the same degree with which he was gifted with genius, he would have reduced the plots of his dramas to order; he would have pruned the luxuriance of his style; he would have discarded all meretricious ornaments, and would have cleared away those incongruities which abound in his writings, like noisome and disgusting weeds amidst a wilderness of sweets. Thus would he have risen from the rank of the darling of a nation to that of the poet of the civilized world. Whilst it must be confessed, that the most approved system of rules cannot kindle the fire of genius, or stimulate the activity of the imagination; yet it is equally true, that a knowledge of the laws of criticism is absolutely necessary to preserve a writer from committing egregious faults. Justly has it been observed by Horace, that the author who wishes to excel, *"Cum tabulis animum censoris sumet honesti."*

And for the direction of his judgment he can take no guide so sure, as those principles which have been sanctioned, by the approbation of enlightened ages, as the laws of just taste.

To enter into a regular detail of the objects embraced in a system of the rules of criticism, would be inconsistent with the design of the present work; but a short enumeration of the principal writers on the subject may not be altogether useless.

Aristotle is the great father of the critic art; and his treatises on Poetry and Rhetoric exhibit the fundamental principles on which that art is built. His style is compressed and abrupt; and his language is so devoid of the attractions of ornament, that, as a celebrated French scholar has justly observed, "in order to be able to read his works, a person must be fully bent upon obtaining instruction The dryness of his manner, however, is amply compensated by the perspicuity of his arrangement, the ingenuity of his disquisitions, and the profundity of his thoughts. Many useful observations on the general principles of composition are to be found in Cicero's treatises on the subject of oratory; and the Institutes of Quintilian also contain a rich mine of criticism. Much useful instruction may also be gained from the critical dissertations, which occasionally occur in the Satires and Epistles of Horace, and especially in his Epistle to the Pises on the art of Poetry. Longinus's work on the Sublime, though occasionally deficient in precision, is written with singular energy and spirit, and evinces a feeling mind, the emotions of which are regulated by exquisite taste.

The spirit of Horace was infused into Boileau, who, of all the French critics, was the most delicate in judgment; though much praise is also due to the critical works of Rapin, Bossu, and Bonhours. Rollin's treatise on the Belles Letters is a book of great value; and in our own days, the seeds of good taste have been widely scattered through the continent of Europe by the publication of La Harpe's Lycée.

The English language is rich in critical disquisitions, of which many excellent ones are to be found in the prefaces prefixed by Dryden to his multifarious productions. In his "Advice to an Author," Lord Shaftesbury has well asserted the dignity and importance of the art of criticism, and has detailed, in measured and elevated style, the principles of fine writing, which he had collected from the study of the Ancients. Pope's Essay on Criticism is too well known to stand in need of commendation; and the critique of Addison on the Paradise Lost is perused with interest by every Englishman of cultivated mind. At a more modern period, Mr. Harris, in his Philological Enquiries, has exhibited the substance of the writings of Aristotle; and Dr. Johnson, in his observations upon the works of the English Poets, has, notwithstanding the occasional aberrations into which he was betrayed by prejudice, given decisive proofs of a superior intellect. Ward's Treatise on Oratory, Priestley's Lectures on Oratory and Criticism, and Kaimes's Elements of Criticism, respectively contain systems of considerable merit. But the standard book on this subject is Blair's Lectures on Belles Lettres. Blair was a scholar and a philosopher; and his works only want a portion of the spirit of enthusiasm, to render them a complete model of didactic composition.

Criticism, *verbal*, is the art of settling, with probability, or, as a practitioner of that art would say, with precision, the text of the ancient Greek and Latin classic authors. This species of criticism takes its rise from the state in which the writings of those authors have come down to modern times. The art of printing being unknown at the period when they were composed, they were presented by transcription; from which circumstance they were evidently liable to be deformed by errors, and those errors must necessarily have been greatly multiplied by the lapse of ages. A passage in Aulus Gellius, which states that a reading in Cicero was justified by a copy made by his learned freedman Tyro, and a reading in Virgil's Georgics by a book which had formerly belonged to Virgil's family, at once demonstrates the early corruption of works of taste, and the early stress which was laid upon the authority of ancient manuscripts.

In the long night of ignorance, which succeeded the subversion of the Roman empire by the barbarians of the north, the classic authors were forgotten, and their works were neglected, and left to perish. But when literature revived in Italy, they became the objects of the most eager and diligent research. In the fifteenth and sixteenth centuries, the discovery of an ancient Greek or Latin manuscript was celebrated as an event of the greatest importance, and gave occasion to the most enthusiastic exultation. The difficulty of perusal, however, which was experienced in some instances, called into exercise the skill of the most practised scholars; and the real or supposed corruptions of the text, in most of the *codices*, which were at this period brought to light, afforded a copious subject for the acumen of the ablest critics. The letters of Ambrogio Traversari, of Leonardo Aretivo, and of Poggio Bracciolini, abundantly prove, that emendation was one of the first duties of the fortunate man of letters, who had rescued a classic author from oblivion. There is too much fear that this duty was not in every instance discharged with the requisite ability and discretion; —but, however this may be, the copies, which were multiplied by the hands or under the inspection of the revivers of literature, are at this day almost the sole authority, to which the learned can refer, in settling the text of the compositions of the most distinguished writers of Greece and Rome.

The invention of the art of printing was, as might naturally be expected, soon employed in multiplying copies of the ancient classics, the impressions of which were carefully superintended by the great luminaries of the age. Among these shine, with pre-eminent lustre, Politian, Landino, and Marcus Musurus, who, by the collation of MSS. and the application of temperate conjecture, endeavoured to exhibit the works of the classic writers in their purity. But of all these friends and promoters of good literature, the place of most distinguished honour is due to Aldus Manutius. This illustrious scholar, by his fame, and by his munificence, attracted to Venice, the place of his residence, the ornaments of the literary world, by whose assistance, in the examination of MSS. and in the other duties of an editor, he was enabled to publish copious editions of almost every Greek and Latin classic, which may be yet regarded as unrivalled in elegance and correctness. From this time, to the present day, may be traced a succession of scholars, who have endeavoured, with various success, to evince their learning and their acumen by their emendations of the text of the ancient classics; and whosoever has studied with due attention the lucubrations of a Heyne, or a Porson, will readily acknowledge, that even at this late period, a rich harvest may be gathered in the field of verbal criticism.

It is much to be lamented, however, that the art of verbal criticism has been brought into discredit by the rashness of certain editors of the ancient classics, who, inspired with the rage of innovation, have despised the authority of manuscripts, and have deformed the finest models of antiquity, by the introduction of their own crude fancies, under the form of conjectural emendations. It has been well observed, that, by such critics as these, "authors have been taken in hand, like anatomical subjects, only to display the skill and abilities of the artist; so that the end of many an edition seems often to have been no more, than to exhibit the great sagacity and erudition of an editor. The joy of the task was the honour of amending, while corruptions were sought with a more than common attention, as each of those afforded a testimony to the editor and his art." The gross impropriety of this pruriency of alteration is well displayed in the Virgilius Restauratus, which is usually printed with the works of Pope, and which, though expressly intended to ridicule the proud presumption of Bently, may be regarded as an anticipated specimen of the lucubrations of certain critics, who have flourished in more modern times.

Nearly allied to verbal criticism is Illustrative Criticism, or the art of explaining the ancient classic authors. This art gave rise to the tribe of scholiasts and commentators. Of these, some restricted themselves to the illustration of particular authors, and others exercised their talents upon a selection of passages from a variety of writers. Among the former may be mentioned Didymus and Eustathius, who bestowed their labours upon Homer; and among the latter may be classed Politian, whose miscellanea contains a copious fund of erudition. The modern writers of these two classes, under the denomination of editors, commentators, and translators, are in a manner innumerable.

CROCODILE. See Lacerta.

Crocodile, *fossil*, one of the greatest curiosities in the fossil world which the late ages have produced. It is the skeleton of a large crocodile, almost entire, found at a great depth under ground, bedded in stone. This was in the possession of Linkius, who wrote many pieces in natural history, and particularly an accurate description of this curious fossil. It was found in the side of a large mountain in the midland part of Germany, and in a stratum of black fossil stone, somewhat like our common slate, but of a coarser texture, the same with that in which the fossil fishes in many parts of the world are found. This skeleton had the back and ribs very plain, and was of a much deeper black than the rest of the stone; as is also the case in the fossil fishes which are preserved in this manner; the part of the stone where the head lay was not found, this being broken off just at the shoulders, but that irregularly, so that in one place a part of the back of the head was visible in its natural form. The two shoulder bones were very fair, and three of the feet were well preserved: the legs were of their natural shape and size: and the feet preserved even to the extremities of the five toes of each.

CROCUS, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla six-parted, equal; stigmas convolute. There are two species. with many varieties, *viz.* C. officinalis, officinal crocus, or saffron, and C. vernus, or spring crocus.

CROISADE, Crusade, or Cruzado, a name given to the expeditions of the Christains against the Infidels for the conquest of Palestine; so called, because those who engaged in the undertaking wore a cross on their clothes, and bore one on their standard. This expedition was also called the holy war, to which people flocked in great numbers out of pure devotion, the pope's bulls and the preaching of the priests of those days making it a point of conscience. The several nations engaged in the holy war were distinguished by the different colours of their crosses; the English wore white, the French red, the Flemish green, the Germans black, and the Italians yellow. From this enterprise several orders of knighthood took their rise. They reckon eight croisades for the conquest of the Holy Land: the first began in the year 1095, at the solicitation of the Greek Emperor and the Patriarch of Jerusalem.

CROMLECH, in British antiquities, are huge broad flat stones, raised upon other stones set up on end for that purpose. They are common in Anglesea. They are supposed by some persons to have been tombs, though others imagine that they were altars for religious services.

CROSIER, or Crozier, a shepherd's crook; a symbol of pastoral authority, consisting of a gold or silver staff, crooked at the top, carried occasionally before bishops and abbots, and held in the hand when they give the solemn benedictions. The custom of bearing a pastoral staff before bishops is very ancient. Regular abbots are allowed to officiate with a mitre and crosier. Among the Greeks none but a patriarch had a right to the crosier.

Crosier, in astronomy, four stars in the southern hemisphere in the form of a cross, serving those who sail in south latitudes to find the antarctic pole.

CROSS, in heraldry, is defined, by Guillim, an ordinary composed of fourfold lines, whereof two are perpendicular, and the other two transverse; for so we must conceive of them, though they are not drawn throughout, but meet by couples in four right angles, near about the fesse-point of the escutcheon. The content of a cross is not always the same; for when it is not charged, it has only the fifth part of the field: but if it be charged, then it must contain the third part thereof. This bearing was bestowed on such as had performed, or, at least, undertaken, some service for Christ and the Christain profession: and is therefore held by several authors the most honourable charge in all heraldry. What brought it into such frequent use was the ancient expeditions into the Holy Land, the cross being the ensigns of that war.

CROSSOSTYLIS, in botany, a genus of the Monadelphia Polyandria class and order. Essential character: calyx simple, four-parted; corolla four-petalled; nectary twenty, corpuscles between the filaments; stigmas four-jagged. There is but one species, *viz.* C. biflora, a native of the Society Isles.

CROSSELET, a little or diminutive cross used in heraldry, where the shield is frequently seen covered with crosselets; also fesses and other honourable ordinaries, charged or accompanied with crosselets. Crosses frequently terminate in crosselets.

CROTALARIA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ, Jussieu. Essential character: legume turgid, inflated, pedicelled filaments connate, with a fissure on the back. There are thirty-two species, all natives of warm climates.

CROUTE, *sour croute.* As this preparation of cabbage has been found of sovereign efficacy as a preservative in long voyages from the sea-scurvy, it may not be unacceptable to give a concise account of the process for making it, according to the information communicated by an ingenious German gentleman. The soundest and most solid cabbages are selected for this use, and cut very small, commonly with an instrument made for this purpose, not unlike the plane which is used in this country for slicing cucumbers. A knife is used when the preparation is made with great nicety. The cabbage thus minced is put into a barrel in layers, hand high, and over each is strewed a handful of salt and carraway seeds; in this manner it is rammed down with a rammer, *stratum super stratum,* till the barrel be full; when a cover is put over it and pressed down with a heavy weight. After standing some time in this state it begins to ferment; and it is not till the fermentation has entirely subsided that the head is fitted to it, and the barrel is finally shut up and preserved for use.

CROTALUS, the *rattlesnake,* in natural history, a genus of Amphibia, of the order of Serpentes. Generic character: scuta on the abdomen; scuta and scales beneath the tail; rattle at the end of the tail. There are five species, all natives of America. The C. horridus, or banded rattle-snake, inhabits North America, and is from three to five feet in length, of a yellowish brown colour. The rattle is fixed at the end of the tail, and is composed of dry and hollow bones, nearly of the same form and size. The tip of every bone superior to the two last, passes within the two immediately beneath it, thus producing a firm coherence, and also an increase of noise, as during the sounding of the rattle each bone strikes against two others. The object of this curious instrument has not a little perplexed naturalists, and some have considered it designed to warn other animals of their danger, while others have regarded it as intended, indeed, to sound the alarm of peril; but such an alarm as is followed by consternation, under which the affrighted victim experiences a prostration of all its faculties, and is bereaved at once of intelligence and motion. These animals were supposed to possess the power of charming others, or of operating upon them by some ineffable power, to induce them to drop from their stations into the very mouth of the destroyer. This opinion, long prevailing, but now exploded, not unnaturally arose from the circumstance just mentioned. The appearance of the rattle-snake to these creatures, who instantly recognise it for their mortal enemy, and the sound of that instrument, which is as it were the signal of execution, impresses them occasionally with a degree of terror, which withers all the energies of their frame. These animals have been known to enter houses in America, and even to insinuate themselves into beds. They move with great slowness; and, with respect to all other animals but those which they subsist on, never inflict any injury but in retaliation, wounding on provocation, and not in aggression. Their bite is not only poisonous, but rapidly fatal, and has been known to kill a man in a few minutes. When the bite is received in a fleshy part, the Indians apply the knife with all possible speed. In slight cases they have recourse to various roots: and in some cases they suck the wound: but when a principal vein or artery is penetrated with the animal's full strength, they abandon their case as hopeless, and apply no remedy whatever. In the territories of America but thinly inhabited, rattle snakes are abundant; but in others they are almost exterminated. They are seldom seen farther north than Lake Champlain, or south than Brazil. They are extremely fond of frogs. In summer they are generally seen in pairs; in winter they are gregarious, and secure themselves from the rigours of the season by withdrawing deeply in the earth, whence a fine day sometimes induces them to appear, but in a state of great weakness, in which they may be attacked without danger, and in which a single person has sometimes destroyed with a stick several score in a single morning. The largest ever seen by Catesby, who, while in Carolina, paid particular attention to them, was about eight feet long, and nearly nine pounds in weight. It is mentioned by Dr. Shaw, from Bouvais, that this snake, which is viviparous, possesses the mode of securing its young ascribed to the European viper, of swallowing them during the period of danger, and disgorging them after it is over. Mr. Bouvais having inadvertently molested a rattlesnake in his walk, saw the animal instantly coil itself up, and distend its jaws, into which five young ones rushed with great rapidity. He watched it for about a quarter of an hour, at the end of which time he saw them thrown up. To remove the possibility of deception, he then re-approached, and saw the parent open the same asylum, and the offspring avail themselves of it with the same celerity; after which the snake moved beyond his observation. From experiments made on various dogs by the bite of this snake, one was killed in a quarter of a minute; another bitten afterwards, in two hours, and a third, bitten last, in above three.

It was a matter of natural curiosity to ascertain whether the animal would destroy itself by its bite, and being provoked by some means to inflict on itself a wound, it expired in about twelve minutes afterwards.

CROTCHES, in ship-building very crooked timbers in the hold or bread-room from the mizen-step aft, fayed across the keelson, to strengthen the ship in the wake of the half timbers.

CROTCHETS, in music, one of the notes or characters of time, marked thus ♩, equal to a half minim, and double of a quaver.

Crotchet, in midwifery, an instrument used in extracting the fœtus.

Crotchet, in printing, a sort of straight or curved line, always turned up at each extreme; serving to link such articles as are to be read together; and used in analytical tables, &c. for facilitating the divisions and subdivisions of any subject.

Crotchets are also marks or characters, serving to inclose a word or sentence, which is distinguished from the rest, being generally in this form [] or this ().

CROTON, in botany, a genus of the Monoecia Monadelphia class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: male, calyx cylindric, five-toothed: corolla five-petalled: stamens ten to fifteen: female, calyx many-leaved; corolla none; styles three, bifid; capsule three-celled; seed one. There are 53 species. The plants of this numerous genus are herbaceous, or more frequently shrubby. Leaves accompanied with stipules; generally alternate, seldom opposite: flowers axillary, or terminating usually in spikes, but sometimes in corymbs: the spikes, are mostly monaecous. These plants are chiefly inhabitants of the East and West Indies.

CROTOPHAGI, the *ani*, in natural history, a genus of birds of the order Picæ. Generic character: bill compressed, semi-oval, arched end cultrated at the top; nostrils round; tongue flat, pointed at the end; tail of ten feathers; toes two before and two behind. These are four species; the principal of which is the C. ani, or the lesser ani. These are found in many parts of the West Indies and South America, and are about the size of a blackbird. A curious peculiarity connected with the history of these birds is, that many females will unite in the construction of one nest, where each will deposit a certain number of eggs, and contribute her part to the general process of incubation. Each will also contribute, after the young are hatched, to provide, as far as her means extend, for the whole family. As soon as she has laid her eggs, the female has been remarked invariably to cover them with leaves, never failing also to do the same previously to her short absence in quest of food. In the warm climate of the West Indies this singularity is not easily accounted for. The food of these birds varies with the season, and consists of grain, worms, and insects, as well as fruit. They appear in flocks of about twenty, are rank and unpalatable as food, and by a chattering and screaming noise, which they utter under every impression of danger, often interrupt and defeat the hopes of the sportsman, by alarming valuable game beyond the reach of his efforts.

CROW. See Corvus.

Crow, in mechanics, a kind of iron-lever with a claw at one end, and a sharp point at the other: used for heaving or purchasing great weights.

Crow's *feet*, in the military art, machines of iron, having four points, each about three or four inches long, so made, that whatever way they fall there is still a point up: they are thrown upon breaches, or in passes where the enemy's calvary are to march, proving very troublesome by running into the horses' feet and laming them.

CROWEA, in botany, a genus of the Decandria Monogynia class and order. Calyx five parted; petals five, sessile; stamina flat, subulate, connected by interwoven hairs; antheræ growing longitudinally from the inner part of the filaments; capsules five, united; seeds coated. One species; *viz*. the saligna, a native of Australasia.

CROWN, an ornament worn on the head by kings, sovereign princes, and noblemen, as a mark of their dignity.

Crown, in heraldry, is used for the representation of that ornament in the mantling of an armory, to express the dignity of persons. See Heraldry.

Crown, in commerce, a general name for coins, both foreign and domestic, which are of the value of five shillings sterling. See Coin.

Crown, in architecture, denotes the uppermost member of the cornice, called also corona.

Crown, in astronomy, a name given to two constellations, the one called borealis, the other meridionalis. See Corona.

Crown, in geometry, is a plane ring included between two concentric perimeters, and is generated by the motion of some part of a right line round a centre, the said moving part not being contiguous to the centre.

The area of a crown will be had by multiplying its breadth by the length of the middle periphery; for a series of terms in arithmetic progression being $n \times \frac{a+w}{2}$, that is, the sum of the first and last multiplied by half the number of terms, the middle element must be $\frac{a+w}{2}$; wherefore that multiplied by the breadth, or sum of all the two terms, will give the crown.

Crown *of colours*, certain coloured rings, which, like halos, appear about the body of the sun or moon, but of the colours of the rainbow, and at a less distance than the common halos. These crowns Sir Isaac Newton shews to be made by the sun's shining in a fair day, or the moon in a clear night, through a thin cloud of globules of water or hail, all of the same bigness. And according as the globules are bigger or lesser, the diameter of these crowns will be larger or smaller; and the more equal these globules are to one another, the more crowns of colours will appear, and the colours will be the more lively.

Crown *office*. The court of king's bench is divided into the plea side, and the crown side. In the plea side it takes cognizance of civil causes, in the crown side it takes cognizance of criminal causes, and is thereupon called the crown office. In the crown office are exhibited informations in the name of the king, of which there are two kinds: 1. Those which are truly and properly the king's own suits, and filed *ex officio* by his own immediate officer, the attorney-general, 2. Those in which, though the king is the nominal prosecutor, yet it is at the relation of some private person, or common informer: and these are filed by the king's coroner and attorney, usually called the master of the crown office.

Crown *wheel of a watch*, the upper wheel next the balance, which by its motion drives the balance, and in royal pendulums is called the swing-wheel.

Crown *work*, in fortification, an outwork, having a very large gorge, generally the length of the curtain of the place, and two long sides terminating towards the field in two demi-bastions, each of which is joined by a particular curtain to a whole bastion, which is the head of the work. The crown work is intended to inclose a rising ground, or to cover the head of a retrenchment.

CRUCIANELLA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Stellatæ. Rubiaceæ, Jussieu. Essential character: calyx two leaved; corolla one-petalled, funnel-form, with a filiform tube and tailed border; seeds two, linear. There are nine species. These are herbaceous plants; leaves stellate, from four to six in a whorl, often linear; flowers bracted, in close terminating spikes, sometimes in corymbs. Natives of warm climates.

CRUCIBLE, a chemical vessel made of earth, and so tempered and baked as to endure the greatest fire. See Laboratory.

CRUCIFORM, in botany, a term applied to cross-shaped flowers, or flowers consisting of four petals which spread at the top in form of a cross. Of this kind is the stock-gillyflower, &c.

CRUDIA, in botany, a genus of the Decandria Monogynia class and order, and found in Wildenow under this name, now referred to Cyclas, which see.

CRUIZERS, in naval affairs, vessels, as the name imports, employed on a cruize. They are in truth small men of war, made use of in the channel and elsewhere, to secure our merchants' ships and vessels from the enemy's small frigates and privateers. They are generally formed for sailing well, and are commonly well manned. The safety of the trade in the channel requires keeping out such ships at sea.

CRUSTACEOUS animals, in natural history, those covered with shells, consisting of several pieces or scales, as those of crabs, lobsters, &c. These are generally softer than the shells of the testaceous kind, which consist of but few pieces or valves, and commonly thicker and stronger than the former; such as those of the oyster, scallop, cockle. See CANCER.

CRUSTS, in chemistry. By crusts we understand those bony coverings, of which the whole external surface of crabs, lobsters, and other similar sea animals, are composed. Mr. Hatchett found them composed of three ingredients: 1. A cartilaginous substance possessing the properties of coagulated albumen. 2. Carbonate of lime. 3. Phosphate of lime. By the presence of this last substance they are essentially distinguished from shells, and by the great excess of carbonate of lime above the phosphate they are equally distinguished from bones. Thus the crusts lie intermediate between bones and shells, partaking of the properties and constitution of each. The shells of the eggs of fowls must be referred likewise to the class of crusts, since they contain both phosphate and carbonate of lime. The animal cement in them, however, is much smaller in quantity. From experiments it is extremely probable that the shells of snails are composed likewise of the same ingredients, phosphate of lime having been detected in them by these chemists.

Mr. Hatchett examined the crusts of crabs, lobsters, prawns, and crayfish. When immersed in diluted nitric acids, these crusts effervesced a little, and gradually assumed the form of a yellowish-white soft elastic cartilage, retaining the form of the crust. The solution yielded a precipitate to acetate of lead, and ammonia threw down phosphate of lime. Carbonate of ammonia threw down a much more copious precipitate of carbonate of lime.

On examining the crust which covers different species of echini, Mr. Hatchett found it to correspond with the other crusts in its composition. Some species of starfish yieldeth phosphate of lime, others none: hence the covering of that genus of animals seems to be intermediate between shell and crust.

CRUZITA, in botany, a genus of the Tetrandria Digynia class and order. Atriplices, Jussieu. Essential character: inner calyx four-leaved; outer three-leaved; corolla none; seeds one. One species, *viz.* C. hispanica, a native of South America.

CRYPSIS, in botany, a genus of the Diandria Digynia class and order. Natural order of Grasses. Essential character: calyx glume two-valved, one-flowered; corolla glume two-valved, awnless. One species, *viz.* C. aculeata, prickly crypsis. This grass is a native of the South of Europe and Siberia; it is common also in Barbary.

CRYPTOCEPHALUS, in natural history, a genus of insects of the Coleoptera order. Characterised by filiform antennæ; four feelers; thorax margined; shells immarginate; body somewhat cylindrical. This is a very extensive genus, nearly 300 species have been enumerated. They are divided into two sections. A. feelers equal, filiform; B. feelers unequal; fore-ones hatchet-shaped. A. is subdivided into *a*, jaw, one-toothed; 1. lip entire, cylindrical; 2. lip entire, palpigerous at the tip; 3. lip bifid; body oblong; *b*, jaw bifid, body oblong. In B. there are some of the genera that have horny lips; others with lip membranaceous, entire; and some whose lip is membranaceous, widely emarginate.

CRYPTOGAMIA, in botany, the name of the twenty-fourth class of Linnæus's Sexual Method, consisting of plants, in which the parts of fructification are, either from their minuteness or their situation, entirely concealed, or imperfectly visible.

CRYPTOSTOMUM, in botany, a genus of the Pentandria Monogynia class and order. Essential character: calyx ventricose, five-cleft; tube of the corolla inserted into the throat of the calyx, border five-cleft; nectary five-toothed, closing the mouth of the corolla; berry; seed scarred. There is but one species, *viz.* C. Guianense, Guiana cryptostomum.

CRYSTALLINE *humour*, in anatomy, a thick, compact humour, in form of a flattish convex lens, situated in the middle of the eye, serving to make that refraction of the rays of light, necessary to make them meet in the retina, and form an image thereon, whereby vision may be performed. See EYE.

CRYSTALLIZATION. When the attraction of aggregation has been weakened, either by the application of heat, or of a chemical affinity, and is suffered to resume its force more slowly or equally, the particles are not united indiscriminately, but in uniting assume a particular arrangement; and thus form masses of regular figures, bounded by plain surfaces and determinate angles. When aggregation is exerted in this manner, and with this result, the operation is named crystallization, and the regularly figured masses are denominated crystals.

CRYSTALLIZATION.

Crystallization is of two kinds: first, as it takes place from the reduction of temperature in a body which has had fluidity communicated to it by the operation of heat; and, secondly, as it proceeds from the diminution of the solvent power of a fluid, which has communicated fluidity to a solid by having combined with it.

Of the first kind of crystallization, water affords an example in passing into ice by a reduction of its temperature. At first long and slender spiculæ form in the fluid, and from these others shoot out at a certain angle, and this continues till the interstices are filled with the crystals, and the whole becomes a solid transparent mass. We have also examples of it in the metals, which, when melted and cooled slowly, assume symmetrical forms. Some inflammables, as sulphur, crystallize in a similar way.

Of the second kind of crystallization, the principal examples are derived from the order of salts, and a few other solids, soluble in water; and with regard to this, several facts of importance require to be stated.

The solution of a solid in a fluid is in almost every case increased by heat, which weakens cohesion: hence a larger quantity of the solid is kept in solution at a high than a low temperature. If, therefore, we prepare a solution of salt in hot water, the solution being saturated, or the fluid having dissolved as much of the salt as it can do, on allowing it to cool, the portion of the salt which the heat enabled the fluid to dissolve will separate; and unless the cooling of the solution has been very rapid, the particles of the solid, in approaching to each other, will pass into those regular arrangements which constitute crystals.

The same result will be obtained by withdrawing parts of the fluid in which the solid is dissolved. If this be done slowly, or by spontaneous evaporation, the particles will obey the law of attraction, which unites them in regular forms; the crystals are in this way formed frequently more regular, and of a larger size than by the former method of reducing the temperature of the solution: some can be crystallized only in this method.

In both cases the fluid in which the crystals form is still a saturated solution of the solid, and by a farther evaporation, joined sometimes with subsequent cooling, will again crystallize.

In general it holds true, that the slower the formation of a crystal, the more perfect is its symmetrical arrangement; it is also larger, harder, and more transparent: whereas, when the process is too rapid, or is disturbed by agitation, or other causes, the arrangement is less regular and the form incomplete. Hence the crystals formed by nature are so much more perfect than those produced by artificial processes.

Crystallization is promoted by affording a nucleus, or solid point, at which it may commence, and still more so, if a crystal be introduced into the solution; crystallization immediately commences from it, if the solution be a saturated one, and it is even capable of causing part of the solid to be separated, if the temperature at which it takes place could have retained it in solution. Even the regularity of the figure of this crystal seems to have an effect in rendering the crystallization more or less regular; and on this Le Blank has founded a method of obtaining large and perfect crystals. It consists in selecting very regular crystals of a salt that have been newly formed, and putting them into a saturated solution of the same salt. They increase in size: and as the side which is in contact with the vessel receives no increase, they are to be turned daily, to preserve their regularity. After some time, the largest and most regular of these crystals are to be selected, and the same process repeated on them; and thus crystals much larger and more regular than are usually formed in a solution may be obtained.

The access of the air has an important influence on this process. If a saturated solution of salt, when hot, be put into a vessel from which the air is excluded, it does not crystallize even when cold. But if the air be admitted, the crystallization immediately commences, and proceeds with rapidity. It has been shewn by Dr. Higgins, that any pressure, equivalent to that of the atmosphere, as the pressure of a column of mercury, has the same effect.

During crystallization a quantity of heat is rendered sensible. In many cases the volume of the substance crystallizing is enlarged, as in the example of water, of iron, and of the greater number of salts; but in others the volume is diminished. Quicksilver, in congealing, contracts about one twenty-third of its whole bulk, yet it exhibits the crystalline texture; and when the congelation is partial, the crystalline figure can even be discovered.

Crystals deposited from water always contain a part of it, which is retained by the affinity of the solid, and has passed with it into the concrete form. It is termed water of crystallization. Its quantity is very various; sometimes it equals or exceeds the weight of the solid, and sometimes it amounts only to a few parts in the hundred. Much of the cold produced during the solution of salts in water is owing to this water of crystallization passing into the fluid state: hence crystallized salts generally produce more cold than when they are uncrystallized. If the water of crystallization be expelled from a crystal, it loses its transparency, and at length its form. Crystals which part with their water of crystallization when exposed to the atmosphere are said to effloresce, and to deliquesce when they attract water and become humid.

Some substances have so strong an affinity for the fluids in which they are dissolved, or so little tendency for cohesion, that they do not crystallize. In some cases their crystallization may be effected by adding to the solution a substance exerting an affinity to the fluid, and of course weakening its affinity for the solid it dissolved.

As different bodies require very different quantities of water for their solution, it is possible, when two such bodies are dissolved in one fluid, to obtain them separate by crystallization, the one which is least soluble, or most disposed to crystallize, first passing into the solid form; and by farther evaporation the other is obtained. A fact on this subject, somewhat singular, is noticed by Mr. Kirwan. If into a saturated solution of two salts in water, a crystal of either be put, that salt crystallizes in preference to the other.

By crystallization, also, salts, the solubility of which is unequally promoted by heat, may be obtained separately from the same solution. Thus, if one salt be much more soluble in hot than in cold water, and another be equally soluble, or nearly so, at any temperature, on evaporating the solution sufficiently, the latter salt will crystallize while the solution is hot; on cooling, the other will shoot into crystals; and by alternate evaporation and cooling, the two may be obtained uncombined, though generally with a little intermixture of each other.

Sometimes, however, when two salts are in solution in the same fluid, and have even different tendencies to crystallization, their mutual affinity leads them to crystallize in one mass, and even to assume a form different from that in which separately they would have crystallized.

In other cases this mutual affinity, between substances in solution, is sufficient to resist their crystallization, or to render it more difficult.

Crystallization sometimes takes place, when bodies in the gaseous form become subject to the attraction of aggregation, as in sublimates; and even solids separated from a liquid by chemical action, in some instances at the moment of their separation, assume a crystallized form.

Every substance in crystallizing is disposed to assume a particular figure. Thus, sea-salt crystallizes in the form of a cube; nitre in that of a hexaedral prism; sugar in that of a four or six-sided prism, with triedral terminations. The crystalline figure in any substance, however, is not invariable, but may be altered by circumstances affecting the crystallization: and we find the same substance crystallized under a variety of forms. Sea-salt crystallizes, not only in cubes, but also in octaedrons; and carbonate of lime is found in nature in the form of an hexaedral prism, an hexaedral and a triedral pyramid.

The effect of light upon the act of crystallization is very remarkable. It is found in general, that the crystals of salts are larger and better formed in the dark than when light falls upon the solution. But this relates only to such crystals as are formed in the fluid. In many, and indeed most salts, there are crystals formed, during the spontaneous evaporation of the solution, which rise above the surface into the air, either in contact with the sides of the vessel, or supported by their own structure. This phenomenon is very striking and curious, and it appears to have been well determined, be experiments of Chaptal and others, that it does not take place without the presence of light. See Vegetation of Salts.

CRYSTALLOGRAPHY. Hauy has succeeded in developing the theory of crystals, so far as to shew, that in every crystallized substance, whatever may be the difference of figure which may arise from modifying circumstances, there is in all its crystals a primitive form, the nucleus, as it were, of the crystal, invariable in each substance, and by various modifications, which he points out, giving rise to the numerous secondary or actually existing forms.

The fact which led to these views is, that crystals can be mechanically divided only in certain directions, so as to afford smooth surfaces, a fact long known by those who work on the gems. Suppose we have a crystal of calcareous spar, a regular hexaedral prism, represented in plate crystallography, fig. 5 and 6, if we endeavour to divide it parallel to the edges which form the outlines of the basis of the prism, we shall find that three of these edges, taken alternately, are the upper extremity of the edges *l f, d c, b m,* readily yield to this division by a knife struck in the proper direction; but that the other three, those which are intermediate, *f d, c b,* and *m l,* cannot be divided in a similar manner: and if broken by a greater force, the fracture, instead of being polished like the others, is rugged and uneven. If we repeat the experiments at the under extremity of the prism, we shall find here, also, that segments of three only of the edges can be detached; but these edges, instead of being the corresponding one with those divisable at the upper extremity, that is, *l f, c d, b m,* are the intermediate ones *f d, c d, b m,* are the intermediate ones *d f, c b,* and *m l.*

The six divisions compose so many trapeziums. Three of these are represented in fig. 6. namely, the two which cut off the edges, *l f, c d,* represented by the dotted lines *p p, o o* and *a a, k k,* and that which cuts off the inferior edge *d f,* and which is marked by the dotted lines *n n, i i.*

Each of these trapeziums will have a smoothness and lustre, from which it can be perceived that it coincides with one of the natural joinings, the assemblage of which form the prism. The prism cannot be divided in any other directions than these. But if the division be continued parallel to the first segments, it necessarily happens, that on one hand the surfaces of the bases of the prism become narrower, and that on the other hand the heights of the sides diminish: and at the point at which, continuing the section, the bases disappear, the prism will be changed into a dodecaedron, with pentagonal faces (fig. 7); six of which, *o o i* O *e*, *o* I *k i i,* &c. are the remains of the sides of the prism, and the other six, E A I *o o*, O A K *i i,* &c. are the immediate results of the mechanical division.

In this, and the two succeeding figures, the hexaedral prism, which circumscribes the solid extracted from it in the division, is still represented, to shew better the progress of the operation.

Beyond this point, the planes at the extremity preserve their figure and dimensions, while the lateral planes continue to diminish in height, until the points *o, k* of the pentagon *o* I *k i i* coinciding with the points *i, i,* and also the other points similarly situated having a like coincidence, each pentagon is reduced to a simple triangle, as is represented in fig. 8.

Lastly, by continuing the section the triangles are made to disappear, so that there remains no vestige of the surface of the original prism; but in place of it we have the obtuse rhomboid E A I O (fig. 9), which is therefore the nucleus, or primitive form.

This discovery of the method of dividing a crystal was made by Hauy, in examining a crystal of calcareous spar which had been detached from a group of which it formed a part. He observed that the fracture had happened at one of the edges of the base of the prism, and that its surface was perfectly smooth and regular. Attempting to detach a segment in a similar direction from the contiguous edge, he could not succeed, but the one next to it was easily divided; and proceeding in this manner, he was able to effect the mechanical division of the crystal in the manner already explained. Struck with the important result of the experiment, he applied the same method to other crystalline forms of the same substance, and obtained from them the same result; the crystal, whatever was its figure, being by this mechanical division converted into a rhomb. Thus, in the dodecaedron, composed of two six-sided pyramids joined by the base, the primitive form may be obtained at once by making a first section, on the edges E O, O I, fig. 10; a second, on the edges I K, G K; a third, on G H, E H; a fourth, on O I, I K; a fifth, on G K, G H; and lastly, a sixth, on E H, E O; and the result is, that these edges become the same with the lateral edges of the primitive form, as may be perceived from mere inspection of fig. 11, which represents this primitive form described in the dodecaedron. He then applied it to other crystalline substances, and found, that from these also, by discovering the joints by which the laminæ composing the crystals were united, a certain primitive form might be extracted. That of fluor spar is an octaedron; and that of the heavy spar, a prism with rhomboidal bases; of corundum, a rhomboid somewhat acute; of beryl, a hexaedral prism; and of the elba iron-ore, a cube. Each of these forms is constant with regard to the species, and is that from which all the forms of the varieties, often extremely numerous, are derived. The latter are denominated, by Hauy, secondary forms. Sometimes, though rarely, the primitive and secondary forms are the same.

It is not every crystallized substance, however, that admits of this mechanical analysis. But with regard to those that have hitherto refused it, Hauy has remarked, that their surface striated in a certain direction, or the relation subsisting among the different secondary forms of the same substance, afford indications which lead to the determination, with at least much probability, of their primitive forms.

Such is the process, by which Hauy establishes what he names the "Primitive Form of Crystals," and which he defines, "A solid of a constant form, inserted symmetrically in all the crystals of the same species, and the faces of which observe the directions of the layers which compose these crystals." The primitive forms hitherto observed are reducible to six; the parallelopipedon, which includes the cube; the rhomb, and all the solids which are terminated by six faces parallel two and two; the tetraedron; the octaedron; the regular hexaedral prism; the dodecaedron, with equal and similar rhomboidal planes; and the dodecaedron with triangular planes.

Hauy carries the division of crystals still further, however, than the primitive forms. The solid which constitutes it is not the last term of the mechanical analysis; it may always be still further subdivided parallel to its different faces, and sometimes even in other directions. All the enveloping matter is equally divisible by sections parallel to the faces of the primitive forms: and the only limit to this possible division is that placed by the composition of the substance. The calcareous spar, to take it as an example, may be reduced to a particle, beyond which the division cannot be carried, without resolving it into its elements, lime and carbonic acid; or at least it may be reduced to a particle, beyond which, if its minuteness allowed us to operate upon it, it is demonstrable its figure would not change. To these last particles, the result of the mechanical analysis, Hauy gives the name of integrant particles, and their union constitutes the crystal. Their forms, so far as experiment has been carried, are three: the tetraedron, the simplest of the pyramids; the triangular prism, the simplest of prisms; and the parallelopipedon, the simplest of solids, which have their faces parallel, two and two. There is little doubt that it is between these that the attraction of cohesion is immediately exerted.

The primitive forms, and the figures of the integrant particles, being determined, it remains to complete the theory of the structure of crystals, to shew by what arrangements the secondary forms, in other words, the actually existing crystals, are produced.

The nucleus of the crystal is the symmetrical solid which constitutes its primitive form, arising from the union of the integrant particles, either by their faces or their edges; and the additional matter, which forms the crystal, consists of layers of these particles superadded to that nucleus, and arranged on its faces; and to account for the formation of the crystal under a figure different from that of its primitive form, these layers, as they recede from it, are supposed to decrease, in the space they occupy, from the regular abstraction of one or more ranges of the integrant particles. This decrease may take place in various modes; and according to these, different figures of crystallization will be produced.

Thus, to take the simplest example, let us suppose the primitive form is a cube; it is easy to conceive that on each of its six sides may be reared a series of decreasing layers, or laminæ, composed entirely of cubical particles, each layer diminishing on each of its edges by one row of the minute cubes of which it consists. The laminæ thus decreasing as they recede from the base on which they rest, until the apex consists of a single particle, it is obvious, that on each side of the cube a four-sided pyramid will be formed. Two of these are represented, (fig. 12.) A B C D, G B C G.

We shall thus have, then, six four-sided paramids, and of course 24 triangles, such as A B C, B C E, C E G, &c. But since the decrease is uniform on all the sides, as from the line B C to A, and from the same line to E, it must also be uniform from A to E; it is obvious, therefore, that the side A B C of the one pyramid will be found exactly in the same plane as the side B C E of the adjacent pyramid; so that the entire surface of these will be the rhomb A B E C. The case must be the same with all the others. The 24 triangles will therefore be reduced to twelve rhombs, and the figure will be a dodecaedron, very remote from the primitive form. Now a crystal of this figure, and having this primitive form, would be resolved into that form, merely by cutting off the six solid angles, by sections, in the direction of the small diagonals of the sides, which go to the formation of these angles. We should thus successively uncover six squares, which will be the faces of the primitive cube.

In explaining the structure of a crystal, although the representation in the figure be such as to shew the decrease of the laminæ, by rows of particles of such a size as to give a surface uneven, similar to a succession of steps, it is obvious, that if we substitute for this the delicate structure of nature, the number of laminæ may be so great, and the number of their cubical particles such, that the depression or channel at their edges will be altogether imperceptible to our senses, and the surfaces will appear perfect planes.

Such is an example of the production of a secondary from a primitive form by a superposition of laminæ, decreasing according to a certain law. It is obvious that the laws of decrement may be various, and accordingly the decrements stated by Hauy are of four different kinds: first, decrements on the edges, or parallel to the sides of the primitive form, of which the above is an example. 2. Decrements on the angles, that is, decrements, of which the lines are parallel to the diagonals of the faces of the primitive form. 3. Intermediate decrements, or those which are parallel to lines situated between the diagonals and edges of that form. 4. Mixed decrements, in which the number of ranges abstracted in breadth or in height give proportions, the two terms of which are beyond unity.

These four laws of decrement explain, by the modifications of which they are susceptible, all the varieties of form, under which crystals are presented to us. These modifications are reduced to the following: 1. Sometimes the decrements take place on all the edges, or on all the angles. 2. Sometimes on certain edges or certain angles only. 3. Sometimes they are uniform by one, two, three ranges, or more. 4. Sometimes the law varies from one edge to another, or from one angle to another. 5. In some cases the decrements on the edges correspond with the decrements on the angles. 6. Sometimes the same edge or the same angle undergoes successively several laws of decrements. And, lastly, there are cases, in which the secondary crystal has faces parallel to those of the primitive form, and which give rise to new modifications, from their combinations with the faces resulting from the decrements.

With such diversity of laws, the number of forms which may exist is immense, and far exceeds what have been observed. Confining the calculation to two of the simplest laws, those which produce subtractions by one or two ranges, it is shewn that carbonate of lime is susceptible of 2044 different forms, a number 50 times greater than that of the forms already known; and if decrements of three and four ranges be admitted into the combination, the calculation will give 8,388,604 possible forms of the same substance. And even this number may be much augmented, in consequence either of intermediate or mixed decrements being taken into account.

In concluding this sketch of Crystallography, which we have extracted from the excellent "System of Chemistry" by Murray, we have also thought it proper, with him, to give the figures of the more usual forms of crystals, and their modifications, with the terms and definitions of Werner, instead of following Hauy in his minute, though valuable, details.

It is necessary to premise, that the parts of which a crystal is conceived to be composed are, planes, edges, and angles. Planes, according to the usual geometrical definition, are surfaces lying evenly between their bounding lines: they are distinguished into lateral, which are considered as those parts of the surface of the body which are of the greatest extent, and which form its confines towards its smallest extent; and extreme or terminal, which are those of smallest extent, and form the bounds of the body towards its largest extent. Edges are formed by the junction of two planes under determinate angles; they also are lateral, or those formed by the junction of two lateral planes; and terminal, formed by the junction of two terminal planes, or of a terminal with a lateral plane. Lastly, angles are formed by the junction of three or more planes in one point.

Werner admits even primary figures of crystals which are susceptible of numerous modifications. These figures are the icosaedron, the dodecaedron, the hexaedron, which includes the cube and the rhomb, the prism, the pyramid, the table, and the lens.

1st. The icosaedron, fig. 13, is a solid, consisting of twenty equilateral triangular planes, united under equal angles. 2d. The dodecaedron, fig. 14, or solid, of twelve equal or pentagonal faces. 3d.

The cube, fig. 15, or solid, composed of six quadrilateral planes united at right angles. 4th. The rhomb, fig. 16, or solid, of six quadrilateral planes united at oblique angles. 5th. The prism, or solid, of two terminal planes, parallel, equal, and similar, connected by quadrangular lateral planes, having one direction; the number of lateral planes may of course be various; the usual form observed in crystals are, the four-sided rectangular prism, fig. 17; and the six-sided equiangular prism, fig. 19. 6th. The pyramid, or solid, the base of which is a plane of an indeterminate number of sides, and the sides triangles, the vertices of which meet in one point, forming the summit: the more common varieties of this figure, as forms of crystals, are the three-sided pyramid, or tetraedron, fig. 20, and the four-sided pyramid, fig. 21. 7th. The table, which, strictly speaking, is nothing but a very compressed prism; it is defined as composed of two parallel lateral planes and of an intermediate number of terminal planes, connected with the lateral planes and with each other, and small, compared with the lateral ones; the principal varieties are, the oblique-angular, or rhomboidal four-sided table, fig. 23, the rectangular four-sided table, fig. 24, and the six-sided table, fig. 24. Lastly, The lens, fig. 25, a solid, consisting only of two planes which are curved, of which there are two varieties, one composed of two convex planes, and another composed of a convex and a concave plane. These simple figures are modified by combination, by truncation, by bevelment, and by acumination.

The modifications by combination are confined to the pyramids, and these are frequent, two pyramids being joined by the base; the lateral planes of the one being set either directly on the lateral planes of the other, as in the double four-sided pyramid, or octaedron, fig. 26, or obliquely, as in the double four-sided pyramid, fig. 27. Fig. 28, is the double six-sided pyramid.

A crystal is said to be truncated, when any or all of its solid angles or edges appear cut off, so that where there would have been an edge or angle we have a plane, as has already been represented in fig. 2 and 3. These two figures represent forms arising from the truncation of the cube: fig. 29, shews the cube with the angles and edges truncated: fig. 30, the six-sided prism, with truncated terminal edges: fig. 31, the same prism, with both the lateral and terminal edges truncated.

A crystal is said to be bevelled, when its edges, angles, or terminal planes, are so altered, that instead of an angle edge or terminal plane, there appear two smaller converging planes, which terminate in an edge: fig. 32, shews the cube with bevelled edges: fig. 33, the three-sided pyramid with bevelled edges: fig. 34, the oblique four-sided prism, bevelled on both extremities.

Lastly, the forms of crystals are altered by acumination. This is that kind of alteration, in which, in place of the angles or terminal planes of a crystal, there are three or more planes converging, and forming a point or edge: fig. 35, shews the cube, with angles acuminated by three planes set on the lateral planes; fig. 36, the rectangular four-sided prism, acuminated by four planes set on the lateral planes: fig. 37, the six-sided prism, acuminated by six planes set on the lateral planes. This kind of modification is often described as consisting of the primary form, with pyramidal terminations.

The forms of crystals from the preceding modifications are frequently still more altered, and rendered complicated, by being super-added and combined; and by the extent of the modifications, one form frequently passes into another. The figures of crystals are likewise rendered complicated by aggregation, two or more crystals of the same substance being more or less closely united.

For the more minute details of this subject, particularly as relatnig to mineralogy, reference may be had to Weaver's translation of the "External Characters of Minerals," by Werner; or the treatise on the same subject by Professor Jameson. See CRYSTALLIZATION.

CRYTANDRA, in botany, a genus of the Pentandria Monogynia class and order. Calyx five-leaved; corolla tubular, with a five-clefted border, and five-hooded scales between the segments; stamina inserted in the throat under each scale; stigma three-cleft, capsule superior, three-valved, three-celled from the inflected valves; seeds solitary, compressed. One species, a shrub found in Australasia.

CUBÆA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Lomentaceæ. Leguminosæ, Jussieu. Essential character: calyx turbinate, five-parted, unequal, permanent; petals five, unequal; filaments villose, three shorter; germ pedicelled; legume villose, six or seven seeded. There are two species.

CUBATURE, *of a solid*, in geometry.

the measuring the space contained in it; or finding the solid content of it.

CUBE, in geometry, a solid body, consisting of six equal square sides. The solidity of any cube is found by multiplying the superficial area of one of the sides by the height. Cubes are to one another in their triplicate ratio of their diagonals; and a cube is supposed to be generated by the motion of a square plane along a line equal to one of its sides, and at right angles thereto; whence it follows, that the planes of all sections, parallel to the base, are squares equal thereto, and, consequently, to one another. See Body.

Cube, *duplication of*, is the finding the side of a cube that shall be double in solidity to a given cube, a problem of great celebrity, first proposed by the oracle of Apollo at Delphos, which, being consulted about the mode of stopping a plague then raging at Athens, returned for answer, that the plague should cease, when Apollo's altar, which was cubical, should be doubled. Hence it is called the Delian problem. This problem cannot be effected geometrically, as it requires the solution of a cubic equation, or requires the finding of two mean proportionals, *viz.* between the side of the given cube and the double of the same, the first of which two mean proportionals is the side of the double cube, as was first observed by Hippocrates. Let a be the side of the given cube, and x the side of the double cube sought, then $x^3 = 2a^3$ or $a^2 : x^2 :: x : 2a$, so that, if a and x be the first and second terms of a set of continued proportionals, then $a^2 : x^2$ is the ratio of the square of the first to the square of the second, which, it is known, is the same as the ratio of the first term to the third, or of the second to the fourth, that is, of $x : 2a$; therefore x being the second term, $2a$ will be the fourth: so that x, the side of the cube sought, is the second of four terms in continued proportion, the first and fourth being a and $2a$; that is, the side of the double cube is the first of two mean proportionals between a and $2a$.

Cube, or *Cubic number*, in arithmetic, that which is produced by the multiplication of a square number by its root; thus, 64 is a cube number, and arises, by multiplying 16, the square of 4, by the root 4.

Cube, or *Cubic quantity*, in algebra, the third power in a series of geometrical proportionals continued; as a is the root, $a\,a$ the square and $a\,a\,a$ the cube.

All cubic numbers may be ranged into the form of cubes; as 8 or 27, whose sides are 2 and 3, and their bases 4 and 9; whence it appears, that every true cubic number, produced from a binomial root, consists of these parts, *viz.* the cubes of the greater and lesser parts of the root, and of three times the square of the greater part multiplied by the lesser, and of three times the square of the lesser multiplied by the greater, as,

$$\begin{array}{l} aa + 2ab + bb \\ a + b \\ \hline aaa + 2aab + abb \\ \qquad\quad aab + 2abb + bbb \\ \hline aaa + 3aab + 3abb + bbb \end{array}$$

From hence it is easy to understand both the composition of any cubic number, and the reason of the method for extracting the cube root out of any member given.

Cube *root of any number or quantity*, such a number, or quantity, which, if multipled into itself, and then, again, the product thence arising by that number or quantity, being the cube root, this last product shall be equal to the number or quantity whereof it is the cube root; as 2 is the cube root of 8, because two times 2 is 4, and two times 4 is 8; and $a+b$ is the cube root of $a^3 + 3a^2b + 3ab^2 + b^3$,

Every cube number has three roots, one real root, and two imaginary ones, as the cube number 8 has one real root 2, and two imaginary roots, *viz.* $\sqrt{-3} - 1$ and $\sqrt{-3} + 1$; and generally, if a be the real root of any cube number, one of the imaginary roots of that number will be $\frac{a + \sqrt{-3aa}}{2}$ and the other $\frac{a - \sqrt{-3aa}}{2}$

CUBEBS. See Materia Medica.

CUBIC, or *Cubical Equation*, in algebra, one whose highest power consists of three dimensions, as $x^3 = a^3 - b^3$ or $x^3 + rxx = p^6$, &c. See Equation.

Cubic *foot of any substance*, so much of it as is contained in a cube, whose side is one foot. See Cube.

CUBIT, in the mensuration of the ancients, a long measure, equal to the length of a man's arm, from the elbow to the tip of the fingers. Dr. Arbuthnot makes the English cubit equal to 18 inches; the Roman cubit equal to 1 foot, 5,406 inches; and the cubit of the Scripture equal to 1 foot, 9,888 inches.

CUCKOW. See CUCULUS.

CUCKOW *spit*. See CICADA.

CUCUBALUS, in botany, a genus of the Decandria Trigynia class and order. Natural order of Caryophyllei. Essential character: calyx inflated; petals five, having claws, but no crown; capsule three-celled. There are seventeen species.

CUCUJUS, in natural history, a genus of the Coleoptera order of insects: antennæ filiform; four feelers equal, the last joined truncate and thicker; lip short, bifid, the divisions linear and distant; body depressed. There are about thirteen species.

CUCULLÆRIA, in botany a genus of the Monandria Monogynia class and order. Calyx four-parted; corolla four-petalled, unequally spurred; filaments petal-like; anthers with distinct cells. One species, found in the woods of Guiana.

CUCULLANUS, in natural history, a genus of the Vermes Intestina. Body sharp, pointed behind and obtuse before; mouth orbicular, with a striate hood. Most of this genus are viviparous, and generally intestinal. There are four sections: A, infesting the mammalia; B, infesting birds; C, infesting reptiles; and D, infesting fish. There are seven species, besides varieties.

CUCULUS, the *Cuckow*, in natural history, a genus of birds, of the order Picæ. Generic character: bill smooth, somewhat bending and weak; nostrils surrounded by a small rim; tongue short and arrowed; toes two forward and two backward; tail wedge-formed, of ten soft feathers. Gmelin enumerates fifty-five species, and Latham forty-six. The following are most deserving of notice: C. Canorus, the Common Cuckow of Europe. This bird is about fourteen inches long. It is found in Europe, Asia, and Africa. Its food consists of insects and the larvæ of moths, but when domesticated, which it may be without much difficulty, it will eat bread, fruits, eggs, and even flesh. When fattened, it is said to be excellent for the table. It is in Great Britain a bird of passage, appearing first about the middle of April, and cheering the vicinity of its habitation with that well-known note with which so many exquisite ideas and feelings are associated. This note is used only by the male bird, and is the intimation of love. It has, very rarely only, been heard, like the song of the nightingale, in the middle of the night. About the close of June this note ceases, but the cuckow remains in England till towards the end of September. It is imagined sometimes to continue in the country for the whole of the year, as it has occasionally been seen there so early as February. Cuckows are supposed to winter in Africa, as they are seen twice a year in the island of Malta.

With the history of these birds have been blended much fable and superstition; their manners, however, are unquestionably in a high degree curious, and fable, in this as in many other cases, is in a great degree connected with fact. It is almost universally agreed by naturalists, that the cuckow does not hatch its own eggs, but deposits them in the nest of some other bird. Buffon mentions the names of twenty birds, or more, on whom the cuckow passes this fraud. Those most frequently duped by it, however, in this manner, are the yellow hammer, the water-wagtail, and the hedge-sparrow, and of these three, by far more than the other two, the hedge-sparrow. The most minute and attentive examiner into this extraordinary peculiarity is Mr. Edward Jenner, from whose observations on this interesting subject we shall select a few of the most important. He states, that the hedge-sparrow is generally four or five days in completing her number of eggs, during which time the cuckow finds an opportunity of introducing to the nest one of its own, leaving the future management of it to the hedge-sparrow; and though it frequently occurs that the latter is much discomposed by this intrusion, and several of the eggs are injured by her, and obliged to be removed from the nest, he states that the egg of the cuckow is never of this number. When the usual time of incubation is completed, and the young sparrows and cuckow are disengaged from the eggs, the former are ejected from the nest, and the stranger obtains exclusive possession. A nest built in a situation extremely convenient for minute observation fell under the particular examination of this gentleman, and was found on the first day to contain a cuckow's and three hedge-sparrow's eggs. On the day following he observed a young cuckow and a young hedge-sparrow, and as he could distinctly perceive every thing passing, he was resolved to watch the events which might take place. He soon, with extreme surprise, saw the young cuckow, born only the day before, exerting itself with its rump and wings to take the young sparrow on its back, which it actually accomplished, and then climbed backwards with its burden to the verge of the nest, from which, with a sudden jerk, it clearly threw off its load; after which it dropped back into the nest, having first, however, felt about with the extremities of its wings, as if to ascertain whether the clearance were completely effected. Several eggs were afterwards put in to the young usurper, which were all similarly disposed of. He observes, that in another instance, two cuckows and a hedge-sparrow were hatched in the same nest, and one hedge-sparrow's egg remained unhatched. Within a few hours a conflict began between the two cuckows for the possession of the nest, which was conducted with extreme spirit and vigour, and in which each appeared occasionally to have the advantage, lifting its adversary to the very brink of the nest, and then, from exhaustion of strength, sinking with it again to the bottom. These vicissitudes of success were repeated and reiterated, but towards the close of the following day the contest was decided in favour of the bird which was rather the larger of the two, who completely expelled his rival; after which the egg and the young hedge-sparrow were dislodged with extreme facility. The infant conquerer was brought up by the stepmother with the most assiduous affection. The sagacity of the female cuckow appears not inconsiderable, in her introducing her egg into the nests of birds whose young are inferior in size and strength to the young cuckow, and which the latter is consequently able to exclude without difficulty from its usurped dominions. See Aves, Plate VI. fig. 1.

C. Indicator, or the Honey-guide. This is an inhabitant of the interior of Africa, and is supposed to feed principally upon honey; it is at least extremely fond of it, and possesses an extraordinary sagacity in discovering where it is to be found. The Dutch farmers and Hottentots near the Cape are reported to derive essential service from this bird. They imitate its peculiar sounds in the morning or evening, before it goes to feed, till they at length get within hearing and sight of it; and when it moves off to its repast, they follow, as correctly as they are able, the direction of its flight, and scarcely ever fail to arrive at some store of wild honey, of which, it is added, they make a liberal allowance to their little guide. It is certain, however, that these people have an extreme regard, and almost veneration, for this bird, founded on its utility; and the curiosity of the celebrated Dr. Sparrman was not gratified by the destruction of one as a specimen for his collections, without exciting high resentment and disdain.

CUCUMIS, in botany, a genus of the Monœcia Syngenesia class and order. Natural order of Cucurbitaceæ. Essencial character: calyx five-toothed; corolla five-parted. Male, filaments three. Female, pistil three-cleft; pome with argute seeds. There are thirteen species. These are all annual plants, with herbaceous scandent stems. C. sativus, common cucumber, generally cultivated for the tables, is so well known, as not to require a particular description. C. melo, common or musk melon, belongs to this genus. There is a great variety of this fruit cultivated in this country, especially by those who supply the markets, where their size is chiefly regarded, so that, by endeavouring to increase their bulk, the fruit becomes of little value. For a particular and elaborate description of this genus, the reader may consult Martyn's excellent edition of Millar's Dictionary.

CUCURBITA, in botany, a genus of the Monoecia Syngenesia class and order. Natural order of Cucurbitaceæ. Essential character: calyx five-toothed; corolla five-cleft. Male, filaments three. Female, pistils five-cleft; seeds of the pome with a swelling margin. There are seven species. The plants of this genus are very nearly allied to those of cucumis, and are distinguished from it chiefly by the swelling rim of the seed. Like them they are annual, with trailing herbaceous stems, furnished with tendrils for climbing.

CUCURBITACÆ, in botany, the name of the thirty-fourth order in Linnæus's fragments of a natural method, consisting of plants which resemble the gourd in external figure, habit, virtues, and sensible qualities. These are divided into two sections.—1. Those with hermaphrodite flowers, as the passion flower. 2. Those with male and female flowers, produced either on the same or distinct roots, as the cucumber, &c. In these the male flowers are generally separated from the female on the same root, and that either in the same angle of the leaves, as in the sicyos or serpent cucumber; or in different angles, as in the gourd, and some species of the bryony.

CUIRASS, a piece of defensive armour, made of iron plate, well hammered, serving to cover the body from the neck to the girdle, both before and behind.

CULEX, *gnat*, in natural history, a genus of insects of the order Diptera. Generic character: mouth consisting of setaceous piercers within a flexible sheath; antennæ approximate, filiform. Gmelin enumerates fourteen species. The common gnat of Europe is produced from an aquatic larva of a very singular appearance, which, when first hatched from the egg, measures about the tenth part of an inch. The eggs of the gnat are deposited in close set groupes of three or four hundred together, and are very small: the whole group is placed on the surface of the water, close to the leaf or stalk of some water-plant. It feeds on the minute vegetable and animal particles which it finds in plenty on stagnant waters, in which it resides, the head being armed with hooks to seize on aquatic insects, and other kinds of food. When arrived at its full growth, it casts its skin, and commences chrysalis. In this state, like the larva from which it proceeded, it is locomotive, springing about in the water nearly in a similar manner. When ready to give birth to the included gnat, which usually happens in the space of three or four days, it rises to the surface, and the animal quickly emerges from its confinement. Gnats, as is known to every body, are very troublesome in all countries; but in Lapland, during their short summer, the air is absolutely filled with such swarming myriads, that the poor inhabitants can scarcely venture out, without first anointing their hands and faces with a composition of tar and cream, which prevents their attacks. This circumstance is not without its advantages, as the legions of larvæ, which fill the lakes of Lapland, form a delicious and tempting repast to innumerable multitudes of aquatic birds, and thus contribute to the support of the very people which they so dreadfully torment. The musquito, of the West Indies and America, is a distinct species from the common European gnat.

CULMINATION, in astronomy, the passage of any heavenly body over the meridian, or its greatest altitude for that day.

CULMUS, in botany, a straw, or haulm, the proper trunk of grasses, which elevates the leaves, flower and fruit.

CUPHEA, in botany, a genus of the Dodecandria Monogynia class and order. Calyx six-toothed, unequal; petals six, unequal, inserted into the calyx; capsule one-celled, with a three-sided follicle. There is but one species.

CULPRIT, a formal reply of a proper officer in court, in behalf of the king, after a criminal has pleaded not guilty, affirming him to be guilty, without which the issue to be tried is not joined. After an indictment for any criminal matter is read in court, the prisoner at the bar is asked whether he is guilty, or not guilty, of the indictment? If he answers, not guilty, there is a replication by the clerk of the arraignments from the crown, by continuing the charge of the guilt upon him, which is expressed in the word culprit. The term culprit is a contraction of the Latin *culpabilis*, and the old French word *prit*, now *pret*, importing that he is ready to prove the criminal guilty.

CULTRATE, in natural history, shaped like a pruning knife.

CULVERIN, in the military art, a large cannon, or piece of artillery.

CUMINUM, in botany, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ. Essential character: involucres four-cleft; umbellules four; fruit ovate, striated. There is but one species, *viz.* C. cyminum cumin. Native of Egypt.

CUNEIFORM, in natural history, shaped like a wedge.

CUNILA, in botany, a genus of the Diandria Monogynia class and order. Natural order of Verticillatæ, or Labiatæ. Essential character: corolla ringent; upper lip erect, flat; filaments two, barren; seeds four. There are four species. One of these, C. pulegioides, is now referred to the genus Hedeoma.

CUNNINGHAMIA, in botany, a genus of the Tetrandria Monogynia class and order. Essential character: calyx very small, four-toothed; corolla four-cleft, with a short tube; berry crowned with a two-celled two-seeded nut. One species, *viz.* C. sarmentosa.

CUNONIA, in botany, so called from Job Christopher Cuno, of Amsterdam; a genus of the Decandria Digynia class and order. Natural order of Saxifragæ, Jussieu. Essential character: corolla five-petalled; calyx five-leaved; capsule two-celled, acuminate, many-seeded; styles longer than the flower. There is but one species, *viz.* C. capensis, a native of the Cape of Good Hope.

CUP *galls*, in natural history, a name given to a curious kind of galls found on the leaves of the oak, and some other trees. They derive their name from their shape. Besides this species, the oak leaves furnish us with several others, of various shapes and sizes, which appear on the leaves at different seasons of the year. They all contain the worm of some small fly, that passes through all its changes in this habitation, being sometimes found in the worm, sometimes in the nymph, and sometimes in the fly state, in the cavity. See Cynips.

CUPANIA, in botany, so named from Francesco Cupani, of Sicily, a genus of the Octandria Monogynia, or Polygamia Monoecia class and order. Natural order of Trihilatæ. Sapindi, Jussieu. Essential character: calyx five-leaved; petals five-cowled at the top; style trifid; capsule three-celled; seeds solitary, arilled. There are two species, *viz.* C. tomentosa, and C. glabra, both natives of the West Indies.

CUPEL, in chemistry, a small vessel, made generally of bone; it absorbs metallic bodies when changed by fire into a fluid scoria. See Laboratory.

CUPELLATION. See Assaying.

CUPOLA, in architecture, a vaulted roof or covering, being the section of a sphere or ellipsoid, formed upon a curvilinear or polygonal plan.

CUPPING, in surgery, the operation of applying cupping glasses for the discharge of blood, and other humours, by the skin.

CUPRESSUS, in botany, a genus of the Monoecia Monadelphia class and order. Natural order of Coniferæ. Essential character: male calyx, scale of an ament; corolla none; anthers four, sessile, without filaments; female calyx of a strobile; scales one-flowered; corolla none; styles, concave dots; nut angular. There are seven species. These are very beautiful and ornamental trees. C. horizontalis, spreading cypress tree, is by far the largest growing tree, and is the most common timber in some parts of the Levant; it is said to resist the worm, moth, and all putrefaction, and to last many hundred years. The doors of St. Peter's Church at Rome were framed of this material, which lasted from Constantine to Pope Eugenius the Fourth's time, which was eleven hundred years, and were then sound and entire, when the Pope changed them for gates of brass. The coffins were made of this material, in which the Athenians used to bury their heroes, and the mummy chests brought with those bodies out of Egypt are made of this wood.

CURATE, properly signifies the parson or vicar of a parish, who has the charge or cure of the parishioners souls.

Curate, also signifies a person substituted by the incumbent, to serve his cure in his stead. A cure is to be licensed or admitted by the bishop of the diocese, or ordinary, having episcopal jurisdiction, and when a curate hath the approbation of the bishop, he usually appoints the salary too; and in such case, if he be not paid, the curate hath a proper remedy in the ecclesiastical court, by a sequestration of the profits of the benefice; but if he have no licence from the bishop, he is put to his remedy at common law, where he must prove the agreement.

CURATELLA, in botany, a genus of the Polyandria Digynia class and order. Natural order of magnoliæ, Jussieu. Essential character: calyx five-leaved; petals four: styles two; capsule two-parted, with two seeds in a cell. There is but one species, *viz.* C. americana, a native of South America.

CURATOR, among civilians, a person regularly appointed to manage the affairs of minors, or persons mad, deaf, dumb, &c. In countries, where the civil law prevails, minors have tutors assigned them, till they are of the age of fourteen, between which and twenty-five they have curators appointed them. There are also curators for the estates of debtors, and of persons dying without heirs.

Curator *of an university*, in the United Netherlands, an officer that has the direction of the affairs of the university, such as the superintendance of the professors, the management of the revenues, &c. these officers, being elective, are chosen by the states of each province. Leyden has three curators

CURCULIGO, in botany, a genus of the Polygamia Monoecia class and order. Essential character: calyx none; corolla six-petalled; filaments six; pistil one; capsule; seeds beaked. There is only one species, *viz.* C. orchoides, native of shady, uncultivated places about Samulcotab, but by no means common. It is the Nallatady of the Telingas.

CURCULIO, *weevil*, in natural history, a genus of insects of the order Coleoptera: antennæ clavate, seated on the snout, which is horny and prominent; four feelers, filiform. Of this genus there have been from 800 to 1000 species enumerated, and there are probably many more that have not been observed by authors who have treated on the subject. These have been separated into three sections, *viz.* A. jaw cylindrical, one-toothed. B. lip bifid; jaw bifid, short; snout short. C. lip rounded, horny; feelers very short. Of these the section A. is distinguished into *a*, snout longer than the thorax; thighs unarmed: *b*, snout longer than the thorax; thighs toothed: *c*, snout longer than the thorax; hind thighs formed for leaping: *d*, snout shorter than the thorax; thighs unarmed: *e*, snout shorter than the thorax; thighs toothed. The larvæ of this most splendid tribe of insects have six scaly legs, and a scaly head; some of them infest granaries, eating their way into grains of corn, and leaving nothing but the husk; some dwell in other seeds, or are lodged in the inside of artichokes, thistles, and various plants; and others devour the leaves of trees and herbs. C. salmarum, or palm weevil, is two inches in length; its larva is large and white, and of an oval shape; it resides in the tenderest part of the smaller palm-trees, and is considered in the West Indies as one of the greatest dainties. C. nucum, or nut weevil, is the insect produced by the maggot residing in the hazel-nut. The insect makes its appearance early in August, and may be found creeping on hazel trees. The female singles out a nut, which she pierces with her proboscis, and then, turning round, deposits an egg in the cavity, and she thus proceeds till she has deposited in different nuts her whole stock of eggs. This is done while the nut is in its young state, which, however, is not injured by the process, but continues to grow and gradually ripens. When the egg is hatched, the young larva begins to feast on the kernel. By the time that it has arrived at its full growth, and has nearly consumed the whole of the kernel, the nut falls, and the inclosed larva, not injured by the fall, continues in the nut some time longer, and then creeps out at the hole in the side, which it has previously made by knawing in a circular direction, and immediately begins to burrow or creep under the surface of the ground, where it lies dormant about eight months, and then, casting its skin, commences a chrysalis, of the same general shape and appearance with the rest of the beetle tribe; and it is not till the beginning of August that it arrives at its complete form, at which period it casts off the skin of the crysalis, creeps to the surface, and commences an inhabitant of the upper world. During this state it breeds, and enjoys for a short time the pleasures of a more enlarged existence. To this genus belongs the weevil, properly so called. Many of the exotic species are large and of great beauty, but the most brilliant and most beautiful is C. imperialis, or diamond beetle, a native of Brazil, which, when seen through a magnifying glass, affords one of the finest sights that can be imagined.

CURCUMA, in botany, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character: stamens four, barren, a fifth fertile; corolla four-parted; nectary three-lobed: filament flat. There are three species, of which C. rotundo, round-rooted turmerick, has a perennial root, with a large ovate bulb, frequently as big as a goose's egg, covered with a thin pelicle, that has parallel rooting rings within, solid, fleshy, reddish yellow, of a bitterish taste, and slightly aromatic smell. Native of the East Indies, the mountains of China, Cochinchina, &c.

CURFEW, a signal giveni n cities taken in war, &c. to the inhabitants to go to bed, advertise the people to secure themselves from the robberies and debaucheries of the night.

The most eminent curfew in England was that established by William the Conqueror, who appointed, under severe penalties, that at the ringing of a bell, at eight o'clock in the evening, every one should put out their lights and fires, and go to bed: whence, to this day, a bell rung about that time is called a curfew-bell.

CURRANS, or Currants. See Grossularia.

CURRENT, is a term used to express the present time: thus, the year 1808 is the current year; the 20th current is the 20th day of the present month. The price current is the known and ordinary price accustomed to be given for it. As applied to commerce, we say, "current coin," for the known and common coin of the country.

Current, in hydrography, a stream or flux of water in any direction. In the sea, they are either natural, occasioned by the diurnal motion of the earth round its axis; or accidental, caused by the water's being driven against promontories, or into gulfs and streights, where, wanting room to spread, they are driven back, and thus disturb the ordinary flux of the sea.

Currents, in navigation, are certain settings of the stream, by which ships are compelled to alter their course or velocity, or both, and submit to the motion impressed upon them by the current. See Hydrography.

CURRYING is the art of dressing cow-hides, calves-skins, seal-skins, &c. principally for shoes: and this is done either upon the flesh or the grain.

In dressing leather for shoes upon the flesh, the first operation is soaking the leather in water until it is thoroughly wet; then the flesh side is shaved on a beam about seven or eight inches broad, with a knife of a peculiar construction, to a proper substance, according to the custom of the country and the uses to which it is to be applied. This is one of the most curious and laborious operations in the whole mystery of currying. The knife used for this purpose is of a rectangular form, with two handles, one at each end, and a double edge. They are manufactured at Cirencester, and composed of iron and steel: the edge is given to them by rubbing them on a flat stone of a sharp gritty substance, till it comes to a kind of wire; this wire is taken off by a fine stone, and the edge is then turned to a kind of groove wire by a piece of steel in form of a bodkin, which steel is used to renew the edge in the operation.

After the leather is properly shaved, it is thrown into the water again, and scowered upon a board or stone commonly appropriated to that use. Scowering is performed by rubbing the grain or hair side with a piece of pumice-stone, or with some other stone of a good grit, not unlike in thickness and shape to the slate with which some houses are covered. These stones force out of the leather a white sort of substance, called the bloom, produced by the oak bark in tanning. The hide or skin is then conveyed to the shade or drying place, where the oily substances are applied, termed stuffing or dubbing. The oil used for this purpose is prepared by the oil leather dressers, by boiling sheep skins or doe skins in cod oil. This is put on both sides of the leather, but in greater and thicker quantity on the flesh than on the grain or hair side.

Thus we have pursued the currying of leather in its wet state, and through its first stage, commonly called getting out.

When it is thoroughly dry, an instrument, with teeth on the under side, called a graining-board, is first applied to the flesh-side, which is called graining; then to the grain-side, called bruising. The whole of this operation is intended to soften the leather to which it is applied. Whitening, or pairing, succeeds, which is performed with a fine edge to the knife already described, and used in taking off the grease from the flesh. It is then boarded up, or grained again, by applying the graining-board first to the grain, and then to the flesh.

It is now fit for waxing, which is performed first by colouring. This is performed by rubbing with a brush, dipped in a composition of oil and lamp black, on the flesh till it be thoroughly black: it is then sized, called black sizing, with a brush or sponge, dried, tallowed with a woollen cloth, and slicked upon the flesh with a small smooth piece of glass; sized again with a sponge; and when dry, this sort of leather, called waxed, or black on the flesh, is curried.

Currying leather on the hair or grain side, called black on the grain, is the same in the first operation with that dressed on the flesh, till it is scowered. Then the first black is applied to it while wet; which black is a solution of the sulphate of iron called copperas, in fair water, or in the water in which the skins as they come from the tanner have been soaked; this is first put upon the grain after it has been rubbed with a stone; then rubbed over with a brush dipped in stale urine; slicked out with an iron slicker, in order to make the grain come out as fine as possible, and then stuffed in the manner already described among the first operations of currying; and when dry it is seasoned, that is rubbed over with a brush dipped in copperas water on the grain till it is perfectly black; then slicked with a stone of a good grit, to take out the wrinkles as much as possible: after this the grain is raised with a fine graining-board, by turning the skin or piece of leather in various directions, and, when a little dried, it is bruised, in order to soften it. When it is thoroughly dry it is whitened, bruised again, and grained in two or three different ways, and when oiled upon the grain with a mixture of oil and tallow it is finished.

Bull and cow hides are sometimes curried for the use of sadlers and collar-makers; but the principal operations are much the same as those we have already described. It should, however, be observed, that only a small portion of flesh is taken off from hides designed for these purposes. Hides for the roofs of coaches, &c. are shaved nearly as thin as shoe hides, and blacked on the grain side.

The oil used in the first operation of stuffing, or dubbing, is called spent oil, and contains a portion of alkali. It has latterly been made up expressly for the curriers. A fact worthy of remark is, that it is imbibed more uniformly and effectually by wet than by dry leather; and this no doubt arises from the gradual evaporation of the water, which gives place to the introduction of the oil by capillary attraction, whereas the air, if interspersed in the pores, would resist it.

CURSITOR, a clerk belonging to the Court of Chancery, whose business it is to make out original writs. In the statute 18 Edward III. they are called clerks of course, and are twenty-four in number, making a corporation of themselves. To each of them is allowed a division of certain counties, into which they issue out the original writs required by the subject.

CURSOR, in mathematical instruments, is any small piece that slides, as the piece in an equinoctial ring-dial that slides to the day of the month; the little label of brass divided like a line of sines, and sliding in a groove along the middle of another label, representing the horizon in the analemma; and likewise a brass point screwed on the beam-compasses, which may be moved along the beam for the striking of greater or less circles.

CURTATE *distance*, in astronomy, the distance of a planet from the sun to that point, where a perpendicular let fall from the planet meets with the ecliptic.

CURTATION, in astronomy, is the interval between a planet's distance from the sun and the curtate distance.

CURTIN, Curtain, or Courtin, in fortification, is that part of the rampart of a place which is betwixt the flanks of two bastions, bordered with a parapet five feet high, behind which the soldiers stand to fire upon the covered way and into the moat.

CURTISIA, in botany, so named from William Curtis, teacher of botany in London, author of "Flora Londinensis," a genus of the Tetrandria Monogynia class and order. Essential character: calyx four-parted; petals four; drupe superior, roundish, succulent, with a four or five-celled nut. There is but one species, *viz.* C. faginea, beach-leaved Curtisia, or hassagay-tree. This is one of the largest trees in the African woods, with very diminutive flowers. The Hottentots and Caffres make the shafts of their javelins, or assagays, from the wood of this tree. They always carry one or two of these with them on their journies. They consist of an iron spear hollowed out on each side, about six inches long, with an iron shaft. It is fastened with thongs of leather to a slender round stick, five feet long, tapering towards the end. With these lances, which they throw with great dexterity to the distance of a hundred paces, the Hottentots and Caffres defend themselves, and kill buffaloes and other wild animals.

CURVATURE, *of a line*, is the peculiar manner of its bending or flexure, by which it becomes a curve of such and such peculiar properties. Any two arches of curve lines touch each other, when the same right line is the tangent of both at the same point; but when they are applied upon each other, in this manner, they never perfectly coincide, unless they are similar arches of equal and similar figures: and the curvature of lines admit of indefinite variety. Because the curvature is uniform in a given circle, and may be varied at pleasure in them, by enlarging or diminishing their diameters, the curvature of circles serves for measuring that of other lines.

Of all the circles that touch a curve in any given point, that is said to have the same curvature with it, which touches it so closely, that no circle can be drawn through the point of contact between them. And this circle is called the circle of curvature; its centre, the centre of curvature; and its semidiameter, the ray of curvature belonging to the point of contact. As in all figures, rectilinear ones excepted, the position of the tangent is continually varying, so the curvature is continually varying in all curvilinear figures, the circle only excepted. As the curve is separated from its tangent by its curvature, so it is separated from the circle of curvature in consequence of the increase or decrease of its curvature; and as its curvature is greater or less, according as it is more or less inflected from the tangent, so the variation of curvature is greater or less, according as it is more or less separated from the circle of curvature.

When any two curve lines touch each other in such a manner that no circle can pass between them, they must have the same curvature; for the circle that touches the one so closely that no circle can pass between them must touch the other in the same manner. And it can be made appear, that circles may touch curve lines in this manner; that there may be indefinite degrees of more or less intimate contact between the curve and the circle of curvature; and that a conic section may be described, that shall have the same curvature with a given line at a given point, and the same variation of a curvature, or a contact of the same kind with the circle of curvature. The rays of curvature of similar arches, in similar figures, are in the same ratio as any homologous lines of these figures, and the variation of curvature is the same. See CURVE.

CURVE, in geometry, a line, which, running on continually in all directions, may be cut by one right line in more points than one. Curves are divided into algebraical or geometrical, and transcendental. Geometrical or algebraical curves are those, whose ordinates and abscisses being right lines, the nature thereof can be expressed by a finite equation having those ordinates and abscisses in it.

Transcendental curve, is such as, when expressed by an equation, one of the terms thereof is a variable quantity.

Geometrical lines or curves are divided into orders, according to the number of dimensions of the equation expressing the relation between the ordinates and abscisses, or according to the number of points by which they may be cut by a right line. So that a line of the first order will be only a right line, expressed by the equation $y + a x + b = 0$. A line of the second, or quadratic order, will be the conic sections and circle, whose most general equation is $y^2 + \overline{a x + b} \times y + c x^2 + d x + e = 0$. A line of the third order, is that whose equations has three dimensions, or may be cut by a right line in three points, whose most general equation is $y^3 + \overline{a x + b} \times y^2 + \overline{e x^2 + dx + e} \times y + f x^3 + g x^2 + h x + k = 0$. A line of the fourth order, is that whose equation has four dimensions, or which may be cut in four points by a right line, whose most general equation is $y^4 + \overline{a x + b} \times y^3 + \overline{cx^2 + dx + e} \times y^2 + \overline{f x^3 + g x^3 + hx + k} \times y + lx^4 mx^3 + n x^2 + p x + q = 0$. And so on.

And a curve of the first kind (for a right line is not to be reckoned among curves) is the same with a line of the second order; and a curve of the second order, the same as a line of the third; and a line of an infinite order, is that which a right line can cut in an infinite number of points, such as a spiral, quadratrix, cycloid, the figures of the sines, tangents, secants, and every line which is generated by the infinite revolutions of a circle or wheel.

As to the curves of the second order, Sir Isaac Newton observes they have parts and properties similar to those of the first. Thus, as the conic sections have diameters and axes, the lines cut by these are called ordinates, and the intersection of the curve and diameter, the vertex; so in curves of the second order, any two parallel lines being drawn so as to meet the curve in three points, a right line cutting these parallels, so as that the sum of the two parts between the secant and the curve on one side is equal to the third part terminated by the curve on the other side, will cut in the same manner all other right lines parallel to these, and meet the curve in three parts, so as that the sum of the two parts on one side will be still equal to the third part on the other side. These three parts, therefore, thus equal, may be called ordinates or applicates: the secant may be styled the diameter; the intersection of the diameter and the curve the vertex; and the point of concourse of any two diameters the centre. And if the diameter be normal to the ordinates, it may be called axis and that point where all the diameters terminate the general centre. Again, as an hyperbola of the first order has two asymptotes; that of the second three; that of the third four, &c.: and as the parts of any right line, lying between the conic hyperbola and its two asymptotes, are every where equal; so in the hyperbola of the second order, if any right line be drawn, cutting both the curve and its three asymptotes in three points, the sum of the two parts of that right line, being drawn the same way from any two asymptotes to two points of the curve, will be equal to a third part drawn a contrary way from the third asymptote to a third point of the curve. Again, as in conic sections not parabolical, the square of the ordinate, that is, the rectangle under the ordinates, drawn to contrary sides of the diameter, is to the rectangle of the parts of the diameter which are terminated at the vertices of the ellipsis or hyperbola, as the latus rectum is to the latus transversum; so in non-parabolic curves of the second order, a parallelopiped under the three ordinates is to a parallelopiped under the parts of the diameter, terminated at the ordinates, and the three vertices of the figure, in a certain given ratio; in which ratio, if you take three right lines, situated at the three parts of the diameter between the vertices of the figure, one answering to another, then these three right lines may be called the latera recta of the figure, and the parts of the diameter, between the vertices, the latera transversa. And as in the conic parabola, having to one and the same diameter but one only vertex, the rectangle under the ordinates is equal to that under the part of the diameter cut off between the ordinates and the vertex, and the latus rectum; so in curves of the second order, which have but two vertices to the same diameter, the parallelopiped under three ordinates is equal to the parallelopiped under the two parts of the diameter, cut off between the ordinates and those two vertices and a given right line, which therefore may be called the latus rectum. Moreover, as in the conic sections, when two parallels terminated on each side of the curve are cut by two other parallels terminated on each by the curve, the first by the third, and the second by the fourth; as here the rectangle under the parts of the first is to the rectangle under the parts of the third; as the rectangle under the parts of the second is to that under the parts of the fourth; so when four such right lines occur in a curve of the second kind, each in three points, then shall the parallelopiped under the parts of the first right line be to that under the parts of the third, as the parallelopiped under the parts of the second line to that under the parts of the fourth. Lastly, the legs of curves, both of the first, second, and higher kinds, are either of the parabolic or hyperbolic kind: an hyperbolic leg being that which approaches infinitely towards some asymptote; a parabolic that which has no asymptote. These legs are best distinguished by their tangents; for if the point of contact go off to an infinite distance, the tangent of the hyperbolic leg will coincide with the asymptote; and that of the parabolic leg recede infinitely and vanish. The assymptote, therefore, of any leg is found by seeking the tangent of that leg to a point infinitely distant, and the bearing of an infinite leg is found by seeking the position of a right line parallel to the tangent, when the point of contact is infinitely remote: for this line tends the same way towards which the infinite leg is directed. For the other properties of curves of the second order, we refer the reader to Mr. Maclaurin's treatise "De Linearum geometricarum Proprietatibus generalibus."

Sir Isaac Newton reduces all curves of the second order to the four following particular equations, still expressing them all. In the first, the relation between the ordinate and the abscisse, making the abscisse x and the ordinate y, assumes this form, $x y^2 + e y = a x^3 + b x^2 + c x + d$. In the second case, the equation takes this form, $x y = a x^3 + b x^2 + c x + d$. In the third case, the equation is $y^2 = a x^3 + b x^2 + c x + d$. And in the fourth case the equation is of this form, $y = a x^3 + b x^2 + c x + d$. Under these four cases the same author enumerates seventy-two different forms of curves, to which he gives different names, as ambigenal, cuspidated, nodated, &c.

Curves, *genesis of, of the second order by shadows.* If (says Sir Isaac Newton) upon an infinite plane illuminated from a lucid point the shadows of figures be projected, the shadows of the conic sections will be always conic sections; those of the curves of the second kind will be always curves of the second kind; those of the curves of the third kind will be always curves of the third kind, and so on *in infinitum.* And as a circle, by projecting its shadow, generates all the conic sections, so the five diverging parabolas by their shadows will generate and exhibit all the rest of the curves of the second kind; and so some of the most simple curves of the other kinds may be found, which will form by their shadows upon a plane, projecting from a lucid point, all the rest of the curves of that same kind.

Curves *of the second order, having double points.* As curves of the second order may be cut by a right line in three points, and as two of these points are sometimes coincident, these coincident intersections, whether at a finite or an infinite distance, are called the double point.

Curves, *use of, in the construction of equations.* One great use of curves in geometry is, by means of their intersections, to give the solution of problems. See Equations.

Suppose, *ex gr.* it were required to construct the following equation of 9 dimensions.

$x^9 + bx^7 + cx^6 + dx^5 + ex^4 + \overline{m+f}.x^3 + g x^2 + h x + k = 0$: assume the equation to a cubic parabola $x^3 = y$; then, by writing y for x^3, the given equation will become $y^3 + b x y^2 + e y^2 + d x^2 y + e x y + m y + f x^3 + g x^2 + h x + k = 0$; an equation to another curve of the second kind, where m or f may be assumed $= 0$, or any thing else: and by the descriptions and intersections of these curves will be given the roots of the equation to be constructed. It is sufficient to describe the cubic parabola once. When the equation to be constructed, by omitting the two last terms $h\,x$ and k, is reduced to 7 dimensions; the other curve, by expunging m, will have the double point in the beginning of the abscisse, and may be easily decribed as above: if it be reduced to six dimensions, by omitting the last three terms $g\,x^2 + h\,x + k$; the other curve, by expunging f, will become a conic section. And if, by omitting the last three terms, the equation be reduced to 3 dimensions, we shall fall upon Wallis's construction by the cubic parabola and right line.

Curves, *family of*, according to Wolfius, is a congeries of several curves of different kinds, all defined by the same equation of an indeterminate degree; but differently, according to the diversity of their kinds. For example, let the equation of an indeterminate degree be $a^{m-1}x = y^m$. If $m = 2$, $a\,x$ will be equal to y^2. If $m = 3$, then will $a^2\,x = y^3$. If $m = 4$, then will $a^3\,x = y^4$, &c.; all which curves are said to be of the same family. The equations, however, by which the families of curves are defined, must not be confounded with transcendental ones; though with regard to the whole family they be of an indeterminate degree, yet with respect to each several curve of the family they are determinate; whereas transcendental equations are of an indefinite degree with respect to the same curve.

CUSCUTA, in botany, a genus of the Tetrandria Digynia class and order. Natural order of convolvuli. Essential character: calyx four-cleft; corolla one petalled; capsule two-celled. There are four species. These are parasitical plants, fastening themselves to, and drawing their nourishment from, others. C. Europæa, common dodder, is a native of Europe, in the hedges, &c. usually on bushes and the loftier plants, as hops, brambles, woody nightshade, fern, thistles, hemp; also on flax, nettles, clover grass, &c. flowering in July and August. Cuscuta Americana is the species indigenous in the United States; it is found on plants growing on the borders of creeks, rivulets, fountains, and other damp places, attaching itself to Impaticus, Chephalanthus, &c.

CUSPIDATE, in natural history, terminating in a sharp point.

CUSSONIA, in botany, so called in memory of Cusson, a celebrated botanist; genus of the Pentandria Digynia class and order. Natural order of Araliæ. Essential character: petals three-cornered; margin of the receptacle dilated into a five-toothed calyx. There are two species, *viz.* C. thysiflora and C. spicata, both natives of the Cape of Good Hope.

CUSTOM, a very comprehensive term, denoting the manners, ceremonies, and fashions of a people, which, having turned into a habit, and passed into use, obtains the force of laws; in which sense it implies such usages as, though voluntary at first, are yet, by practice, become necessary.

Custom is hence, both by lawyers and civilians, defined *lex non scripta*, a law, or right, not written, established by long usage, and the consent of our ancestors: in which sense it stands opposed to the *lex scripta*, or the written law.

As no law can bind people without their consent, so, wherever that is had, and a certain rule used as a law, such rule gives it the force of a law; and if it be universal, then it is common law; but if restrained to this or that particular place, it is custom.

Custom had its beginning, and received the sanction of the law, thus; when a reasonable act, once done, was found to be beneficial to the people, and they had frequent recourse to it; and by repetitions thereof, it became a custom, which being continued *ultra tritavum*, time out of mind, without any interruption, it obtained the power of a law, and binds the places, persons, and things, concerned therein.

All customs ought to have a reasonable commencement, be certain, not ambiguous, have uninterrupted continuance, and not be against the King's prerogative: these are incidents inseparable: yet a custom is not unreasonable for being injurious to private persons and interest, so as it tends to the general advantage of the people: but if any custom be contrary to the public good, or if it injures a multitude, and benefits only some certain persons, such a custom is repugnant to the laws of reason, and consequently void. Custom must always be alleged in many persons; and so it may be claimed by copyholders, or the inhabitants of a place, as within such a county, hundred, city, borough, manor, parish, &c. but regularly they shall not allege a custom against a statute: nor may custom be pleaded against custom; though acts of parliament do not always take away the force of customs. The general customs used throughout England, being the common law, are to be determined by the judges, who can over-rule a custom that is against natural reason, &c.; but particular customs are determinable by jury. See PRESCRIPTION.

CUSTOM *of London.* It is a custom of London, that where a person is educated in one trade, he may set up another; that where a woman uses a trade without her husband, she is chargeable alone, as a *feme sole* merchant, and, if condemned, shall be put in prison till she pays the debt; likewise the bail for her are liable, if she absent herself, and the husband, in these cases, shall not be charged. If a debtor be a fugitive, by the custom of London he may be arrested before the day, in order to find better security, &c. These are customs of this city, different from those of other places.

CUSTOM *of merchants.* If a merchant gives a character of a stranger to one who sells him goods, he may be obliged to satisfy the debt of the stranger for the goods sold, by the custom of merchants. And when two persons are found in arrears, upon an account grounded on the custom of merchants, either of them may be charged to pay the whole sum due, &c.

CUSTOMS, in commerce, the duties or taxes payable upon the importation or exportation of merchandize. They appear to have been originally levied to reimburse the sovereign for the expense he incurred in protecting foreign trade, and were considered as taxes upon the profits of the merchants, being imposed equally upon all sorts of goods, necessaries as well as luxuries, goods exported as well as goods imported; but at a higher rate on the goods of aliens than on such as belonged to the merchants of the country.

The customs of England appear to have originated from the ancient claim of purveyance and pre-emption, or the right of buying by the intervention of the King's purveyors, for the use of the royal household, at an appraised valuation, in preference to all other persons, and even without the consent of the owner; this claim being extended to goods imported from foreign parts, was called prisage, and was levied by taking a determined part of the goods for the King's use, at a price to be set by the King, and called the King's price, which was always lower than the current price. Wine being the principal article of foreign produce then in request, was the chief object of this duty, and the claim was two tons from every ship laden with twenty tons or more, one to be taken before, and the other behind the mast. A small duty of two shillings for every ton of wine imported by merchant strangers was called butlerage, from being paid to the King's chief butler.

From the charta mercatoria of Edw. I. granted in 1304, it appears that there were known and established customs or duties long before that time, both on importation and exportation, as the duties then imposed were to be paid over and above the old customs; which, with respect to wool, the principal article of export, was six shillings and eight pence for every sack, and the new duty three shillings and four pence. In the year 1354 the whole revenue arising from the customs of England was 82,426*l.* 18*s.* 10*d.* of which the duties on the imported goods amounted to only 580*l.* 6*s.* 8*d.* Nearly the whole of the export duties was levied on wools and wool-fells, and as the duties on wool thus formed one of the chief branches of the revenue of the crown, the exportation of this important material was encouraged, in order to augment the produce of the customs.

The ancient customs of England have usually been divided into three branches. 1. The duties upon wool and leather. 2. The duty upon wine, which, being imposed at so much per ton, was called a tonnage. 3. A duty upon all other goods, which, being imposed at so much in the pound of their supposed value, was called a poundage. The first branch declined when the woollen manufacture began to make some progress in this country, and has since wholly ceased, from the prohibition of the exportation of wool. The other two branches were usually granted by the same act of parliament, and were called the subsidy of tonnage and poundage. The subsidy of poundage having continued for a long period at one shilling in the pound, or at five per cent. a subsidy became the general denomination for a custom duty at this rate per cent. The original subsidy was levied according to a book of rates established in the 12th year of Charles II. and was called the old subsidy, to distinguish it from the subsidy of tonnage and poundage imposed in 1698. Other subsidies were imposed at subsequent periods, differing from the old subsidy only in being laid almost wholly on goods imported, whereas that included both imports and exports.

The introduction of the funding system occasioned very frequent impositions of new and additional duties, which were generally adjusted on the principles of the old subsidy; that is, the value of the goods was ascertained by a book of rates, and the amount computed by the quantities of the goods, either with respect to gauge, to weight, or to tale; the duty, therefore, was not a certain proportion of their real value, but of an arbitrary value, agreeing perhaps with the current value at the time of imposing the duty, but which, from the natural fluctuations of trade and manufactures, must necessarily be liable to many changes and alterations. There was also another mode by which duties were imposed; this was, by a proportion to the value on goods not rated, being levied according to the actual value of the same, as sworn to by the importers. These principles being once adopted, were followed in all the new and additional duties of customs, which were imposed for payment of the interest on the various loans which were raised from time to time for the public service. In some instances the additional duties were calculated by a per centage on the duties previously paid; in others a further duty was laid on a different denomination of the commodity, either with respect to its value, its bulk, its weight, or its number; and by proceeding repeatedly in this manner, the numerous additions made, at length, became such a mass of confusion, as produced an infinity of inconvenience and delay in business, and became the subject of universal complaint among mercantile persons. From the great complexity of the whole of this branch of the revenue, arising from the multiplicity of duties, which, being appropriated to separate funds, were obliged to be kept distinct, scarcely any merchant could ascertain by calculations of his own, the duties he was to pay, but was left in a great measure at the mercy of the officers of the customs, who, from being intended as a check upon the merchants, thus became their agents.

The Commissioners of accounts, appointed in the year 1780, in their 13th, 14th, and 15th reports, the last of which was dated 19th December, 1786, have given a full explanation of the constitution of this department of the revenue, the duties of its several officers, and the mode of collecting it, both in London and the out-ports. They also pointed out a variety of important regulations for retrenchment of expense, reduction of the establishment and accommodation of the merchants, most of which have since been carried into effect. But the most extensive and useful measure recommended by them as a consolidation of all the existing duties, by the substitution of one single duty on each article, amounting as nearly as possible to the aggregate of all the various duties then payable. This was effected in 1787, by an act 27 Geo. III. cap. 13, by which the accounts of the custom-house were much simplified, and the rates of duty rendered intelligible to all persons affected by them.

In the year 1797 eight new branches of duties had been created since the consolidation, which made it necessary to keep so many new and distinct accounts. At this time the number of articles subject to the custom duties amounted to not less than 1200, not more than 160 of which appear upon the annual accounts presented to parliament, as yielding the sum of 1000*l.* and upwards; the remaining 1040 are classed together, under the general head of "sundry small articles," and did not produce, in the whole, more than from 85,000*l.* to 110,000*l.* per annum; each of these articles, nevertheless, had some special regulation belonging to it, and the accumulated mass of these details had, in the opinion of the Select Committee on Finance, rendered the whole system much too complex. That this opinion was well founded will be admitted from the circumstance, that the statutes relative to the customs alone, make six very large volumes in folio.

In the year 1803 the customs were again consolidated, by 43 Geo. III. cap. 68; but additional duties have been since imposed, which will render it necessary to have recourse again to this useful measure at a future period.

Total gross receipt of the customs of Great Britain, in the year ending 5th of January, 1807, with the payments to which it was subject, and the nett amount paid into the Exchequer.

	L.	s.	d.
Balance in the hands of the different Collectors on the 5th of January, 1806	50,843	16	3
Balance in the hands of the Receiver General of Scotland	54,657	3	8½
Bills arising and remitted out of the revenue of 1805, but not brought to account till 1806	283,759	1	3¾
Gross receipt of permanent and temporary duties within the year	12,379,983	19	1¼
Total	L.12,769,244	0	4½

	L.	s.	d.
Paid drawbacks, repayments on over-entries, and bounties of the nature of drawbacks	1,560,346	11	8¼
Bounties for promoting national objects	307,864	3	1¼
Money imprest in the hands of out-port collectors, &c.	34,989	13	3
Paid towards the expenses of the civil government of Scotland	76,445	18	6½
Charges of management	655,603	8	10½
Payments into the Exchequer	9,733,813	12	1½
Balance in the hands of the different collectors on the 5th of January, 1807	58,594	11	6½
Balance in the hands of the Receiver General of Scotland on the 5th of January, 1807	61,542	8	7½
Bills arising and remitted out of the revenue of 1806, but not brought to account till 1807	280,043	12	7½
Total	L.12,769,244	0	4½

Deducting from the gross receipt of 12,379,983*l.* 19*s.* 1¼*d.* the amount paid for drawbacks on exportation, and in bounties for promoting national objects, being 469,983*l.* 14*s.* 2*d.*; the total nett produce of the year will be 11,910,000*l.* 4*s.* 11¼*d.* which arose as follows :

	L.	s.	d.
From duties inwards	10,166,561	13	4¾
——— outwards	621,566	16	5¼
——— coastways	1,035,988	17	8
—— remittances from the plantations, quarantine duty, &c.	85,882	17	5¼
Total	L.11,910,000	4	11¼

The total expense of collecting the customs of Great Britain was, in the year 1795, at the rate of 6*l.* 19*s.* 5*d.* per cent. on the gross receipt, or 10*l.* 3*s.* 5*d.* per cent. on the nett produce; but, in consequence of the various regulations which have since been adopted, the expense of the collection has been considerably reduced. In the year ending the 5th of January, 1807, it amounted to 5*l.* 2*s.* 8*d.* per cent. on the gross receipt, or 6*l.* 4*s.* 3*d.* per cent. on the nett produce.

CUSTOS *brevium*, the principal clerk belonging to the court of common pleas, whose business is to receive and keep all the writs made returnable in that court, filing every return by itself; and, at the end of each term, to receive of the prothonotaries all the records of the nisi prius, called the posteas. The posteas are first brought in by the clerks of assize of every circuit to that prothonotary who entered the issue in the causes, in order to enter judgment; and after the prothonotary has entered the verdict and judgment thereupon into the rolls of the court, he delivers them over to the custos brevium, who binds them into a bundle. The custos brevium makes likwise entries of writs of covenant, and the concord upon every fine: by him also are made out exemplifications and copies of all writs and records in his office, and of all fines levied, which, being engrossed, are divided between him and the chirographer, which last keeps the writ of covenant and the note; and the former the concord and foot of the fine. The custos brevium is made by the king's letters patent.

CUSTOS *rotulorum*, an officer who has the custody of the rolls and records of the sessions of peace, and also of the commission of the peace itself. He usually is some person of quality, and always a justice of the peace, of the quorum in the county where he is appointed. This officer is made by writing under the king's sign manual, being the Lord Chancellor's warrant to put him in commission. He may execute his office by a deputy, and is empowered to appoint the clerk of the peace, but he may not sell the place, on divers penalties.

CUTICLE, *cuticula*, in anatomy, a thin membrane, closely lying upon the skin or cutis, of which it seems a part, and to which it adheres very firmly, being assisted by the intervention of the corpus reticulare.

CUTIS, the skin, in anatomy, is that strong covering which envelopes the whole external surface of animals. It is composed chiefly of a thin white elastic layer on the outside, called the epidermis or cuticle, and a thicker layer, composed of fibres thickly interwoven, and disposed in different directions, which is the cutis or real skin. The epidermis is that part of the skin which is raised in blisters. This is readily separated from the cutis by maceration in hot water. It is very elastic, and in soluble in water and alcohol. Pure fixed alkalies and lime dissolve it entirely. Mr. Hatchett, from many experiments, has shewn that the epidermis resembles albumen in many of its properties, or rather that it is nothing more than a peculiar modification of coagulated albumen. The cutis is a thick dense membrane, composed of fibres interwoven like the texture of a hat. When it is macerated some hours in water, and agitation and pressure are employed to accelerate the effect, the blood, and all the extraneous matter with which it was loaded, are separated from it, but its texture remains unaltered. On evaporating the water employed, a small quantity of gelatine may be obtained. No subsequent maceration in cold water has any farther effect. When distilled, it yields the same products as fibrin. The concentrated alkalies dissolve it, converting it into oil and ammonia. Weak acids soften it, render it transparent, and at last dissolve it. Nitric acid converts it into oxalic acid and fat, while, at the same time, azotic gas and prussic acid are emitted. When heated, it contracts, and then swells, exhales a fetid odour, and leaves a dense charcoal, difficult to incinerate. By spontaneous decomposition in water or moist earth, it is converted into a fatty matter, and into ammonia, which compose a kind of soap. When allowed to remain long in water, it softens and putrefies, being converted into a kind of jelly. When long boiled in water, it becomes gelatinous, and dissolves completely, constituting a viscid liquor, which, by proper evaporation, is convert- into glue. Hence the cutis of animals is commonly employed in the manufacture of glue.

From these facts, the cutis appears to be a peculiar modification of gelatine, enabled to resist the action of water, partly by the compactness of its texture, and partly by the viscidity of the gelatine of which it is formed; for those skins which dissolve most readily in boiling water afford the worst glue. The skin of the eel is very flexible, and affords very readily a great proportion of gelatine. The skin of the shark also readily yields ahundance of gelatine; and the same remark applies to the skins of the hare, rabbit, calf, and ox; the difficulty of obtaining the glue, and its goodness, always increasing with the toughness of the hide. The hide of the rhinoceros, which is exceedingly strong and tough, far surpasses the rest in the difficulty of solution, and in the goodness of its glue. When skins are boiled, they gradually swell and assume the appearance of horn; then they dissolve slowly.

CUTLERY. Though cutlery, in the general sense, comprises all those articles denominated edge-tools, it is more particularly confined to the manufacture of knives, forks, scissars, penknives, razors, and swords. Damascus was anciently famed for its razors, sabres, and swords. The latter are said to possess all the advantages of flexibility, elasticity, and hardness. These united distinctions are said to have been effected by blending alternate portions of iron and steel in such a manner, that the softness and tenacity of the former could prevent the breaking of the latter.

The Germans, it appears, were acquainted with the art of making various cutlery, previous to such manufacture being known in this country. The steel employed for cutlery in Germany is immediately made from the crude iron into bars, without requiring afterwards to be converted. It is generally of great tenacity, but does not take a good polish, and in consequence has been long superseded by the artificial steel of this country, made from the bar-iron of Sweden and Russia.

All those articles of cutlery which do not require a fine polish, and are of low price, are made from blistered steel. Those articles which require the edge to possess great tenacity, at the same time that superior hardness is not required, are made from sheer-steel. The finer kinds of cutlery are made from steel which has been in a state of fusion, and which is termed cast-steel, no other kinds being susceptible of a fine polish. See the article Steel.

Table Knives are mostly made of sheer-steel, the tang and shoulder, or bolster, being of iron, the blade part being attached by giving them a welding heat. The knives after forging are hardened by heating them red hot and plunging them into water; they are afterwards heated over the fire till they become blue; they are then ground upon stones of large diameter, for the purpose of making their sides flat, since it is the disposition of small stones to make the sides concave. The blades are finished upon an instrument called a glazor, which consists of a circular piece of wood covered with leather, and coated with glue and emery. The handles of table knives are made of ivory, plassed horn, bone, stag horn, and wood, into which the blades are cemented with resin and pulverized brick: and for ivory, instead of the latter, whitening.

Forks are made almost altogether by the aid of the stamp and appropriate dies. The prongs only are hardened and tempered, by a method similar to that employed for the knives, being required of about the same degree of hardness.

The shank and bosom of the fork are ground upon a thin stone, which is round upon the face; it is of very rough and open texture, and is employed in the dry state. The prongs are ground upon a stone, which is broad and flat upon the face; they are finished upon glazors coated with emery and glue; the insides of the prongs are dressed by means of a thin leathern strap, coated with glue and emery; for this purpose the fork is placed in an horizontal position, and the strap drawn backward and forward. Silver forks are a distinct branch of manufacture, being confined to the silversmiths: they are cast into moulds of fine sand, and finished in a manner similar to that of other silver goods.

Razors. Almost all razors are made of cast steel, the quality of which should be very good, the edge of a razor requiring the combined advantages of great hardness and tenacity. After the razor blade is forged, it is hardened, by gradually heating it to bright red heat, and plunging it into cold water. It is tempered, by heating it afterwards till a brightened part appears of a straw colour. Though this is generally performed by placing them upon the open fire, it would be more equally effected by sand, or what is still better, in hot oil, or fusible mixture, consisting of eight parts of bismuth, five of lead, and three of tin; a thermometer being placed in the liquid at the time the razors are immersed, for the purpose of indicating the proper temperature, which is about 500 of Fahrenheit. Razors are ground crosswise upon stones, from four to seven inches in diameter, a small stone being necessary to make the sides concave. Razors, having the concave form, have been thought to shave with more facility; but if it be remarked that the canal formed by honing the razors is a portion of a wedge, the length of which is equal to the breadth of the razor, and of a thickness equal to that of the back, it will be readily seen that the concave form cannot possess any other advantage, than that of saving time in sharpening the razor, owing to the small surface exposed to the action of the hone or the strap. After the razor has been ground into its proper shape, it is finished by two processes, one called laping, or glazing, and the other polishing. The lap, or glazor, is formed of wood, faced with an alloy of lead and tin; after its face is turned to the proper form and size, it is filled with notches, which are filled up with emery and tallow. This instrument gives to the razor a smooth and uniform surface, and consequently a fine edge. The last process is that of polishing; the polisher consists of a piece of circular wood running upon an axis, like that of the stone or the glazor. It is coated with leather, having from time to time its surface covered with crocus martis. The surface of the polisher, when in motion, moves at the rate of 75 feet in a second. This is slow, when compared with the velocity of the stone and the glazor; the surface of the former moving at the rate of 576 feet in a second, and the latter with about twice that velocity. The handles of high priced razors are made of ivory and tortoise-shell, but in general they are of polished horn, which are preferred on account of their cheapness and durability. The horn is cut into pieces and placed between two corresponding dies, having a recess of the shape of the handle. The dies are previously heated to about 500° of Fahrenheit, and placed with the horn in a process of such power, that allowing the man's strength to be 200*lb.* it will be equal to 43000*lb.* By this process the horn admits of considerable extension; if the horn is not previously black, the handles are dyed black by means of a bath of logwood and green vitriol. They afterwards require to be dressed, first with sand and water, and lastly upon a buff, which is a species of glazor, covered upon the face with buff leather, and smeared over with rotten-stone and oil.

The clear horn handles are sometimes stained so as to imitate the tortoise-shell; this is effected by laying upon the handle a composition of three parts of potash, one of minium, ten of quicklime, and as much water as will make the whole into a pulpy mass. Those parts of the handle requiring darker shades are covered thicker than the other. After this substance is laid upon the handles, they are placed before the fire for a few hours, the time requisite for giving the proper effect.

Penknives. The manufacture of penknives is divided into three departments; the first is the forging of the blades, the spring, and the iron scales; the second, the grinding and polishing of the blades; and the third, the handling, which consists in fitting up all the parts and finishing the knife. The blades are made of the best cast steel, and hardened and tempered to about the same degree with that of razors. In grinding they are made a little more concave on one side than the other; in other respects they are treated in a similar way to razors. The handles are covered with horn, ivory, and sometimes wood, but the most durable are those of stag-horn. The most general fault in penknives is that of being too soft. The temper ought to be not higher than a straw colour, as it seldom happens that a penknife is so hard as to snap on the edge.

Scissars. The beauty and elegance of polished steel is not displayed to more advantage than in the manufacture of the finer kinds of scissars. The steel employed for the more valuable scissars should be cast steel of the choicest qualities; it must possess hardness and uniformity of texture, for the sake of assuming a fine polish; great tenacity when hot, for the purpose of forming the bow or ring of the scissar, which requires to be extended from a solid piece, having a hole previously punched through it. It ought also to be very tenacious when cold, to allow that delicacy of form observed in those scissars termed ladies scissars. After the scissars are forged as near to the same size as the eye of the workman can ascertain, they are paired, and the two sides fitted together. The bows and some other parts are filed to their intended form, the blades are also roughly ground, and the two sides properly adjusted to each other, after being bound together with wire and hardened up to the bows. They are afterwards heated till they become of a purple colour, which indicates their proper temper. Almost all the remaining part of the work is performed at the grinding mill, with the stone, the lap, the polisher, and the brush. The latter consists of a circular piece of wood, fitted upon an axis, and set upon the face with very strong bristles. It is used to polish those parts which have been filed, and which the lap and the polisher cannot touch. Previous to screwing the scissars together for the last time, they are rubbed over with the powder of quicklime, and afterwards wiped clean with the skin of soft sheep leather. The quick lime absorbs the moisture from the surface, to which the rusting of steel is justly attributed. Scissars are frequently beautifully ornamented by blueing and gilding, and also with studs of gold or polished steel. They are at present most elegantly ornamented by the gold being inlaid on a level with the surface of the steel, the gold surface being afterwards increased. The very large scissars are partly of iron and partly of steel, the shanks and bows being of the former. These, as well as those all of steel, which are not hardened all over, cannot be polished; an inferior sort of lustre, however, is given to them by means of a burnish of hardened polished steel, which is very easily distinguished from the real polish by the irregularity of the surface. (For swords, see SWORD.)

Casting of Cutlery. From the great alliance of pig-iron to steel, it has been long thought practicable to cast the steel into the articles required, and by that means save all the expense of forging, and at the same time make the articles much nearer their intended form than could possibly be done by the hammer. The steel in its perfect state is, however, incapable of this advantage, though when in a state of fusion it is capable of being cast into large ingots. It is so imperfectly liquid at that temperature, as to preclude the possibility of casting it into articles so small as knives or scissars. That species of pig-iron, called N°. 1, is susceptible of so perfect a liquidity as to be cast into needles and fish-hooks, and has been employed for making a great variety of cutlery, particularly forks and scissars. Immediately after the articles are cast, which is generally into wet sand, they are as brittle as glass, and in that state could not be used for any purpose. By being stratified with sand, and kept at a red heat for twenty four hours, they assume a degree of softness and tenacity, which will allow them to bend to a considerable angle. This process is called annealing. This branch of manufacture has of late undergone very considerable improvement, by an invention of Mr. Lucas of Sheffield, for which he has obtained a patent. The articles are cast of the most fusible pig-iron, and are afterwards converted into a state of steel by cementation. The pig-iron, which only differs from steel in containing an excess of carbon, is stratified in close vessels, with some substance capable of furnishing oxygen, with which the carbon of the pig-iron combines, forming carbonic acid, which escapes in the form of gas. See the article STEEL.

CUTTER, in naval affairs, a small vessel, commonly navigated in the channels of England, furnished with one mast and a straight running bowsprit, or which can be run in on deck occasionally; except which, and the largeness of the sails, they are rigged much like sloops.

CUTTLE FISH. See SEPIA.

CYANELLA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Asphodeli, Jussieu. Essential character: corolla six-petalled; the three lower petals hanging forwards; stamens lower declined, longer than the rest. There are three species, natives of the Cape.

CYATHIFORM, in natural history, shaped like a wine glass, more or less obconical and concave.

CYATHEA, in botany, a genus of the Cryptogamia Filices class and order. Fructification in roundish scattered dots, seated on a columnar receptacle, within the calyx-like involucre which opens at top; there are about nine species.

CYATHUS, in botany, a genus of the Cryptogamia Fungi: fungus campanulate or cylindrical, bearing lentiform capsules within. There are six species.

CYCAS, in botany, a genus of the Dioecia Polyandria class and order. Natural order of Palms. Filices, or Ferns, Jussieu. Essential character: male, ament. strobile form, with the scales covered every where beneath with pollen. Female spadix sword-form, germ immersed into the corners of it solitary; style one; drupe with a woody nut. There are two species, *viz.* C. circinalis, broad-leaved cycas, and C. revoluta, narrow-leaved cycas. The first is a native of the Cape, the other of China, where it is cultivated for its beauty.

CYCLAMEN, in botany, English cyclamen, or sow-bread, a genus of the Pentandria Monogynia class and order. Natural order of Preciæ. Lysimachiæ, Jussieu. Essential character: corolla rotate, reflex, with a very short tube and prominent throat; berry covered with a capsule. According to Martyn there are five species. Linnæus reckons two. Millar and Parkinson made eight and ten. The flowers are borne singly on a naked stem, peduncle or scape, and are nodding. The root is roundish, solid, and tuberous. Linnæus observes, that the several varieties connect the plants which have angular leaves with those which have round ones so intimately, that limits are assigned to them with difficulty. They are most of them natives of the South of Europe.

CYCLAS, in botany, a genus of the Decandria Monogynia class and order. Natural order of Lomentaceæ. Leguminosæ, Jussieu. Essential character: calyx four-parted, spreading, with a short turbinate tube; corolla none; filaments inserted into the neck of the calyx; style flexuose; legume roundish, winged, one-seeded. There are two species, *viz.* C. spicata, and C. aromatica, both very tall trees, natives of the great forests of Guiana, flowering in November and December. *Vide* Willd. *Sub.* Crudia.

CYCLIDIUM, in natural history, a genus of Vermes Infusoria. Worm invisible to the naked eye, very simple, pellucid flat, orbicular, or oval. There are seven species. C. bulla; orbicular, transparent; in infusions of hay; pellucid, white, with the edges a little darker; motion slow and circular. C. milium; elliptical, transparent; in vegetable infusions; pellucid, crystalline, membranaceous, with a line through the whole length.

CYCLOID, in geometry, a curve of the transcendental kind, called also the trochoid. It is generated in the following manner: if the circle C D H (Plate III. Miscel. fig. 15.) roll on the given straight line A B, so that all the parts of the circumference be applied to it one after another, the point C that touched the line A B in A, by a motion thus compounded of a circular and rectilinear motion, will describe the curve A C E B, called the cycloid, the properties of which are these: 1. If on the axis E F be described the generating circle E G F, meeting the ordinate C K in G, the ordinate will be equal to the sum of the arc E G and its right sine G K; that is, C K will be equal to E G + G K. 2. The line C H parallel to the chord E G is a tangent to the cycloid in C. 3. The arc of the cycloid E L is double of the chord E M, of the corresponding arc of the generating circle E M F: hence the semi-cycloid E L B is equal to twice the diameter of the generating circle E F; and the whole cycloid A C E B is quadruple of the diameter E F. 4. If E R be parallel to the base A B, and C R parallel to the axis of the cycloid E F, the space E C R, bounded by the arc of the cycloid E C, and the lines E R and R C, shall be equal to the circle area E G K: hence it follows, if A T, perpendicular to the base A B, meet E R in T, the space E T A C E will be equal to the semi-circle E G F: and since A F is equal to the semi-circumference EGF, the rectangle EFAT, being the rectangle of the diameter and semi-circumference, will be equal to four times the semi-circle E G F; and therefore the area E C A F E will be equal to three times the area of the generating semi-circle E G F. Again, if you draw the line E A, the area intercepted betwixt the cycloid E C A, and the straight line E A, will be equal to the semi-circle E G F; for the area E C A F E is equal to three times E G F, and the triangle E A F = A F × ½ E F, the rectangle of the semi-circle and radius, and consequently equal to 2 E G F; therefore their difference, the area E C A E, is equal to E G F. 5. Take E *b* = O K, draw *b* Z parallel to the base, meeting the generating circle in X, and the cycloid in Z, and join C Z, F X; then shall the area C Z E C be equal to the sum of the triangles G F K and *b* F X. Hence an infinite number of segments of the cycloid may be assigned, that are perfectly quadrable.

For example, if the ordinate C K be supposed to cut the axis in the middle of the radius O E, then K and *b* coincide; and the area E C K becomes in that case equal to the triangle G KF, and E *b* Z becomes equal to F *b* X, and these triangles themselves become equal.

This is the curve on which the doctrine of pendulums and time-measuring instruments in a great measure depend; Mr. Huygens having demonstrated, that from whatever point or height a heavy body oscillating on a fixed centre begins to descend, while it continues to move in a cycloid, the time of its falls or oscillations will be equal to each other. It is likewise demonstrable, that it is the curve of quickest descent, *i e.* a body falling in it from any given point above, to another not exactly under it, will come to this point in a less time than in any other curve passing through those two points.

CYCLOPÆDIA, or Encyclopædia, denotes the circle or compass of arts and sciences.

CYCLOPTERUS, the *sucker*, in natural history, a genus of fishes of the order Cartilaginei. Generic character: head obtuse; tongue short and thick; teeth in the jaws; body short, thick, and without scales; ventral fins united into an oval concavity, forming an instrument of adhesion. There are ten species, of which the principal is C. lumpus, the lump-sucker. The shape of this fish is very similar to that of the bream, and it sometimes grows to the weight of seven pounds. Beneath the pectoral fins it possesses an oval aperture, surrounded with a soft muscular substance, edged with small thready appendages, which act as so many claspers. By this apparatus the sucker is enabled to adhere with extreme tenacity to any substance, and in several cases it has been found impossible to make it quit its hold, but by the application of a force which has lacerated and destroyed it. M. Pennant mentions that one of these fishes, soon after being caught, was flung into a pail of water containing several gallons, and attached itself in a few moments so strongly at the bottom of the vessel, that, on taking the fish by the tail, the whole vessel was lifted, together with its contents, and the fish appeared to shew no disposition to quit its hold. These fishes are eaten commonly in Greenland, where their oily quality renders them particularly pleasing. In England they are thought tasteless and flabby. In Scotland, near Caithness, suckers are found in immense shoals. They are pursued on that coast with the most destructive havock by the seals, which there also abound. During the season in which these ravages are committed, the spot under which they take place is distinguishable by the smooth and oily surface of the water for a considerable extent. The skins of the suckers, which are rejected by the seals, are also found in vast abundance on the shores. For a variety of this species, called C. pavonius, or the Pavonian sucker, see Pisces, Plate. III. fig. 3.

CYDER, a well-known liquor, serving in many parts of England as a common beverage, though not considered to be so wholesome as well made beer, especially to presons troubled with gravel, or chronic complaints of any kind. Cyder is made from apples, which should be mellow ripe, and gathered when perfectly dry. It was formerly held as a general opinion, that "the worse the fruit, the better for cyder;" but such an absurd opinion was in time, though slowly, refuted. The best pippins make the best flavoured and the wholesomest liquor; and such as are duly ripe will produce a proportionate increase, both of the quantity and of the flavour. Some persons are so curious in this particular, that they select their apples individually, and keep the juice barrelled for several years, whence it acquires considerable strength and richness, equal, if not superior, to many of the inferior classes of foreign wines. When boiled, and kept in this way, it is called cyder wine.

It is to be lamented, that very large quantities of crude cyder are made in some districts from unripe apples, especially from windfalls. This liquor is peculiarly unwholesome, and rarely fails, if drank to excess, to induce violent colics, and spasms of long duration. The evil is increased by the incautious practice of drawing the expressed liquor into copper or leaden vessels, from which it receives a metallic solution, that proves in most instances fatal. Even those who make cyder with the utmost care and cleanlisess from unripe apples should be particularly attentive to its due fermentation, without which, though it may not immediately turn sour, it will neither be palatable nor wholesome. Such should be aided while fermenting by the addition of a very large toast, made of good wheaten bread, well leavened; and if that should fail, the cyder should not be used, without the addition of about a quart of good spirits to two or three gallons of the liquor. This will prevent the acetous fermentation from taking place, and reduce the bad qualities of this crude beverage.

Exclusive of the state of the fruit when gathered, much depends on the care with which it is taken down, and conveyed to the sweating room: such apples as are bruised should be rejected, or at least be made separately; for they will give a taint to the liquor; and if numerous, will also occasion the fermentation to be unequal: a matter of great importance! Apples should be gathered by hand, and slipped into a basket by means of such a ladder and cloth funnel as represented in the Agricultural Magazine for September or October, 1807, whereby they are saved from injury.

The proper degree of ripeness is easily ascertained by those who are in the habit of gathering; such persons know by the touch, and by the mellow appearance of proper fruits, when they are fit for the press: the shaking of the kernels is extremely uncertain, as is also the colour of the kernels. When a hard sort of apple bites crisp, and flakes without toughness, it is in proper condition. The softer fleshed apples may be tried by pressing the thumb on that side which has not been exposed to the sun. If the flesh pits easily, and soon assumes a bruised appearance, the juices are sufficiently prepared for expression. By trying the sun side of the apple much deception is often experienced.

Those who are very curious in their cyder pick off all their stalks, and wipe each with a dry cloth; but this cannot be done upon a large scale. However, all filth should be avoided as much as possible. The fruit when first pulled should be laid to air on a floor, and in a day or two should be piled. If the weather proves frosty, a blanket should be laid at night over each heap, that the whole may be kept in a very gentle sweat. This dissipates much of the aqueous fluid, and disposes the apples to break freely in the mill, without which there would be double labour and far less produce. When they appear clammy, or begin to look shrivelled, they are in a state for milling. The mill and press are made upon different plans in various parts; those who make cyder for sale, and can shew many hundred hogsheads, generally have a horse walk, and grind the apples by means of a trough, wherein they are crushed by a large stone roller, about a foot broad, and three or four feet high, which revolves on an axis fast at one end to a central post, and at the other having a hook, to which the horse is attached. The horse goes round at an easy pace, so as not to hurry the apples out of the trough, while the stone partakes of the circular motion, and mashes the apples, which are confined by the two concentric sides of the trough. The mills are usually made in a very negligent manner, whereby the apples are very insufficiently and unequally ground; besides, it is extremely difficult to keep the troughs clean, and to prevent the apples from jumping out when first acted upon by the stone, unless the walls or sides are inconveniently high, or that only a thin layer is bruised at a time. To remedy this, we offer a new form for the trough and stone, which it will be obvious remedies the former evil. (See fig. 3 and 4, Plate IV. Miscel.)

In the same plate is shewn the mode of keeping the apples from rising before the wheel: it is simply a board, which fits flat upon the top of the circular trough. This board is fixed by two arms to the axis on which the stone revolves, and by means of hinges at their junction will rise and fall, according as the stone may sink more or less into the trough; thus causing the board always to keep at its proper distance in front. The board may have one or two iron pins on each side, pointing downwards for two or three inches, for the purpose of guiding and retaining it in the proper direction on the circular surface of the trough.

The best and most commodious grinding mill for ordinary use consists of an oblong funnel, capable of containing about two bushels; this directs the apples down to two cylinders, placed horizontally at about half an inch or less asunder. Each cylinder is furnished with many rows of strong teeth; between each two there is a mortice, so that as one is set in motion by a crank, or winch handle, it locks mutually in with the other, and causes it to revolve with a counter motion, thereby catching in the apples, and forcing them through between the rollers, into a receiver placed below. The cylinders may be about a foot long, and perhaps four or five inches in diameter. Many use iron teeth; but those made of lignum vitæ are preferable. They should be about an inch square, and project nearly as much, their ends being cut to a wedge form. These teeth ought to be in regular bands, with intermediate mortices for the reception of those locking in from the other cylinder; the bands or rows to be about two or three inches asunder, and the teeth about two inches apart. Fig. 5, in the same plate, will give some idea of this machine, which will be found also in the Agricultural Magazine, for February or March, 1808.

The pulp is put into cloth receivers, made of horse hair; and being piled in as many layers as the machine will contain, is compressed by the means of large levers turning a wooden pillar screw, the same as in the paper manufactories, &c. so that all the juice is forced out, and the pulp is rendered dry and thin. The liquor thus obtained is called stum, and the residuum is called murk. The latter is frequently broken up, and being infused with boiling water, is again pressed, for the purpose of giving a small liquor, called cyderkin, purre, or perkin. Some add hops thereto, which makes it keep very well. If too much water be not put, say about one-third the quantity of expressed juice, the cyderkin will prove good. It ought to remain 48 hours before repressed. The best way is to grind the murk a second time, whereby much more liquor will be obtained. The cyder should be put into very clean sweet casks, which should not be filled, but a small space left for the working. The duration of the ferment is uncertain, being from a week to a month, or more, according to the state of the atmosphere. If the fruit be in a proper state, and that no frost should intervene, it will generally be regular; but in the latter case, artificial warmth, not exceeding 60 degrees, may be used, and a piece of well-toasted bread be put in. When the fermentation is declining, draw off the cyder from its lees, by means of a cock at a few inches from the bottom of the cask, and put it into another vessel, which must, after the first effervescence, be well filled, and be bunged up very close.

It is proper to state in this place, that very large quantities of good stum are annually spoilt, by being placed either in too hot situations, where the fermentation proceeds unduly to the second, or acetous degree; or in too cold or damp a cellar, &c. as where the fermentation is tardy and imperfect. Cyder left to work upon coarse foul lees will ferment with great vigour, but is apt to expand itself, and to leave either an insipid subacid liquor, or to burst the casks, if closed too soon. Spirits are the best preventative to both: on the continent, and in America, we understand that those few who make good cyder (which is extremely scarce in those parts, though apples of the finest qualities abound) invariably doctor the stum when the fermentation is either defective or excessive: having abundance of spirits, they can easily prevent that mischief, which in this country could not be obviated at any moderate expense. When cyder fails, and becomes acid, the acetous change should be encouraged: it makes excellent vinegar, worth at least two shillings and six-pence the gallon; whereas in cyder countries the same quantity used as beverage would not produce more than two shillings; from which deduct the duty, which is about five-pence per gallon. When cyder has been well made, and is put into capacious vessels, it will keep sound for many years; becoming rich and mellow: in small quantities it is more apt to become flat. When bottled for many years, it is common to find it taste very strongly of the cork; and if the straw in which it is packed be not thoroughly dry, the liquor will acquire a very unpleasant musty flavour. All preparations used for fining cyder are highly injurious to its quality; racking from the lees into fresh vessels, after the fermentation has moderated, is the only proper mode of removing the impurities.

We are concerned to state, that those kinds of apples which were so long famous for yielding a fine stum are much on the decline; and that no means have hitherto been discovered of preventing the untimely decay of the trees. It is to be hoped, that we shall either receive some fresh grafts from the continent, or that some ingenious person will devise the means of preserving what we have from the canker, which destroys our best orchards after a few years growth.

Explanation of Plate IV. Miscel. fig. 3. A. shews the vertical section of the stone roller, with its axis C C. The suggested improvement consists in rounding its edges, and in suiting the bottom of the trough B, B, B to that shape.

Fig. 4, shews the side of the wheel, half way buried in the trough, of which L is the upper line, and K K the bottom. The arm E moves freely on the axis F, and is fastened at C, by a hinge, to the board H H; which is kept in its place on the surface of the trough, by the pins I I; of which there are two on each side. Thus the wheel (or stone) D revolves, at whatever height the board will maintain its position. If too light, it may be loaded.

Fig. 5, shews the two cylinders, with their manner of locking into each other; one crank turning both; the teeth *o*, *o*, fitting into the mortices *p*, *p*. The wheels M and N, having by this means contrary motions, catch the apples between their approaching surfaces, and by aid of the teeth crush them into small pieces; which are reduced to a perfect pulp as they pass between the rollers into the vessel below. X is the handle of the winch.

This machine, fig. 5, is in common use in the west of England, and is found to answer well.

CYGNUS, in astronomy, a constellation of the northern hemisphere. See ASTRONOMY.

CYLINDER, in geometry, a solid body, supposed to be generated by the rotation of a parallelogram. If the generating parallelogram be rectangular, the cylinder it produces will be a right cylinder, that is, it will have its axis perpendicular to its base. If the parallelogram be a rhombus, or rhomboides, the cylinder will be oblique or scalenous.

CYLINDER, *properties of the*. 1. The section of every cylinder by a plane oblique to its base is an ellipsis. 2. The superficies of a right cylinder is equal to the periphery of the base multiplied into the length of its side. 3. The solidity of a cylinder is equal to the area of its base multiplied into its altitude. 4. Cylinders of the same base, and standing between the same parallels, are equal. 5. Every cylinder is to a spheroid inscribed in it, as 3 to 2. 6. If the altitudes of two right cylinders be equal to the diameters of their bases, those cylinders are to one another as the cubes of the diameters of their bases.

To find a circle equal to the surface of a cylinder, we have this theorem: the surface of a cylinder is equal to a circle, whose radius is a mean proportional between the diameter and height of the cylinder. The diameter of a sphere and altitude of a cylinder equal thereto being given, to find the diameter of the cylinder, the theorem is, the square of the diameter of the sphere is to the square of the diameter of the cylinder equal to it;

nearly, as triple the altitude of the cylinder to double the diameter of the sphere.

CYLISTA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: calyx very large, four-parted; the upper division cleft at the end; corolla permanent. There is but one species, *viz.* C. villosa, hairy cylista. It flowers in April and May, was introduced in 1776, but from what country is not known. It is a shrub, and requires the heat of the stove to preserve it.

CYMATIUM, in architecture, the crowning members of a cornice, being synonymous with cyma recta, and cyma reversa.

CYMBACHNE, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Gramina, or grasses. Essential character: inflorescence half spiked; herm, calyx two-glumed, one-flowered, parallel to the rachis; outer valve linear, the opposite boat-form; female calyx one glumed, ovate, opposite to the rachis. One species, *viz.* C. ciliata. This is a slender grass, a foot in height, with several culms, simple or branched, with a single leaf, or leaflets. It is found in Bengal.

CYMBAL, a musical instrument in use among the ancients. The cymbal was round, made of brass, like our kettle-drums, and, as some think, in their form, but smaller, and of different use.

CYMBARIA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx ten-toothed; capsule cordate, two-celled. There is only one species, *viz.* C. daurica, a native of the mountains of Dauria.

CYNANCHUM, in botany, a genus of the Pentandria Digynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; nectary cylindric, five-toothed. There are twenty seven species. These shrubs are commonly twining; leaves opposite; flowers axilliary or terminating, disposed in spikes, corymbs, or umbels. These are plants chiefly inhabitants of hot climates. They are tender, and will not thrive in this country, unless they are placed in a bark stove. A new species has been discovered in Egypt by Mr. Nectoux, to which he has given the specific name of *Oleafolium.* He says this species is mixed with the capia lanceolata of Lamark, or true senna: and that the natives say it is superior to the senna as a mild purgative.

CYNARA, the *artichoke*, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Capitatæ. Cinarocephalæ, Jussieu. Essential character: calyx dilated, imbricate, with fleshy scales, emarginate, with an acumen. There are six species. The artichoke in its wild state is said to attain the height of a man. The leaves are more tomentose than in the garden plant, and every small division of them is armed with a strong yellowish spine. The heads are smaller, and have larger stronger spines at the ends of the scales. It is a native of the South of Europe. In some parts it is eaten raw in its wild state by the common people. It will dye a good yellow: the flowers are used instead of rennet to turn milk for cheese. The whole plant has a peculiar smell, and a strong bitter taste.

CYNICS, a sect of ancient philosophers, who valued themselves upon their contempt of riches and state, arts and sciences, and every thing, in short, except virtue or morality.

The sect of the Cynics, founded by Antisthenes, is not so much to be regarded as a school of philosophy, as an institution of manners. It was formed, rather for the purpose of providing a remedy for the moral disorders of luxury, ambition, and avarice, than with a view to establish any new theory of speculative opinions. The disciples of Antisthenes, and other leaders of this sect, considered their masters, not as authors of any new doctrine, but as patrons of strict and inflexible virtue; and were regarded by them, rather as examples for their imitation in the conduct of life, than as preceptors to guide them in the search of truth.

The sole end of the Cynic philosophy was, to subdue the passions, and produce simplicity of manners. The characteristic peculiarities of the sect were, an indignant contempt of effeminate vices, and a rigorous adherence to the rules of moral discipline. A Cynic, according to the original spirit of the sect, was one who appeared in a coarse garb, and carried a wallet and staff, as external symbols of severity, and who regarded every thing with indifference, except that kind of virtue which consists in a haughty contempt of external good, and a hardy endurance of external ill. Simplicity and moderation were indeed in this sect carried to the extreme of austerity, and at last produced the Stoic system of apathy; but the real design of the founders, both of the Cynic and the Stoic Sect, seems to have been to establish virtuous manners. The rigorous discipline which was practised by the first Cynics, and which afterwards degenerated into the most absurd severity, was at first adopted for the laudible purpose of exhibiting an example of moderation and virtuous self-command. If, in executing this praise-worthy design, a portion of vanity blended itself with the love of virtue, who will not be inclined to pardon the weakness, out of respect to the merit of the character? That they might be perfectly at liberty to apply themselves to the cultivation of virtuous habits and manners, without interruption from the noisy contests of speculative philosophy, the Cynics renounced every kind of scientific pursuit; contending, that to those, who are endued by nature with a mind disposed to virtue, the pursuits of learning are an unnecessary and troublesome interruption of the main business of life. Hence they entirely discarded all dialectic, physical, and mathematical speculations, and confined themselves to the study, or rather to the practice, of virtue. This was certainly injudicious; but it is some apology for their error, that Socrates had taken pains to inspire his followers with a contempt of theoretical science, when considered in comparison with practical wisdom. It may also be added, that the learning which flourished at that time in Greece chiefly consisted in futile speculations, and an illegitimate kind of eloquence, which contributed little towards the happiness of society, or the real improvement of the human mind.

The sum of the moral doctrine of Antisthenes and the Cynic sect is this: Virtue alone is a sufficient foundation for a happy life. Virtue consists, not in a vain ostentation of learning, or an idle display of words, but in a steady course of right conduct. Wisdom and virtue are the same. A wise man will always be contented with his condition, and will live rather according to the precepts of virtue, than according to the laws or customs of his country. Wisdom is a secure and impregnable fortress; virtue, armour which cannot be taken away. Whatever is honourable is good; whatever is disgraceful is evil. Virtue is the only bond of friendship. It is better to associate with a few good men against a vicious multitude, than to join the vicious, however numerous, against the good. The love of pleasure is a temporary madness. The following maxims and apothegms are also ascribed to Antisthenes: As rust consumes iron, so doth envy consume the heart of man. That state is hastening to ruin, in which no difference is made between good and bad men. The harmony of brethren is a stronger defence than a wall of brass. A wise man converses with the wicked, as a physician with the sick, not to catch the disease, but to cure it. A philosopher gains at least one thing from his manner of life, a power of conversing with himself. The most necessary part of learning is, to unlearn our errors. The man who is afraid of another, whatever he may think of himself, is a slave. Antisthenes being told that a bad man had been praising him, said, "What foolish thing have I been doing?"

CYNIPS, *gall-fly*, in natural history, a genus of insects of the order of Hymenoptera. Generic character: mouth with a short one-toothed membranaceous jaw, the mandibles vaulted; horny cleft, the lip entire, feelers four, short, unequal, capitate; antennæ moniliform; sting spiral, often concealed within the body. There are 35 species enumerated. The numerous excrescences, or galls, found on the roots, branches, and leaves of various trees, are produced by the puncture of these insects; the larva is without feet, soft, cylindrical, and inhabits within the gall, feeding on the juices of the tree; the pupa resembles the perfect insect, except in having only the rudiments of wings. C. querci, or oak-leaf cynips, is of a burnished shining brown colour. It is found in the hard galls under oak leaves, generally fastened to the fibres. Frequently, instead of the cynips, there is seen an ichneumon, which is a larger insect. This is not the inmate of the gall, or he that formed it, but a parasite, whose mother deposited her eggs in the yet tender gall, which, when hatched, brings forth a larva that destroys the larva of the cynips, and comes out when it has undergone its metamorphosis, and acquired its wings. The cynips of the oak-bud is of a very dark green, slightly gilded: it produces one of the finest galls, leafed like a rose-bud begining to blow. The gall is often an inch in diameter.

CYNOGLOSSUM, in botany, English hound's tongue, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: corolla funnel form, the throat closed with arches; seeds flat, affixed to the style by the inside only. There are twelve species.

CYNOMETRA, in botany, a genus

of the Decandria Monogynia class and order. Natural order of Leguminosæ. Essential character: calyx four-leaved; anthers bifid at the tip; legume fleshy, crescent shaped; one-seeded. There are two species, *viz.* C. cauliflora, and C. ramiflora. These trees are natives of the East Indies. Their flowers are conjugate; and their peduncles are many flowered.

CYNOMORIUM, in botany, a genus of the Monoecia Monandria class and order. Natural order of Amentaceæ. Essential character: male calyx an imbricate ament; corolla none; female calyx in the same ament; corolla none; style one, seed one, roundish. There are three species.

CYNOSURUS, in botany, dog's tail, a genus of the Triandria Digynia class and order. Natural order of Gramina, or Grasses. Essential character: calyx two-valved, many flowered; receptacle proper, unilateral, leafy, there are twenty species. Several of them are natives of the East and West Indies. Few of these are known in Europe, otherwise than by specimens or description.

CYPERUS, in botany, a genus of the Triandria Monogynia class and order. Natural order of Calamariæ. Cyperoideæ, Jussieu. Essential character: glumes chaffy, imbricate in two rows; corolla none; seed one, naked. There are fifty-three species. Most of these plants have three cornered culms or stems. The flowers in aggregate peduncled and umbelled spikes. The lower chaffs are frequently empty. The greater part of them are natives of the East or West Indies, and will therefore, if propagated here, require the protection of the bark-stove.

CYPHER, or CIPHER. To write in cypher denotes the art of communicating by writing in such a manner, as shall be legible only to those who are acquainted with the rules by which the characters made use of are formed or disposed. It is principally used in diplomatic correspondence, or on other national affairs, such as those relating to the operations of war. As the nature of alphabetic writing, and the structure of languages, necessarily imply certain indispensable habitudes of the letters and words, it often happens that the laws or conditions made use of for the sake of secrecy can be detected by skilful persons, and the secret by that means discovered. The art of discovering the sense of writings of the description here mentioned is called decyphering.

One of the most obvious methods of disguising the alphabet will consist in changing the characters. Thus, for example, if the English language were written in Greek characters, it would not be legible by a person unacquainted with them; or if the English alphabet were to be transposed, as by taking every consequent letter for its antecedent, namely, *b* for *a*, *c* for *b*, *d* for *c*, &c.; or by any other rule of arrangement, the same consequence would follow, and the writing would be secret, unless the sagacity of the reader should enable him to develope the conditions; which in the cases here mentioned it would not be difficult to do.

From the comparative facility of decyphering writings made in a disguised single alphabet, it became necessary to use contrivances of less simplicity. By substituting figures in the place of letters, and by using more than one figure to denote each letter; and, in addition to this, by adopting a considerable number of distinct characters, letters, or combinations of figures, for each letter of the alphabet, the difficulty of decyphering may be prodigiously augmented. Thus, for example, if a table were made consisting of twenty-four vertical columns, having a letter of the alphabet at the head of each; and six distinct ranges of characters were placed on horizontal lines beneath; and, in particular, if a greater number of characters were allowed for the vowels, in proportion to their frequency of recurrence; and if, in writing, each range be used in succession; the developement of a communication thus made would be extremely difficult. Or, otherwise, if a square of twenty-five compartments be made resembling the multiplication table, but containing the letters of the alphabet, and the first five digits be placed over the top row and down the side, each letter may be denoted by the two figures which stand opposite the same, namely, at the top and the side, as in the table beneath.

1	2	3	4	5	
a	*f*	*k*	*p*	*v*	1
b	*g*	*l*	*r*	*w*	2
c	*h*	*m*	*s*	*x*	3
d	*i*	*n*	*t*	*y*	4
e	*j*	*o*	*u*	*z*	5

In this manner, the letter *a* will be denoted by 11, and the letter *b* by 12, the letter *n* by 34, and the letter *w* by 52,

&c.; and as it is advantageous, in every kind of cypher, that the words should not be written from each other, or with spaces between, but that every line should be continuous throughout, the other digits, namely, 67890, may be used to denote blank spaces. It is manifest also, that if there were four or five of these tables, each containing the alphabet in a different order of arrangement, and the several lines of the intended communication were to be written, in succession, according to each of the tables respectively, the task of decyphering would be greatly enhanced.

In fact it does not appear difficult to contrive a multiplicity of cyphers, which shall be beyond the reach of human skill to develope, otherwise than by some fortuitous circumstance or happy observation, not dependant upon rule; but at the same time it must be observed, that most of those cyphers which are the most difficult to discover are also tedious, and not unfrequently difficult in the use.

For the sake of brevity we pass over the variety of arbitrary marks, which may be substituted for the letters of the alphabet, or for entire words; such as a single dot or right line, or unvaried character, deriving its distinct significance from its several positions with regard to ruled lines or spaces on the paper; which lines may either be actually drawn or apparent, or else their places may be indicated by dots or other marks, to enable the reader himself to draw them. Writing, by means of the characters of music, comes under this class; and the telegraphic signals now so generally adopted may be referred to those arbitrary combinations of dots which signify letters or words. And when the notion of these combinations has once been clearly apprehended, it will be easy to deduce the methods of communicating intelligence by combinations, either contemporaneous or successive, of torches, fires, rockets, or the sounds of bells, trnmpets, cannon, and other suitable instruments.

The number of contrivances which have been or may be adopted, for the conveyance of secret intelligence, seem capable of unlimited variation, according to the acuteness of the contrivers. Pantomimic signs and gestures are practised by every one, and are usually carried to such an extent, that we forget that the performers in this description of comedy have no oral communication. The expedients of a knotted string, which, when stretched out, shall apply to letters or words upon a gage possessed by the receiver: the scytale of Lysander, or slip of parchment, containing writing which became legible when wrapped round a staff: the elaborate invention of Hystiæus, who pretended to cure a servant of sore eyes by shaving his head, and writing his secret upon the scalp with a scarifying instrument, after which the man being confined till his hair had grown, this extraordinary epistle became in a fit state to be forwarded, along with its bearer, to the place of destination. These, and many others of sufficient note in history, as well as the events of common life among smugglers and others, manifest a variety of instances of the secret conveyance of small parcels, such as parchment, paper, cambric, lace, and the like. A pye, or a bottle of wine or beer, small casks of pickles or provision; the interior of the construction of saddles, of shoes, or other parts of wearing apparel; a false skin laced upon a dog: the intestines of a living animal, or of the human subject employed in swallowing a small receptacle, containing a letter, to be afterwards evaculated.—This short list of vehicles may point out how extensive the general means of secret communication may be made.

We shall conclude the present article, which would require a volume to do it justice, by mentioning two other modes of communication with a considerable degree of secrecy, though they are perhaps liable to the objection of slowness in the writing. The first consists in the use of a dictionary, or other work, which must be paged throughout, and, if convenient, the lines should be counted: but this last necessity may be supplied by means of a scale, or slip of parchment, with lines and numbers from top to bottom, which may be applied to any page, when wanted for readily counting the lines. The correspondents being each provided with the same edition of the same work, the writer is to complete his letter in the usual manner; but, instead of sending off that copy, he sends another, wherein, instead of the words, he writes for each the page, line, and numerical situation in the line, of each word. The correspondent will therefore discover them by seeking in his dictionary, or printed work. It will easily be seen that this method amounts to the same thing, as if an index locupletissimus were made of the author to the minuteness here mentioned, and one of the numeral indications were to be put down in each instance instead of the word itself. The other method consists in the use of a piece of parchment, ruled with lines corresponding with other lines upon the paper upon which the letter is to be written. Holes are cut through the parchment here and there upon the lines. The parchment thus prepared being laid upon the paper, the letter is to be written through the holes; after which the paper is to be uncovered, and the remaining spaces between the words filled with other matter, so as to make a significant letter. The true letter can therefore only be read by a correspondent in possession of a parchment exactly like the original.

Upon this contrivance it may be remarked, that it is crude and inartificial; and that it supposes the writer to possess sufficient ingenuity and talent to make a rational and clear letter by filling the spaces, and also that he has so much command and management of his pen, as that the secret words shall not be discovered by some crookedness in the line, crowding of the space, difference in the pen or ink, or some other circumstance attendant on the writing. In the event of these or any other failure, the letter will be liable to suspicion. It is true, nevertheless, that the method of writing by interposed words may be rendered less objectionable, by placing the significant parts at certain intervals among the others; not by measure, but by reckoning from the beginning according to some agreed rule; and in this method the objections with regard to penmanship will be done away by writing the letter over again, after it has been once completed.

The method of secret writing by transparent or invisible inks has been little used in real business, and is entitled to no confidence. This process is effected by using a transparent or dilute solution of some ingredient which becomes coloured by the action of heat or light, or of some other ingredient. Thus, if a letter be written with a dilute solution of sulphate of iron, or green copperas, it will be invisible when dry: but if the paper be wetted by a feather dipped in the infusion of galls, the writing will become black; or if the prussiate of potash be used instead of the galls, the letters will be blue. The objection to sympathetic inks is, that the writing becomes visible spontaneously after a short time, and that most of them are rendered visible by the application of any metallic solution, or simply by holding them to the fire till the paper is a little scorched. When a secret ink is used, it is advisable, in order to prevent suspicion, that a common letter should be written with the ordinary ink between the lines. See INK, and also DECYPHERING.

CYPRÆA, *cowry*, in natural history, a genus of the Vermes Testacea. Animal a slug; shell univalve, involute, sub-ovate, smooth, obtuse at each end, linear, extending the whole length of the shell, and toothed on each side. This is a very numerous genus, of which there are several distinct families; one of these is dintinguished by being obtuse, and without any manifest spire; such as the caput serpentinus and tigris, the last of which is well known by the appellation tiger cowry. Another kind is perforated or furnished with an umbellicus, as in the C. ziczac. A different sort is margined like the common West India cowry, commonly called "blackamoor's teeth." In the young, the cypræa have much the appearance of a volute, and are entirely destitute of the thick denticulated lip or margin, so obvious in the adult shells.

CYPRESS, the English name of a genus of trees. See CUPRESSUS.

CYPRINUS the *carp*, in natural history, a genus of fishes of the order Abdominales. Generic character: mouth small and without teeth; gill membrane, with three rays; ventral fins often, and, perhaps, generally nine-rayed. Of this fish there are fifty species, of which it will be sufficient to notice the following: C. carpio, or the common carp. This fish inhabits the slow and stagnant waters of many countries in Europe, in which it is found extremely to vary in size, from 16 inches to the length of 3 or 4 feet. In Persia the carp is not unfrequently found of this length, and will weigh from 30 to 40 pounds. It was introduced into England in the 16th century. It feeds on herbs, worms, and water insects: it is extremely prolific, the roe having been occasionally found to weigh as much as the real substance of the fish: the principle of vitality in the carp is uncommonly strong: it may be kept alive in a damp situation for a very considerable time after being taken from the water; and if wrapped in wet moss, and plunged in water every four hours, and fed on bread and milk, will not only continue to exist, but will thrive and fatten; it has been ascertained to live to a very considerable age, when they become completely white. The carp was classed by the ancients among sea-fish ; it is, however, generally found in ponds and rivers ; and now considered as a fresh-water fish. For a variety of this species, called the large scaled carp, see Pisces, Plate III. fig. 4.

C. auratus, or gold-fish. This was introduced into England at the close of the 17th century: and, towards the middle of the last, was become extremely common. It exceeds in splendour all the other inhabitants of the waters: in the full grown fish the prevailing colour is that of the richest gold, accompanied by a tinge of scarlet on the upper part, and of silver on the lower. Its native spot is supposed to be the province of Kiang in the south of China, from which it has been conveyed to every part of that vast empire, being introduced into the gardens of the opulent, and even into their apartments, in vases of immene size, and the most exquisite workmanship. It appears sensible to favours, and capable of attachment; and by the sprightliness of its movements also, as well as the unrivalled splendour of its colours, is one of the most interesting objects of care and attention to the ladies of that country. In England it has now long excited particular regard. It is fed with small worms and fine bread, and occasionally with the yolks of eggs dried and pounded to powder ; it breeds as rapidly as the common carp; a frequent change of water is desirable for it, particularly in hot weather, and the vessel in which it is kept should be considerably open to the air.

C. tinca, or the tench. This is found in almost every country, and is sometimes seen of the weight of eight, ten, and even twenty pounds : its common length, however, is about twelve inches ; and its scales, as numbered by some curious naturalists, to have amounted to thirty thousand ; its favourite haunts are stagnant waters, which have a soft and muddy bottom, and under this it is supposed, by many, to lie concealed and torpid during the winter. The ancients considered it as a fish fit only for vulgar tables, and in Germany the same opinion is now prevalent ; in England, however, it is considered as a delicacy. It differs much in quality, according to the situation it dwells in, and the male fish is generally considered as far superior to the famale. The tench resembles the carp in extraordinary tenaciousness of life, as also in rapid growth and extreme fecundity.

C. jeses, the chub, is a fish frequently to be met with in this country, but is generally much smaller here than in many other parts of Europe, as it weighs in Germany commonly from five to eight pounds : it is strong and swift, and prefers the most clear and rapid streams : it grows but slowly, and it is considered as tasteless and coarse food.

C. gobio, or gudgeon, abounds much in the rivers of this country, particularly in the Kennet and Cole, where it is also in the highest perfection. Gudgeons very rarely exceed a few ounces in weight : they prefer small lakes and gently flowing rivers, especially where there is a gravelly bottom, to all other situations : small worms and aquatic insects are their food, and in quest of these they almost always remain at the bottom of the streams where they reside : they are extremely prolific, and highly admired for the table : they do not deposit at once all their spawn, but with considerable intervals, so that the whole process continues for a month. In some places of Germany the lakes are most copiously stored with these fish.

C. phoxinus, or minnow, is frequent in clear gravelly streams, and in England appears first in March, and towards November shelters itself in the muddy or gravelly bottom, remaining in this secreted, and, perhaps, in a torpid state, during the winter; it is about three inches in length ; and is one of the most elegant of European fishes : it is gregarious, and though but seldom used for food, on account of its minute size, is regarded as a very delicate fish : it is frequently employed as bait for trout and other comparatively large fishes, known to prey upon them with great avidity.

CYPRIPEDIUM, in botany, English ladies' slipper, a genus of the Gynandria Diandria class and order. Natural order of Orchideæ. Essential character : nectary ventricose, inflated, hollow. There are five species.

CYRILLA, in botany, so named in honour of Dominico Cyrillo, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Essential character : calyx superior, five-leaved ; linear lanceolate ; corolla declined, funnel form ; tube cylindric, gibbous on its lower edge ; throat tricallous ; segments roundish, the three lower more produced ; filaments inserted into the margin of the corolla, incurved, with a fifth barren ; anthers cohering ; germ inferior, half emerging, with a nectareous lid ; style bent down ; stigma two-lobed ; capsule half two-celled, with two parted receptacles ; seeds numerous. There is but one species, *viz.* C. pulchella, a native of Jamaica.

CYRTANTHUS, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Spathaceæ. Narcissi, Jussieu. Essential character: corolla tubular, club-shaped, crooked, six-cleft; segments ovate oblong; filaments inserted into the tube, converging at top. There are two species, *viz.* C. angustifolius, narrow-leaved cyrtanthus, and C. obliquus, oblique-leaved cyrtanthus. These are both natives of the Cape of Good Hope.

CYTINUS, in botany, a genus of the Gynandria Octandria class and order. Natural order of Aristolochiæ, Jussieu. Essential character: style one; calyx four-cleft, superior; corolla none; anthers sixteen, sessile; berry eight-celled, with many seeds. There is but one species, *viz.* C. hypocistis, rape of cistus, a parasitical plant, growing at the roots of the cistus; leaves sessile, closely imbricate; flowers terminating, heaped. Native of the country of Nice, Spain, Portugal, and Barbary.

CYTISUS, in botany, laburnum, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: calyx two-lipped; upper lip two-cleft: lower three-toothed; legume attenuated at the base. There are eighteen species. All the cytisus's are shrubs without spines, most of them fit for ornamental plantations. They are hardy; the leaves are ternate, and in some the flowers grow in bunches.

D.

D, One of the letters of the alphabet, the fourth in order, and the third consonant. It is formed in the voice, by applying the top of the tongue to the fore-part of the palate, and then separating them with a gentle gust of the breath, the lips being at the same time open.

As a numeral D denotes 500; and with a dash over it thus, $\overline{D}$, 5000. Used in abbreviation, it has various significations: thus, D. stands for doctor, as M. D. doctor of medicine; D. T. doctor of theology; D. D. signifies doctor of divinity; D. D. D. is used for dat, dicat, dedicat; and D. D. D. D. for dignum deo donum dedit.

DAB. See PLEURONECTES.

DACE, a species of Cyprinus.

DACTYL, in ancient poetry, a metrical foot, consisting of one long and two short syllables, as mūrmŭrĕ. The dactyl and spondee are the only feet or measures used in hexameter verses; the former being esteemed more sprightly, and the latter more solemn and grave.

DACTYLIOMANCY, a sort of divination, performed by means of a ring; consisting chiefly in holding the ring suspended by a fine thread over a round table, on the edge whereof were made several marks with the twenty-four letters of the alphabet; and as the ring, in shaking or vibrating over the table, happened to stop over certain of the letters, these being joined together composed the answer required.

DACTYLIS, in botany, a genus of the Triandria Digynia class and order. Natural order of Grasses. Essential character: calyx two-valved, compressed; one valve larger, keeled. There are seven species, of which D. cynosuroides, American cock's-foot grass, is a perennial, and a native of Virginia and Canada. The culms are two feet high and reedy; leaves on the culm six, broad, very glossy, scabrous about the edge, bent in; spikes six or more, diverging, chaffy; calyxes one flowered, scabrous on the keel, mucronate; pistils villose, very long.

DÆMON, a name given by the ancients to certain spirits, or genii, which, they say, appeared to men, either to do them service or to injure them. The Platonists distinguish between gods, dæmons, and heroes. The gods are those whom Cicero calls *Dii majorum gentium.* The dæmons are those whom we call angels. Christians, by the word dæmon, understand generally evil spirits; but the late learned Mr. Hugh Farmer has investigated the subject with the utmost care, and shews, upon seemingly incontestible evidence, that the word is applied always to human spirits. From the arguments adduced by the same author, it should appear that all persons, spoken of as possessed with devils in the New Testament, were either deranged or epileptic, and in the same condition with madmen and epileptics of modern days.

DAFFODIL, the same with the narcissus of botanists.

DAGYSA, in natural history, a genus of the Vermes Mollusca. Generic character: body loose, nayant, angular, tubular, and open at each extremity. One species, *viz.* D. notata, found in the Spanish sea, is about three inches long and one thick. Body marked at one end with a brown spot. This genus is very like the SALPA; which see.

DAIRY. See AGRICULTURE.

DAIS, in botany, a genus of the Decandria Monogynia class and order. Natural order of Vepreculæ. Thymeleæ, Jussieu. Essential character: involucre four-leaved; corolla four or five-cleft; berry one-seeded. There are three species, of which D. cotinifolia, cotinus-leaved dais, is an ornamental green-house shrub, of the deciduous kind; not having yet produced any perfect seeds here, as it does in Holland, it keeps up a very high price among nursery men.

DAISY. See BELLIS.

DALBERGIA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: filaments two, four-cleft at top. Fruit pedicelled, not opening, leguminose, membranaceous, compressed. There are two species, *viz.* D. lanceolaria and D. monetaria; the former is a native of Malabar and Ceylon, the latter of Surinam, in moist places.

DALECHAMPIA, in botany, so called in honour of Jacobus Dalechampius; a genus of the Monoecia Monadelphia class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: outer common involucre with four leaflets; inner with two trifid leaves: male, umbellule ten-flowered; involucre two-leaved, with numerous chaffs; proper perianth-five leaved; corolla none; filaments very many, connate; female floscules three; involucle three-leaved; proper perianth with eleven leaflets; corolla none; style filiform; capsule tricoccous. There are two species, *viz.* D. colorata, coloured dalechampia, found in New Granada: and D. scandens, climbing dalechampia, is a native of the West Indies.

DAMA. See CERVUS.

DAMASKEENING, or DAMASKING, the art or operation of beautifying iron, steel, &c. by making incisions therein, and filling them up with gold and silver wire; chiefly used for adorning sword blades, guards, and gripes, locks of pistols, &c.

DAMASONIUM, in botany, a genus of the Hexandria Hexagynia class and order. Essential character: spathe one-leafed, perianth one-leafed, three-parted; petals three; berry ten-celled, inferior. There is but one species, *viz.* D. alismoides, with heart-shaped leaves, nerved, floating, unarmed; scape naked, quadrangular, one-flowered. There are only six stamens in the flower, with six bifid styles. Native of the East Indies, Malabar, Ceylon, &c.

DAMPS, in natural history, noxious steams and exhalations, frequently found in mines, pits, wells, and other subterraneous places. See GAS.

DANCE, or DANCING. The causes which produce the active operation of dancing are as completely inherent in the human system, as any of those which are generally called involuntary affections of the nerves. A review of the history of mankind will serve to prove, that the passions are expressed by the same disposition of the muscles in every quarter of the globe, and that joy has produced an inclination to dance throughout the individuals of nations, who know not of each other's existence. In the very early ages of the world, before civilization had polished the ideas, sudden joy may be supposed to have been almost the only stimulus to dancing, and this supposition is corroborated by present observation; the moderns have, indeed, so far refined their feelings, that their disposition to leap or skip with joy is confined to the minuet step in walking, which may be frequently discovered when the features express pleasure. On the contrary, the rude child of nature, endued with nerves of exquisite sensibility, having obtained some desired object, received that inexplicable shock, which the Divinity hath decreed man shall not fully comprehend; immediately the subtle pleasure extended to every fibre of his frame, and the convulsive motion became a dance; as joy is communicable, his family were inspired, his neighbours caught the infection, and the manner of this first dance necessarily assumed some degree of method, to prevent collision. Such may have been the principal cause of dancing; another arises from certain combinations of sounds, which, vibrating strongly upon the air, communicates an impulse to the delicately sensible something residing in the nervous system; when the sounds are musical, the limbs are compelled to answer to them; and whether they are merely sufficient to produce a march, or measured steps, or powerful enough to excite violent action, they equally belong to dancing. In order to demonstrate the truth of the above remarks, it may be necessary to mention the present state of dancing in savage life; the natives of Africa, particularly, carry it to the most extravagant excess; a few strings stretched across a dried calabash, struck by the fingers, producing a set of deep discordant tones, is a sufficient stimulus for the inhabitants of a village to weary nature completely, and this passion never leaves even the unhappy slaves conveyed thence to the West Indies and America, who dance away those hours granted them for repose. The Indians of North America, more ferocious in their manners, have their war dances, and others suited to the dreadful operation of torturing their prisoners. The natives of the places discovered by captain Cook entertained him with well contrived movements by their experienced dancers, and he witnessed others locally festive and funereal; and the Mexicans dance in a barbarous style to the sounds of drums and pipes, similar to those of Otaheite.

Having thus shewn that dancing is less an art, than a natural effect of joy and lively musical sounds, it will be necessary to trace its history when polished and improved by art; some indeed consider it as a branch of the fine arts, and closely allied to dramatic poetry. Dancing was used by the refined nations of antiquity as a religious tribute; the apostate Israelites danced round their golden calf; and at the more improved period, when king David composed his inspired lines, the Supreme Being received public homage in solemn movements; and that monarch, affected by the most lively joy at the return of the sacred ark from captivity, danced before it, with the greatest fervour, in the grand procession which restored it to the lawful proprietors.

Plato classes the dances of antiquity under three heads; the gymnopedique, performed by naked children, which were preparatory to the enoplian, or pyrrhic, danced by young men armed, in which they were taught the movements necessary for attack or defence; the Spartans decreed by law, that all male youths, who had attained their fifth year, should be trained to these military dances. The second class, mentioned by Plato, was solely for amusement; amongst the variety under this head, they had some extremely simple, particularly the ascoliasmus, performed by jumping with one foot on oiled and distended bladders, to the sound of voices, and the kybeslesis, now known in England as the somerset; but those, and others of their dances, degenerated into voluptuousness and indecency. The third class, or the religious, were considered indispensable in the celebration of all their mysteries; the most ancient was the bacchic, the most solemn the hypochematic, suited to the accompaniments of a lyre and the voice. Plutarch mentions a dance composed by Theseus, and performed by him and a number of youths round the altar of Apollo, on his return from Crete, which consisted of the strophe, the antistrophe, and the stationary; in the first, the movements were from the right to the left; in the second, the reverse; and in the last, the performers danced a slow movement before the altar.

The Greeks made dancing an appendage to their dramatic representations, and were imitated, and even excelled, by the Romans, particularly in the Augustan age, when Pylades danced and used such action and gesticulation, as expressed all the pathetic emotions of tragedy, and Bathylus, his contemporary, was equally happy in exhibiting the more lively passions. In short, such were their excellence in ballet or pantomimic dancing, that as they had brought the art to its acme, so it declined with them, nor was it revived till the celebration of the marriage of Galias, duke of Milan, with Isabella of Arragon, in the 15th century, when a Lombard nobleman exhibited a ballet at Tortona of the most splendid description, that excited the warmest approbation throughout Europe, and served as a model for imitation. Since the above period, almost every civilized nation has adopted stage dancing, which is now arrived to great perfection in England; nor has private dancing experienced less attention, as many treatises have been written on the subject, amongst which is "Weaver's Essay towards an History of Dancing," and Tomlinson, a celebrated dancing master in the reign of queen Anne, published an entertaining work, in which he terms dancing a science, and described the steps by printed characters; to those may be added, Noverre's, Gallini's, and Peacock's observations and instructions; the latter gentleman declares "the fondness the Highlanders have for this quartett, or trio, (the Scotch reel) is unbounded; and so is their ambition to excel in it. This pleasing propensity, one would think, was born with them, from the early indications we sometimes see their children shew for this exercise. I have seen children of theirs, at five or six years of age, attempt, nay even execute, some of their steps so well, as almost to surpass belief. I once had the pleasure of seeing, in a remote part of the country, a reel danced by a herd boy and two young girls, who surprised me much, especially the boy, who appeared to be about twelve years of age. He had a variety of well chosen steps, and executed them with so much justness and ease, as if he meant to set criticism at defiance. Circumstances like these plainly evince, that those qualities must either be inherent in the Highlanders, or that they must have an uncommon aptitude for imitation." The music and dancing of Scotland is greatly admired in England; in truth, there is something so exhilarating and lively in the sounds of the former, that the writer of this article has frequently observed the heads and feet of a large audience suddenly set in motion by the unexpected performance of one of their favourite airs. Sensible of this predilection, it is not uncommon for the London professors of dancing to visit Edinburgh, in order to obtain a thorough knowledge of the steps and inflections used in the reels, and other dances peculiar to Scotland. Many modern votaries of this art have acquired the greatest precision in the movements and figures, to which they have added so much animation and dignity in their performance, that instances have occurred of personages of high rank, who, in the simple minuet, displayed such noble grace, as interested some of the spectators even to tears. This circumstance serves to prove, that the utmost care should be taken to prevent dancing from degenerating into the insinuating prelude to vice, as many of the experienced female performers on our different stages dress and exhibit their persons in a manner rather reprehensible, and at least remind us of the dancing girls of the East, where sets of young and beautiful prostitutes are taught the art of pleasing as a science, and to dance as a principal allurement. Some of those unfortunate beings are attached to the Gentoo temples, and the service of their priests, and the fascinations of several have been sufficiently powerful to attract the affections of chiefs and princes; others have acquired great wealth, and in the neighbourhood of Goa is a village, founded by them, where they reside, and attend the rich, when they choose to send for them to their voluptuous entertainments. These wantons array themselves in the utmost splendour and extravagance, and are certainly agreeable objects in the estimation of their countrymen; but Europeans differ greatly in their opinions respecting their persons and dances, some pronouncing their movements merely lascivious, and others graceful and dangerous. These observations are the more necessary, since dancing has become a favourite spectacle at our theatres, and as many of the grand ballets are attended with a considerable degree of pathos and effect, though frequently degraded by the extremity of gesticulation and distortion of the limbs, which can only be applauded for their difficulty, as they are directly opposite to the true principles of the art, founded on ease, grace, and agility.

Rope dancing, now classed with the low amusements of a fair, or theatres of the minor description, is of considerable antiquity, and an art very difficult to acquire, as it is almost impossible even to stand on the narrow diameter of a rope, extended several feet from the ground, without the utmost correctness of vision, and the total absence of apprehension; when this circumstance is recollected, it must be allowed that proficients in rope dancing deserve the applause they universally obtain, particularly when they unite their agile springs with graceful movements of the arms and legs, and throw themselves on their backs at length on the rope, turn suddenly round, leap over garters, pass through hoops, or ascend the steep line of the rope to the spot where it is fastened.

DANÆA, in botany, a genus of the Cryptogamia Filices class and order. Fructification oblong, linear, transversely immersed in front, parallel, many celled; cells in a double row, opening upwards; seeds numerous, very minute. There are two species, *viz.* the nodosa and alata.

DANEGELT, a tax, or tribute, on every hide of land, imposed on our ancestors, the Saxons, by the Danes, on their frequent invasions, as the arbitrary terms of peace and departure. It was first imposed as a continual yearly tax upon the whole nation, under King Ethelred. It was levied by William I. and II. but was released by Henry I. and finally abolished by King Stephen. No church, or church-land, paid the danegelt, because, as is set forth in the ancient Saxon law, the people of England placed more confidence in the prayers of the church, than in any military defence they could make.

DAPHNE, in botany, a genus of the Octandria Monogynia class and order. Natural order Vepreculæ. Thymeleæ, Jussieu. Essential character: calyx none: corolla four-cleft, corollaceous, withering, including the stamens; berry one-seeded. There are 28 species: these are shrubs about five feet high. D. Mezereum. Mezereon is a strong woody plant, putting forth branches on every side, so as to form a regular head. The flowers come out very early in the spring, before the leaves, in clusters all round the shoots of the former year. The leaves are smooth and entire, of a pale green colour, about two inches long and three quarters of an inch broad. It is a native of Lapland, Sweden, Denmark, Germany, Switzerland, France, and Great Britain. Another species, *viz.* Daphne lagetto, yields the *lace bark* of the West Indies. It is a native of Jamaica.

DARAPTI, among logicians, one of the modes of syllogisms of the third figure, whose premises are universal affirmatives, and the conclusion is a particular affirmative: thus,

Dar- Every body is divisible;
ap- Every body is a substance;
ti. Therefore some substance is divisible.

DAREA, in botany, a genus of the Cryptogamia Filices class and order. Fructification in scattered nearly marginal lines: involucre originating laterally from a vein, opening towards the margin. There are nine species.

DARII, in logic, one of the modes of syllogism of the first figure, wherein the major proposition is an universal affirmative, and the minor and conclusion particular affirmatives: thus,

Da- Every thing that is moved is moved by another;
ri- Some body is moved:
i. Therefore some body is moved by another.

DASYPUS, the armadillo, in natural history, a genus of Mammalia of the order Bruta. Generic character: no tusks; grinders short and cylindrical, and seven or eight in each jaw; body covered with a shelly armour, intersected by circles. These animals chiefly inhabit South America, where they burrow like rabbits in the ground, and live principally upon roots and fruits. They exhibit a singular difference from other quadrupeds, in that testaceous substance which covers them completely, and yet is so admirably adapted to their frame, by its minute intersections, as by no means to interfere with flexibility or quick movement. When attacked, they roll themselves up into the compactness of a ball; thus presenting to the enemy almost impenetrable armour. They repose by day, and at night quit their habitations for food. They are perfectly inoffensive. In a state of confinement they will devour with considerable appetite animal food, for which in a state of nature they do not appear to have any relish. They drink most copiously, and are often found extremely fat. They are regarded as a very great luxury for the table, and are not unfrequently dug from their burrows to be sold for food: for this purpose, however, they should always be taken young. Their claws are of uncommon size and strength, and enable them to form their subterraneous habitations with extreme facility. Shaw reports, that the female produces three or four times in a year; and Gmelin states, that she produces every month. It is ascertained, therefore, that they are highly prolific. It is the practice of naturalists to define the different species by the different number of testaceous circles in the body. Gmelin enumerates ten species, and Shaw six. This extraordinary variety among quadrupeds deserves the particular attention of naturalists, who do not appear to have so clearly defined the several species, or to have collected so many particulars of the manners and habits of the animal in general, as its most singular structure excites a desire to be informed of.

DATA, among mathematicians, a term for such things or quantities as are given or known, in order to find other things thereby that are unknown. Euclid uses the word data (of which he hath a particular tract) for such spaces, lines, and angles, as are given in magnitude, or to which we can assign others equal. The data of Euclid is the first in order of the books that have been written by the ancient mathematicians, to facilitate and promote the method of resolution and analysis. In algebra, the given quantities, or data, are expressed by the first letters of the alphabet, and the unknown quantities by the last letters; thus, if the problem be, from the sum and product of two quantities given, to find the quantities themselves, the quantities are represented by y and z; and $y+z=a$, the sum given, and $yz=b$, the product given. From the primary use of the word data in mathematics, it has been transplanted into other arts, where it expresses any quantity, which, for the sake of a present calculation, is assumed as true, without stopping to give a proof of it; called also the given quantity, number, or power. Hence also such things as are known are now frequently by physical writers denominated data.

DATE, in law, is the description of the day, month, year of our Lord, and year of the reign of the King, in which a deed or other writing was made. Anciently, deeds had no dates but only of the month and year, and now, if in the date of any deed the year of our Lord is right, though the year of the King's reign be wrong, it shall not hurt the same. A deed is good, though it has no date of the day, or if that be mistaken, or though it contains an impossible date; but then he that pleads such a deed must set forth the time when it was delivered: for every deed or writing has a date in law, and that is the day of the delivery; and where there is none, a plaintiff, it is said, may count it of any date.

In writings of importance, the date should be written in words at length.

In letters, it is usually written in figures.

An ante-date, is a date prior to the real time when the instrument was signed.

A post-date, is that posterior to the real time when the instrument was passed.

DATE. See Phœnix.

DATISKA, in botany, a genus of the Dioecia Dodecandria class and order. Essential character: male, calyx five-leaved; corolla none; anthers sessile, long, fifteen; female, calyx two-toothed; corolla none; styles three; capsule triangular, three-horned, one-celled, pervious, many-seeded, inferior. There are two species; *viz.* D. cannabina, smooth stalked bastard hemp, found in Candia; and D. hirta, rough stalked bastard hemp, a native of Pennsylvania. These are tall upright herbs, with alternate unequally pinnate leaves. The flowers are in spiked racemes, axillary, with one bracte; the flower is apetalous; fruit is inferior, and contains many seeds.

DATISI, in logic, a mode of syllogisms in the third figure, wherein the major is an universal affirmative, and the minor and conclusion particular affirmative propositions. For example,

Da- All who serve God are kings;
ti- Some who serve God are poor;
si. Therefore some who are poor are kings.

DATURA, in botany, English *thorn-apple*, a genus of the Pentandria Monogynia class and order. Natural order of Luridæ. Solaneæ, Jussieu. Essential character: corolla funnel-form, plaited; calyx tubular, angular, deciduous; capsule four-valved. There are eight species: these are all herbs, and annual, excepting one; the flowers and branches are solitary; they have a strong narcotic smell; most of the species, coming from hot countries, require the protection of a stove or glass case.

DAVELLIA, in botany, a genus of the Cryptogamia Filices. Fructifica in roundish distinct dots near the margin; involuce membraneous from the surface, half-hooded, distinct, somewhat truncate, opening toward the margin. There are eighteen species.

DAVIESIA, in botany, a genus of the Decandria Monogynia class and order. Calyx angular, simple, five-cleft; corolla papilionaceous; stigma simple, acute; legume compressed, one-seeded. One species, D. australasia, described by Dr. Smith in the fourth vol. of the "Linn. Transactions."

DAVIT, in a ship, that short piece of timber, with a notch at one end, wherein, by a strap, hangs the fish-block. The use of this block is to help up the fluke of the anchor, and to fasten it at the ship's bow, or loof. The davit is shiftable from one side of the ship to the other, as there is occasion. There is also a small davit in the ship's boat, that is set over her head with a shiver, in which is brought the buoy rope, wherewith to weigh the anchor; it is made fast to the carlings in the boat's bow.

DAUCUS, in botany, English *carrot*, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ. Essential character: corolla subradiate, all hermaphrodite; fruit hispid, with hairs. There are seven species, of which we shall mention D. carota, wild carrot, or bird's nest; this, in its wild state, has a slender, hard, brownish, fusiform root; the stem is two feet high, upright, grooved with alternate branches, which are long, commonly from six to ten inches; they have one leaf, except the primary or terminating one, which is naked; and have a single umbel of flowers at top; the universal umbel has sometimes from thirty to forty unequal rays; the middle rays being very short, the outer ones above an inch long: the flowers are white, those in the middle tinged with purple, these are fertile, those in the circumference, which are irregular and larger, are frequently neuter, or have pistils only; the fruit is spheroidal, composed of planoconvex seeds, on the back of which are four membranaceous narrow crests, pectinated with linear, setaceous, innocuous, flexible teeth. The carrot is commonly cultivated in gardens for the kitchen; the different varieties of it are in some places esteemed; in London, the orange carrot is preferred to all others.

DAY. In common language, the day is the interval of time which elapses from the rising to the setting of the sun; the night is the interval that the sun continues below the horizon. The astronomical day embraces the whole interval which passes during a complete revolution of the sun. It is the interval of time which passes from twelve o'clock at noon till the next succeeding noon. It begins when the sun's centre is on the meridian of that place. It is divided into twenty-four hours, reckoning in a numerical succession from one to twenty-four: the first twelve are sometimes distinguished by the mark P. M. signifying post meridiem, or afternoon; and the latter twelve are marked A. M. signifying ante meridiem, or before noon. But astronomers generally reckon through the twenty-four hours from noon to noon; and what are by the civil or common way of reckoning called morning hours, are by astronomers reckoned in the succession from twelve, or midnight, to twenty-four hours. Thus, nine o'clock in the morning of February 14th is by astronomers called February the 13th, at 21 hours. An astronomical day is somewhat greater than a complete revolution of the heavens, which forms a sideral day. For if the sun cross the meridian at the same instant with a star, the day following it will come to the meridian somewhat later than the star, in consequence of its motion eastward, which causes it to leave the star; and after a whole year has elapsed, it will have crossed the meridian just one time less than the star. A sideral day is less than the solar day, for it is measured by 360°; whereas the mean solar day is measured by 360° 59′ 8″ nearly.

If an astronomical day be = 1, then a sideral day is = 0.997269722; or the difference between the measures of a mean solar day and a sideral day, *viz.* 59′ 8″, reduced to time, at the rate of 24 hours to 360°, gives 3′ 56″; from which we learn that a star, which was on the meridian with the sun on one noon, will return to that meridian, 3′ 56″, previously to the next noon: therefore, a clock, which measures mean days by 24 hours, will give $23^h\ 56^m\ 4^s$, for the length of a sideral day.

Astronomical or solar days, as they are also called, are not equal. Two causes conspire to produce their inequality, namely, the unequal velocity of the sun in his orbit, and the obliquity of the ecliptic. The effect of the first cause is sensible. At the summer solstice, when the sun's motion is slowest, the astronomical day approaches nearer the sideral, than at the winter's solstice, when his motion is most rapid. To conceive the effect of the second cause, it is necessary to recollect, that the excess of the astronomical day above the sideral is owing to the motion of the sun referred to the equator. The sun describes every day a small arch of the ecliptic. Through the extremities of this arch suppose two meridian great circles drawn, the arc of the equator, which they intercept, is the sun's motion for that day referred to the equator; and the time which that arc takes to pass the meridian is equal to the excess of the astronomical day above the sideral. See Time, *equation of.*

The nychthemeron is divided into twenty-four parts, called hours, which are of two sorts, equal and unequal, or temporary.

Different nations begin their day at a different hour: thus the Egyptians began their day at midnight, from whom Hippocrates introduced that way of reckoning into astronomy; and Copernicus and others have followed him: but the greatest part of astronomers reckon the day begun at noon, and so count 24 hours till the noon of the next day; and not twice 12, according to the vulgar computation. The method of beginning the day at midnight prevails also in Great Britain, France, Spain, and most parts of Europe. The Babylonians began their day at sunrising, reckoning the hour immediately before its rising again the 24th hour of the day, from whence the hours reckoned in this way are called the Babylonic. In several parts of Germany they begin their day at sun-setting, and reckon on till it sets next day, calling that the 24th hour: these are generally termed Italian hours. The Jews also began their day at sun-setting; but then they divided it into twice 12 hours, as we do, reckoning 12 for the day, be it long or short, and 12 for the night; so that their hours continually varying with the day and night, the hours of the day were longer than that of the night for one half year, and the contrary the other: from whence their hours are called temporary; those at the time of the equinoxes became equal, because then those of the day and night are so. The Romans also reckoned their hours after this manner: as do the Turks at this day. This kind of hours are called planetary, because the seven planets were anciently looked upon as presiding over the affairs of the world, and to take it by turns each of these hours, according to the following order: Saturn first, then Jupiter, Mars, the Sun, Venus, Mercury, and last of all the Moon; hence they denominated each day of the week from that planet, whose turn it was to preside the first hour. Thus assigning the first hour of Saturday to Saturn, the second will fall to Jupiter, the third to Mars, and so the twenty-second will fall to Saturn again; and therefore the twenty-third to Jupiter, and the last to Mars; so that on the first hour of the next day it will fall to the Sun to preside; and by the like mannsr of reckoning, the first hour of the next will fall to the Moon; of the next, to Mars; of the next, to Mercury; of the next, to Venus: hence the days of the week came to be distinguiseed by the Latin names of *Dies Saturni, Solis, Lunæ, Martis, Mercurii, Jovis,* and *Veneris;* and among us, by the names of Saturday, Sunday, Monday, &c.

Day, in a legal sense, relates to the day of appearance of parties, or the continuance of suits, where a day is given, &c. See Essoin.

In real actions there are common days and special days given by the judges in an assize, &c.

Days *in bank,* are days set down by statute or order of the court, when writs shall be returned, or when the party shall appear on the writ served. They say, also, if a person be dismissed without day, he is finally discharged.

Days *of grace,* are those granted by the court, at the prayer of the defendant, or plaintiff, in whose delay it is.

Days *of grace,* in commerce, are a customary number of days allowed for the payment of a bill of exchange, &c. after the same becomes due.

Three days of grace are allowed in England; ten in France and Dantzic; eight at Naples; six at Venice, Amsterdam, Rotterdam, and Antwerp; four at Frankfort; five at Leipsic; twelve at Hamburg; six in Portugal; fourteen in Spain; thirty in Genoa, &c.

Day *light,* in our law; some time after sun-setting, and before sun-rising, being accounted part of the day, when the hundred is liable for any robberies committed within that time.

Day's *work,* in naval affairs, the reckoning or account of a ship's course and distance, run during 24 hours, or from noon to noon, according to the rules of trigonometry. Sea Dead Reckoning.

DEACON, one of the three sacred orders of the Christian church. The word is sometimes used in the New Testament for any one that ministers in the service of God, in which sense bishops and presbyters are styled deacons; but in its restrained sense it is taken for the third order of the clergy, as appears from the concurrent testimony of ancient writers, who constantly style them ministers of the mysteries of Christ, ministers of episcopacy and the church, and the like.

DEAD *men's eyes,* in the sea language, a kind of blocks with many holes in them, but no sheevers, whereby the shrouds are fastened to the chains: the crow-feet reeve also through these holes; and in some ships the main stays are set taught in them; but then they have only one hole, through which the laniards are passed several times.

Dead *nettle.* See Lamium.

Dead *reckoning,* in navigation, the calculation made of a ship's place by means of the compass and log; the first serving to point out the course she sails on, and the other the distance run. From these two things given, the skilful mariner, making proper allowances for the variation of the compass, lee way, currents, &c. is enabled, without any observations of the sun or stars, to ascertain the ship's place tolerably well.

DEAFNESS, the state of a person who wants the sense of hearing; or the disease of the ear, which prevents its due reception of sounds. Deafness generally arises, either from an obstruction or a compression of the auditory nerve; or from some collection of matter in the cavities of the inner ear; or from the auditory passage being stopped up by some hardened excrement; or, lastly, from some excrescence, a swelling of the glands, or some foreign body introduced within it. Those born deaf are also dumb, as not being able to learn any language, at least in the common way. However, as the eyes in some measure serve them for ears, they may understand what is said by the motion of the lips, tongue, &c. of the speaker; and even accustom themselves to move their own, as they see other people do, and by this means learn to speak. Thus it was that Dr. Wallis taught two young gentlemen, born deaf, to know what was said to them, and to return pertinent answers. Digby gives us another instance of the same, within his own knowledge; and there was a Swiss physician lately living in Amsterdam, one John Conrad Amman, who effected the same in several children born deaf with surprising success.

In the "Phil. Trans." No. 312, we have an account by Mr. Waller, R. S. Secretary, of a man and his sister, each about 50 years old, born in the same town with Mr. Waller, who had neither of them the least sense of hearing; yet both of them knew, by the motion of the lips only, whatever was said to them, and would answer pertinently to the question proposed. It seems they could both hear and speak when children, but lost their sense afterwards; whence they retained their speech, which, though uncouth, was yet intelligible. Such another instance is related by Bishop Burnet of a young woman. "At two years old, they perceived she had lost her hearing; and ever since, though she hears great noises, yet hears nothing of what is said to her: but by observing the motions of the mouth and lips of others, she acquired so many words, that out of these she has formed a sort of jargon, in which she can hold conversation whole days with those that can speak her language. She knows nothing that is said to her, unless she see the motion of their mouths that speak to her, so that in the night they are obliged to light candles to speak to her. One thing will appear the strangest part of the whole narration: she has a sister, with whom she has practised her language more than with any body else; and in the night, by laying her hand on her sister's mouth, she can perceive by that what she says, and so can discourse with her in the dark.

It is observable, that deaf persons, and several others thick of hearing, hear better, and more easily, if a loud noise be raised at the time when you speak to them; which is owing, no doubt, to the greater tension of the ear-drum on that occasion. Dr. Wallis mentions a deaf woman, who, if a drum were beat in the room, could hear any thing very clearly; so that her husband hired a drummer for a servant, that by this means he might hold conversation with his wife. The same author mentions another, who, living near a steeple, could always hear very well if there was a ringing of three or four bells, but never else. See Dumbness.

DEAL, a thin kind of fir planks, of great use in carpentry: they are formed by sawing the trunk of a tree into a great many longitudinal divisions, of more or less thickness, according to the purposes they are intended to serve. Deals are rendered much harder by throwing them into salt water as soon as they are sawed, keeping them there three or four days, and afterwards drying them in the air or sun; but neither this, nor any other method, yet known, will preserve them from shrinking. Deals are imported into this country from Christiana, and other parts of Norway; from Dantzic, and various parts of Prussia; from St. Petersburg, Archangel, Narva, Memel, &c. They are sold by the piece, or by the standard hundred, or by the long hundred of 120. A standard, or reduced deal, is one inch and a half thick, eleven inches wide, and twelve feet long.

DEAN, an ecclesiastical dignity in cathedral and collegiate churches, and head of the chapter. As there are two foundations of cathedral churches in England, the old and the new, so there are two ways of creating deans. Those of the old foundation, founded before the suppression of monasteries, as the deans of St. Paul's, York, &c. are raised to that dignity much after the manner of bishops, the king first sending his congé d'elire, the chapter electing, and the king granting his royal assent, the bishop confirms him, and gives his mandate to install him. Those of the new foundation, whose deaneries were raised upon the ruins of priories and convents, such as the deans of Canterbury, Durham, Ely, Norwich, Winchester, &c. are donative, and installed by virtue of the king's letters patent, without either election or confirmation. Canonists distinguish between deans of cathedral and those of collegiate churches. The first, with their chapter, are regularly subject to the jurisdiction of the bishop. As to the latter, they have usually the contentious jurisdiction in themselves, though sometimes this belongs to them in common with the chapter. There are cathedral churches which never had a dean, and in which the bishop is head of the chapter, and in his absence the archdeacon: Such are the cathedrals of St. David and Landaff. There are also deans without a chapter, as the dean of Battle in Sussex, dean of the arches, &c. and deans without a jurisdiction, as the dean of the chapel royal. In this sense the word is applied to the chief of certain peculiar churches or chapels.

Dean *and chapter*, are the bishop's council, to assist him in the affairs of religion, and to assent to every grant which the bishop shall make to bind his successors. As a deanery is a spiritual dignity, a man cannot be a dean and prebendary of the same church.

DEATH. Physicians usually define death by a total stoppage of the circulation of the blood, and a cessation of the animal and vital functions consequent thereon; as respiration, sensation, &c.

An animal body, by the actions inseparable from life, undergoes a continual change. Its smallest fibres become rigid; its minute vessels grow into solid fibres, no longer pervious to the fluids; its greater vessels grow hard and narrow; and every thing becomes contracted, closed, and bound up; whence the dryness, immobility, and extenuation, observed in old age. By such means, the offices of the minuter vessels are destroyed; the humours stagnate, harden, and at length coalesce with the solids. Thus are the subtilest fluids in the body intercepted and lost, the concoction weakened, and the reparation prevented; only the coarser juices continue to run slowly through the greater vessels, to the preservation of life, after the animal functions are destroyed. At length, in the process of these changes, death itself becomes inevitable, as the necessary consequence of life. But it is rare that life is thus long protracted, or that death succeeds merely from the decays and impairment of old age. Diseases, a long and melancholy train, cut the work short.

The signs of death are in many cases very uncertain. Between life and death the shade is often so very undistinguishable, that even all the powers of art can scarcely determine where the one ends and the other begins. The colour of the visage, the warmth of the body, and suppleness of the joints, are but uncertain signs of life still subsisting; while, on the contrary, the paleness of the complexion, the coldness of the body, the stiffness of the extremities, the cessation of all motion, and the total insensibility of the parts, are but uncertain marks of death begun. In the same manner, also, with regard to the pulse and breathing; these motions are so often kept under, that it is impossible to perceive them. By bringing a looking-glass near to the mouth of the person supposed to be dead, people often expect to find whether he breathes or not. But this is a very uncertain experiment; the glass is frequently sullied by the vapour of the dead man's body; and often the person is still alive, though the glass is no way tarnished. In the same manner, neither burning nor scarifying, neither noises in the ears, nor pungent spirits applied to the nostrils, give certain signs of the discontinuance of life; and there are many instances of persons who have endured them all, and afterwards recovered without any external assistance, to the astonishment of the spectators. This ought to be a caution against hasty burials, especially in cases of sudden death, drowning, &c.

All our first associations with the idea of death are of the disgustful and alarming kind; and they are collected from all quarters, from the sensible pains of every sort, from the imperfection, weakness, loathsomeness, corruption, and disorder, where disease, old age, death, animal or vegetable, prevail, in opposition to the beauty, order, and lustre of life, youth, and health, from the shame and contempt attending the first, in many instances; whereas the last are honourable, as being sources of power and happiness, the reward of virtue, &c. and from the sympathetic passions in general. And it is necessary, that the heedlessness and inexperience of infancy and youth should be guarded by such terrors, and their headstrong appetites and passions curbed, that they may not be hurried into danger and destruction before they are aware. It is proper, also, that they should form some expectations with respect to, and set some value upon, their future life in this world, that so they may be better qualified to act their parts in it, and make the quicker progress to perfection during their passage through it.

Death *watch*, in natural history, a little insect, famous for a ticking noise like the beat of a watch, which the vulgar have long taken for a presage of death in the family where it is heard; an error that cannot be too often confuted by facts. There are two kinds of death watches. Of the first we have a goo account in the Phil. Trans. of London. It is a small beetle, half an inch long, of a dark brown colour, spotted; having pellucid wings under the vagina, a large cap or helmet on the head, and two antennæ proceeding from beneath the eyes, and doing the office of proboscides. The part it beats with, the writer observes, was the extreme edge of the face, which he calls the upper-lip, the mouth being protracted by this bony part, and lying underneath out of view. This account is confirmed by Dr. Derham, with the difference that, instead of ticking with the upper-lip, he observed the insect to draw back its mouth and beat with its forehead. That author had two death watches, a male and a female, which he kept alive in a box several months, and could bring one of them to beat whenever he pleased, by imitating its beating. From some circumstances, the ingenious author concludes those pulsations to be the way whereby these insects woo one another. See Ptinus.

The second kind of death-watch is an insect, in appearance quite different from the first. The former only beats seven or eight strokes at a time, and quicker; the latter will beat some hours together without intermission; and his strokes are more leisurely, and like the beat of a watch. This latter is a small greyish insect, much like a louse when viewed with the naked eye. It is very common in all parts of the house in the summer months: it is very nimble in running to shelter, and shy of beating when disturbed, but will beat very freely before you, and also answer the beating, if you can view it without giving it disturbance, or shaking the place where it is, &c. See Termes.

DEBENTURE, a term of trade, used at the custom-house for a kind of certificate signed by the officers of the customs, which entitles a merchant exporting goods to the receipt of a bounty or drawback. All merchandises that are designed to be taken on board for that voyage being entered and shipped, and the ship being regularly cleared out, and sailed out of port on her intended voyage, debentures may be made out from the exporter's entries, in order to obtain the drawbacks, allowances, bounties, or premiums; which debentures for foreign goods are to be paid within one month after demand. And in making out these debentures, it must be observed, that every piece of vellum, parchment, or paper, containing any debenture for drawing back customs or duties, must, before writing, be stamped, and pay a duty.

Debenture, in military affairs, is a kind of warrant given in the office of the board of ordnance, whereby the person whose name is thereby specified is entitled to receive such a sum of money as by former contract had been agreed on. Debenture, in some acts of parliament, denotes a kind of bond or bill, by which the government is charged to pay the soldier, creditor, or his assigns, the money due on auditing the account of his arrears. The payments of the board of ordnance for the larger services at home are always made by debentures; and the usual practice has been, to make those payments, which are said to be in course of office, at a period which is always something more than three months after the date of each debenture.

DEBET, among merchants, signifies the sums due to them for goods sold on credit, for which they have charged their journal or ledger. It is more particularly understood of the remainder of debts, part of which has been paid on account

Debet, among book-keepers, is used to express the left hand page of the ledger, to which are carried all articles supplied or paid, on the subject of an account.

DEBT, a sum due from one person to another, in consequence of work done, goods delivered, or money lent, for which reimbursement has not been made. The non-payment, in these cases, is an injury, for which the proper remedy is by action of debt, to compel the performance of the contract, and recover the special sum due.

Debt, *national*, the engagement entered into by a government, to repay at a future period money advanced by individuals for the public service, or to pay the lenders an equivalent annuity. National debts have arisen from the necessity of obtaining larger sums of money than could be raised, at the time they were wanted, by direct contributions; and often, when it would not have been absolutely impossible to raise the requisite sum, if a heavy tax had been imposed, and strictly levied, it has been deemed more prudent to avoid the evils attendant on such a measure by the less obnoxious expedient of a loan. In most countries, the subordinate governors, to whom is generally consigned the task of providing for the public expences, being desirous of popularity, have shown a great predilection for this mode of obtaining money, as it enables them to support a profuse expenditure, without appearing to oppress the people in so great a degree as they otherwise must: the system of getting into debt, or the funding system, as it is generally called, from particular funds being usually appropriated for payment of interest on the debts contracted, has therefore been adopted by most of the states of Europe, by many of the colonies, and by the American republic.

The persons who lend the money which a government has occasion to borrow generally make a profit by it, but nothing is brought into the country, nor the least addition made to its total wealth, by a transaction of this kind; whatever therefore is gained by any individual concerned in it must be taken from others, and as those who lend the money are persons already possessing considerable property, and those from whom the sums requisite for paying the interest or repaying any part of the principal is to be drawn, are the public at large, it is evident that all transactions of this nature contribute to increase the existing disparity in the condition of the different classes of the community, and consequently that the natural tendency of the funding system, when made a constant resource, is to destroy the intermediate ranks, and divide a nation into the two classes only, as unequal in number as in circumstances, of very rich and very poor. It may however be carried to a very great extent, without fully producing this effect, if counteracting circumstances exist, sufficiently powerful to dissipate the gains of the rich nearly as fast as they are acquired, and thus prevent a rapid accumulation of wealth. This has been the case in Great Britain; but although the great increase of necessary and fashionbble expense has prevented the wealthy from becoming so enormously rich as they otherwise would have been, there can be little doubt, that taken collectively, they are possessed of more property and income than the wealthy members of the community at any former period, and that the number of the poor is considerably augmented. In a state where taxation is general, the effects of the borrowing system are somewhat retarded, by the lenders themselves contributing to the taxes levied to pay them interest, and therefore the practice may be carried to a greater extent than in those states, where particular classes, as the nobility or priesthood, are exempt from taxation, and under whose privileges the money lenders may shelter themselves from contributing their just proportion.

Most governments have begun to borrow upon their general credit, without assigning any particular fund for the payment of the debt; and when this resource has failed them, they have gone on to borrow upon assignments or mortgages of particular funds. What is called the unfunded debt of Great Britain is contracted in the former of those ways; but this is a mode which never can be carried to a great extent, without bringing the finances of a country into disorder; the other mode is subject to no limitation, while efficient funds can be found for securing the regular payments stipulated with the lenders. Borrowing on the security of particular funds is done in two ways; sometimes the assignment or mortgage is made for a short period of time only, a year or a few years, for example: and sometimes for perpetuity. In the former case, the fund is supposed sufficient to pay, within the limited time, both principal and interest of the money borrowed; in the other, it is supposed sufficient to pay the interest only, which is either an annuity terminable at the end of a certain number of years, or a perpetual annuity, which the government retains the liberty of redeeming at any time, upon paying back the principal sum borrowed. When money is raised in the one way, it is said to be raised by anticipation; when in the other, by funding.

The great expense attending the modern system of warfare appears to have created the necessity of contracting national debts: the practice originated in Italy, and was soon adopted in other countries, but it has been brought into a more regular system, and carried to a much greater extent in Great Britain, than in any other nation.

In the reign of King William, and during a great part of that of Queen Anne, before the practice of funding on perpetual annuities had become familiar, the greater part of the new taxes were imposed for a short period of time (for four, five, six, or seven years only) and the principal part of the grants of each year consisted of loans in anticipation of the produce of those taxes. The produce being, frequently insufficient for paying, within the limited time, the principal and interest of the money borrowed, deficiencies arose; to make good which, it became necessary to prolong the original term. This expedient was repeated, and money was sometimes borrowed on a fund already anticipated for several years to come. Exchequer bills were issued, and lotteries introduced, but all these temporary means were found inadequate to the rapid increase of the public expenditure; which of course soon caused an accumulation of public debts; and as the interest payable to the public creditors was frequently some time in arrear, public credit was occasionally reduced to a very low ebb, and apprehensions were entertained that the public debt had already become too heavy a burthen for the country to prosper under.

In the year 1711 a project was formed for relieving the government from the financial difficulties under which it laboured, by permitting the proprietors of various debts and arrears, amounting to 8,971,325*l.* to subscribe them towards raising the capital of a company formed for carrying on a trade to the South Seas. The actual capital of the company was 9,177,967*l.* 15*s.* 4*d.*, which, for the further accommodation of government, was increased in 1715 to ten millions.

The total amount of the national debt, on the 31st of December, 1716, was 48,364,501*l.* 8*s.* 4*d.* which, on the opening of the following session of parliament, was mentioned in the King's speech, and the Commons' address, as an insupportable weight, and the government appears to have thought it necessary to concert seriously such measures, as might lay the foundation of an effectual plan for its reduction. In consequence of this disposition, all the existing taxes, except the land and malt, were made perpetual; and, having been distributed into three classes, called the Aggregate, South Sea, and General Funds, the surplusses remaining, after satisfying the previous charges upon these respective funds, were formed into a separate fund, called the Sinking Fund, for the express purpose of discharging the principal and interest of such national debts and incumbrances as were incurred before the 25th of December, 1716. See Sinking Fund.

The memorable South Sea scheme, in the year 1720, was to have furnished a considerable sum, to be employed in the reduction of the public debts; instead of which it increased their amount by an addition to the capital of 3,034,769*l.* 11*s.* 11*d.* while the annual charge was rather augmented than diminished by the allowance for management on the increased capital. The reduction of a part of the interest was, however, secured; and as the company's capital was redeemable, a further reduction of interest might be effected at a future period; but this depended on future circumstances: whereas, had the terminable annuities which were converted into redeemable perpetuities by this scheme, remained in their original state, there was a certainty of their expiring at a fixed period.

In 1727 the interest on 37,738,007*l.* of the public debt was reduced from 5 to 4 per cent. which produced an important addition to the Sinking Fund. An opinion, however, began to prevail, that the public debts had increased since the establishment of the fund, and that this provision was inadequte to the purpose for which it was designed. This occasioned the publication of an excellent essay on the public debts, which has been generally ascribed to Sir Nath. Gould, in which it was clearly shewn, that although from the South Sea subscription, and from several articles being brought to account which were actually due before the 25th of December, 1716, there was an appearance of increase, the debt had in reality been diminished, and that from the great addition now made to the Sinking Fund, by the reduction of interest, it would, if not diverted to any other purpose, discharge all the debts then existing in about 56 years, or with a further reduction of interest in a shorter period.

The application of the sinking fund to its original object was, however, of short duration: in 1733 half a million was taken from it towards the supplies: larger sums were taken in the following years, and the whole amount paid off by the fund, from its establishment to the year 1739, was only 8,328,354*l.* leaving the total amount of the national debt 47,314,829*l.* The war which began in this year increased the debt to 78,293,313*l.* the interest on which amounted to 3,061,004*l.* per annum: but the rise in the price of the public funds on the peace enabled government, in 1749, to lessen the annual charge, by reducing the interest on 57,703,475*l.* from 4 to 3½ per cent. till the 25th December, 1757, and thence 3 per cent. This reduction produced a saving of 612,735*l.* per annum; and with the salt duties, amounting to about 220,000*l.* per annum, formed another important addition to the sinking fund, the yearly produce of which, on an average of ten years previous to this augmentation, was 1,356,578*l.*; an income sufficient to have effected a very considerably diminution of the public debts, if it had been strictly applied to the purpose for which it was designed; but being constantly taken towards the yearly supplies, scarce any progress was made in the reduction of the debt.

The total amount of the national debt at the commencement of the seven year's war, in 1756, was 74,980,886*l*; and as the increased expenditure, beyond the charge of preceding wars, which is one of the inevitable consequences of perpetuating taxes, rendered it necessary to borrow larger sums than had ever before been raised on loan, the debt increased rapidly, and at the end of the war, including the loan of 1763, and a valution of the terminable annuities, it amounted to 136,367,757*l.*, exclusive of the unfunded debt.

After the peace in 1763, the income of the sinking fund increased considerably. The causes of this were, partly the falling in of life annuities, and the greater productiveness of the taxes arising from the increase of commerce and population. But the principal cause was, the falling in of the interest of about ten millions and a half of the public debt, which was discharged during the twelve years of peace ending with 1775. This diminution of the public debt could not, however, be said to be made by the sinking fund, as other sources supplied the principal part of the amount: these were, a contribution from the East India Company of 400,000*l.* per annum, begun in 1768, and continued for five years: the profits of ten lotteries; the composition agreed to be paid by the King of France for the maintenance of French prisoners; monies arising from the sale of French prizes taken before the declaration of war, and other extraordinary receipts, amounting in the whole to above eight millions. The sinking fund, therefore, did not pay off more than two millions and a half, the rest of its produce having been employed in bearing the expences of the peace establishment, which during that period were not much less than double what they had been in any former period.

At the commencement of the American war, then considered as litte more than a partial insurrection, which would be speedily suppressed, the resources and perseverance of the colonists were much underrated: it was not, therefore, deemed necessary to incur any great expense for the purpose of subduing them; but when the interference of France extended the operations of the war in all directions, very serious exertions became requisite, and the expenditure was in consequence augmented far beyond its amount in former wars. The sums which it was necessary to borrow thus increased from two millions to five, seven, and twelve millions, and in 1782 the loan was thirteen millions and a half. The apparent magnitude of the debt was also much increased, by the practice of entitling the subscribers to the loans to a larger capital of stock than the money advanced, by which means, for the total sum of 75,500,000*l.* borrowed during this war, including the loan of 1784, a debt was created of 97,400,000*l.* exceeding the money borrowed by 21,900,000*l.* The interest payable on the whole amounted to 4,119,125*l.* per annum, being equal to 5*l.* 9*s.* 1*d.* per cent. on the sums, borrowed. In addition to these sums, a very considerable amount of navy debt was funded after the conclusion of the war, which, being properly part of the expenses of it, makes the total debt incurred by the American war amount to 115,267,992*l.*, and the interest payable thereon 5,012,562*l.* per annum.

The total amount of the national debt, funded and unfunded, including a valuation of the terminable annuities at their current prices, was, on the 5th January, 1786, 268,100,379*l.* and the amount of the annual interest 9,512,232*l.* At this period, the general conviction of the absolute necessity of some provision being made for the gradual reduction of the debt, induced government to propose the establishment of a new sinking fund, under regulations which rendered it a considerable improvement on the fund formerly established for the same purpose. But although the revenue was represented as sufficiently productive to furnish a considerable surplus for this purpose, which, with a few new taxes, would amount to a million per annum, it was found necessary in 1789 to borrow, towards the supplies, 1,002,140*l.* on a tontine, and 187,000*l.* on short annuities.

The total amount of the national debt, as it stood in 1792, being the year previous to the war with the French republic, was, according to the official statement, 238,231,248*l.*; but, including the value of the terminable annuities, and the amount of the unfunded debt, the total was 268,267,272*l.* the annual interest and allowance for management on which amounted to 9,752,673*l.* From this amount, however, a deduction of more than eight millions is to be made for the stock which had been bought up at that period by the commissioners for the reduction of the debt. The magnitude of the sums borrowed in the course of the war which began in 1793, and the circumstance of the loans being chiefly made on 3 per cent. stock, caused an unparalleled increase of the national debt, attended with a great depreciation of the current prices of the public funds, which obliged the government to pay a very high interest for the money borrowed. In the years 1797 and 1798, it was found impracticable to raise the sums required without paying upwards of 6 per cent. interest, being a higher rate than had been paid on any money borrowed for the public service since the reign of Queen Anne. In the latter years of the war, large sums being levied by extraordinary taxes, the amount of the loans was rendered somewhat less than it otherwise must have been; they were still, however, of unprecedented magnitude; and in 1802, after the conclusion of the war, it was found necessary to borrow twenty-five millions more, to make good expenses of the war which had not been provided for. The total amount of the loans of this war was 200,500,000*l.* by which a debt was created of 310,424,323*l.*; to this must be added the amount of stock created by funding Navy and Exchequer bills, making the total amount of funded debt incurred by the war 351,125,730*l.* and the interest payable thereon 11,676,144*l.* per ann. This is exclusive of the Imperial loans, which there can be little doubt will remain a perpetual burthen to this country.

Among other financial occurrences of this period, the public debt of Ireland became in a great measure blended with that of Great Britain, from which it has hitherto been entirely distinct. Ireland has constantly had a public debt from about the year 1760, but its amount was for many years very small, in comparison with the magnitude to which it has since increased, as will appear from the following statement:

Years.		Debt.
1761	. . . *L.*	223,438
1771	. . .	773,320
1781	. . .	1,551,704
1791	. . .	2,464,590
1801	. . .	31,950,656

The loans which became necessary, in consequence of the war, were in the first year raised wholly in Ireland on 5 per cent. stock. In 1794, an inducement was offered to persons resident in England to subscribe to the loans of Ireland, by making the dividends on part of the stock receivable at the Bank of England; and the same plan was followed in 1795 and 1796: but in 1797 the alarm of invasion, and the disturbed state of the country, rendered it impracticable for the government of Ireland to raise the loan necessary for the service of the year, without submitting to the most exorbitant terms: in consequence of which it was deemed preferable, that it should be chiefly raised and funded in Great Britain, as part of the sum borrowed by the government of that country. The joint loans for Great Britain and Ireland were, therefore, raised as one sum, the interest of the whole being charged on the consolidated fund of Great Britain; and in this manner all the principal loans for the service of Ireland have been since raised, the government of that country remitting annually the interest, charges of management, and appropriation of one per cent. on the capital, in order to reimburse the payments made from the consolidated fund on this account.

The total amount of the funded debt of Ireland, on the 5th of January 1807, was 64,721,356*l.* 15*s.* the principal part of which, having been actually borrowed by the government of Great Britain, is included in the following statement, as with respect to the public creditors, the whole of the sums thus borrowed are the proper debt of Great Britain.

Statement of the National Debt of Great Britain at Midsummer, 1806.

	Capital.			Interest and Management.		
	L.	s.	d.	L.	s.	d.
Consolidated 5 per cent. annuities	46,674,742	1	8	2,354,740	14	9
5 per cent. annuities, 1797 and 1802	2,406,132	13	3	121,389	7	10
Consolidated 4 per cent. annuities	49,725,084	17	2	2,011,379	13	7
Reduced 3 per cent. annuities	164,705,570	6	5	5,015,284	12	3
Consolidated 3 per cent. annuities	406,116,201	18	5¼	12,366,238	6	11
Deferred 3 per cent. annuities	1,740,625	0	0			
3 per cent. annuities, 1726	1,000,000	0	0	30,450	0	0
Bank of England	11,686,800	0	0	356,502	3	5
South Sea Stock	3,662,784	8	6 }			
Old South Sea annuities	11,907,470	2	7 }	735,974	13	11
New South Sea annuities	8,494,830	2	10 }			
South Sea annuities, 1751	1,919,600	0	0	58,667	15	6
Value of the long annuities	21,245,367	16	0	1,151,510	9	1½
Ditto of the short annuities	211,519	12	10	423,039	5	9
Ditto of the life annuities	279,074	7	6	55,814	17	6
Annuities with survivorship, 1765	18,000	0	0	540	0	0
Tontine annuities, 1789	239,428	4	3	19,952	7	0¼
Funded debt	L 732,033,231	11	5¼	L 24,701,484	7	6¾
Navy, Victualling, and Transport debt	6,000,000	0	0 }			
Exchequer bills	12,000,000	0	0 }	630,000	0	0
Ditto for the bank charter	3,000,000	0	0 }			
Ordnance debt, Treasury bills, &c.	3,000,000	0	0 }			
Total funded and unfunded debt	L 756,033,231	11	5¼	L 25,331,484	7	6¾
Redeemed by the commissioners	117,581,858	0	0	3,316,252	14	9
Total unredeemed debt	L 638,451,373	11	5¼	L 22,015,231	12	9¾

The capital redeemed by the Commissioners, for the reduction of the national debt, is given as it stood on the 1st of February, 1807, their accounts being made up to that period.

The statement is exclusive of the capital of Imperial 3 per cent. annuities, being 7,502,633*l.* 6*s.* 8*d.*; the dividends on which, amounting to 225,079*l.* per annum, and likewise the annuities for 25 years of 230,000*l.* per annum, have become as regular a charge upon the consolidated fund as any part of the debt of Great Britain.

For the terms on which the public debts have been contracted, see Loans. For the particulars of the different funds of which they consist, and the mode of transacting business therein, see Funds.

DEBTS *and credits*, in military affairs. Every captain of a troop or company in the British service is directed to give in a monthly statement of the debts and credits of his men; and it is the duty of every commanding officer to examine each list, and to see that no injustice or irregularity has been countenanced or overlooked in this business.

DECAGON, in geometry, a plane figure with ten sides and ten angles: it is called a regular decagon, when all the sides and angles are equal.

If we suppose the radius of a circle to be r, then will $\sqrt{\frac{5}{4}r^2}-\frac{1}{2}r$, or $\frac{\sqrt{5}-1}{2}\times r$, be the side of a decagon inscribed in that circle. Again, supposing the side of a decagon to be 1, the area thereof will be 8.69; whence, as 1 to 8.68, so is the square of the side of any given decagon to the area of that decagon.

DECAGYNIA, in botany, the name of an order, or secondary division, in the class Decandria, of the sexual method, consisting of plants whose flowers are furnished with ten stamina, and the same number of styles. Neurada and American night-shade furnish examples.

DECALOGUE, the ten precepts or commandments delivered by God to Moses, after engraving them on two tables of stone.

DECANDRIA, in botany, the name of the tenth class in Linnæus's system, consisting of plants, whose flowers, as the name imports, are furnished with ten stamina or male organs. This class, as well as the other classes in Linnæus's method that are compounded with a numeral, has another character, which is not expressed in the title, *viz.* that the flowers are all hermaphrodite, that is, have both stamina and pointels, which, according to our author, are the male and female organs of generation within the same covers. In this respect, the classes in question differ from the Monœcia and Diœcia of the same author, in which the male and female organs are separated; being placed, in the former, upon different parts of the same plant: in the latter, upon distinct plants. This observation merits attention, because character, which is the subject of it, is indispensably necessary; and a plant having ten, or any number of stamina, is not on that account to be referred to its respective numeral class, unless both male and female organs are found contained within the covers of the flower. To take an example from the class which we are now considering; the flowers of the curious exotic, papaw, or popo-tree, have ten stamina; and yet the plant cannot be arranged under the class Decandria, because the male and female parts are not only placed within different covers, but likewise produced upon distinct plants: the popo seed ripened by the female flowers producing both male and female trees. Besides the sexes of the flowers, it is necessary that the stamina be of an equal length, and distinct; that is, neither joined at the bottom nor top; circumstances, which would remove the plants in which they are found, to classes whose essential character is no ways connected with the number of the male and female organs.

The orders or secondary divisions in this numerous class are five, and take their name from the number of styles, or females organs. Fraxenilla, lignum vitæ, dwarf rose-bay, and strawberry-tree, have one style; soap-wort, and carnation, have two; cucubalus, viscous campion, and sand-wort, three; hog-plum, navel-wort, and house-leek, five; neurada, and American night-shade, ten.

Decandria is likewise the name of an order or secondary division in the classes Monadelphia, Diadelphia, Gynandria, and Diœcia, in all which, the classic character being unconnected with the number of stamina, that circumstance, properly enough, serves as a foundation for the secondary or subordinate division.

DECEM *tales*, in law, a writ that issues directed to the sheriff, whereby he is commanded to make a supply of jurymen, where a full jury does not appear on a trial at bar.

DECIDUUS, in botany, a term expressive of the second stage of duration in plants, but, like caducus, susceptible of different senses, according to the particular part of the plant to which it is applied. A leaf is said to be deciduus which drops in autumn; petals are deciduus which fall off with the stamina and pistillum; and this epithet is applied to such flower-cups as fall after the expansion, and before the dropping of the flower. This last is exemplified in berberry, and the flowers of the class Tetradynamia.

Most plants in cold and temperate climates shed their leaves every year. This happens in autumn, and is generally announced by the flowering of the common meadow saffron. The term is only applied to trees and shrubs; for herbs perish down to the root every year, losing stem, leaves, and all. All plants do not drop their leaves at the same time. Among large trees, the ash and walnut, although latest in unfolding, are soonest divested of them; the latter seldom carries its leaves above five months. On the oak and horn-bean the leaves die and wither as soon as the colds commence; but remain attached to the branches till they are pushed off by the new ones, which unfold themselves the following spring. These trees are doubtless a kind of evergreens; the leaves are probably destroyed only by cold; and, perhaps, would continue longer upon the plant, but for the force of the spring-sap, joined to the moisture.

With respect to deciduus trees, the falling off of the leaves seems principally to depend on the temperature of the atmoshere, which likewise serves to hasten or retard the appearance in question. An ardent sun contributes to hasten the dropping of the leaves. Hence, in hot and dry summers, the leaves of the lime-tree and horse-chesnut turn yellow about the 1st of September; whilst, in other years, the yellowness does not appear till the beginning of October. Nothing, however, contributes more to hasten the fall of the leaves than immoderate cold or moist weather in autumn; moderate droughts, on the other hand, serve to retard it. It deserves to be remarked, that an evergreen tree, grafted upon a deciduus, determines the latter to retain its leaves. This observation is confirmed by repeated experiments, particularly by grafting the laurel, or cherry-bay, an evergreen, on the common cherry; and the ilex, or ever-green oak, on the oak.

DECIMAL *arithmetic*, the art of computing by decimal fractions.

DECIMAL *fraction*, that whose denominator is always 1, with one or more cyphers: thus an unit may be imagined to be equally divided into 10 parts, and each of these into 10 more; so that by a continual decimal subdivision the unit may be supposed to be divided into 10, 100, 1000, &c. equal parts, called tenth, hundredth, thousandth part of an unit. In decimal fractions, the figures of the numerator are only expressed, the denominator being omitted, because it is known to be always an unit with so many cyphers as there are places in the numerator. A decimal fraction is distinguished from an integer with a point prefixed, as .2 for $\frac{2}{10}$, .34 for $\frac{34}{100}$, .567 for $\frac{567}{1000}$, &c. The same is observed in mixed numbers, as 678.9 for $678\frac{9}{10}$, 67.89 for $67\frac{89}{100}$, 6.789 for $6\frac{789}{1000}$, &c.

Cyphers at the right hand of a decimal fraction alter not its value; for .5 or .50 or .5000 is each of them of the same value, equal to $\frac{5}{10}$, or $\frac{1}{2}$: but cyphers at the left hand, in a decimal fraction, decrease the value in a tenfold proportion; for .05 is $\frac{5}{100}$, .005 is $\frac{5}{1000}$, .0005 is $\frac{5}{10000}$, &c.

As the denominator of a decimal is always one of the numbers 10, 100, 1000, &c. the inconvenience of writing these denominators down may be saved, by placing a proper distinction before the figures of the numerator only to distinguish them from integers, for the value of each place of figures will be known in decimals, as well as in integers, by their distance from the 1st, or unit's place of integers, having similar names at equal distances, as appears by the following scale of places, both in decimals and integers:

&c.	6	6	6	6	6	6	6		6	6	6	6	6	6,	&c.
	millions	hun. of thousands	tens of thousands	thousands	hundreds	tens	units		tenths	hundredths	thousandths	ten thousandths	hun. thousandths	millionths	

Decimal fractions are easily reduced into a common denominator, by making, or even supposing, all of them to consist of the same number of places; so .3, .45, .067, .0089, may be written thus, .3000, .4500, .0670, .0089; all which consisting of four places, their common denominator is an unit with four cyphers, namely, 10000.

Addition and subtraction of decimals are the same as in whole numbers, when the places of the same denomination are set under one another, as in the following examples:

To	34.25	From	16.5
Add	3.026	Subtract	.125
Sum	37.276	Rem.	16.375

In multiplication the work is the same as in whole numbers, only in the product; separate, with a point, so many figures to the right hand as there are fractional places both in the multiplicand and multiplier; then all the figures on the left hand of the point make the whole number, and those on the right a decimal fraction.

It is to be noted, that if there be not so many figures in the product, as ought to be separated by the preceding rule, then place cyphers at the left, to complete the number, as may be seen in *Ex.* 5.

Ex. 1. Mult.	456	*Ex.* 2. Mult.	45.6
by	21.3	by	21.3
	1368	Product	971.28
	456		
	912		
Product	9712.8		

Ex. 3. Multiply	456
by	0.213
Product	97.128

Ex. 4. Multiply	45.6
by	0.213
Product	97.128

Ex. 5. Multiply	0.0456
by	0.213
Product	0.0097128

In division the work is the same as in whole numbers, only in the quotient, separate, with a point, so many figures to the right hand for a decimal fraction, as there are fractional places in the dividend, more than in the divisor, because there must be so many fractional places in the divisor and quotient together, as there are in the dividend.

As division of decimal fractions is extremely difficult, especially with regard to the value of the figures of the quotient, we shall here give a general rule for ascertaining their values, *viz.*

Rule, place the first multiple of the divisor under the dividend, as in operations of common division; then will the unit's place of this multiple stand under such a place of the dividend, as the first significant figure of the quotient is to be; that is, the first significant figure of the quotient will be of the same name or value with the figure of the dividend which stands above the unit's place of the multiple.

This rule will hold in all cases. 1. When the number of decimals are equal in the divisor and dividend, the quotient will be integers, or whole numbers: for placing the first multiple of the divisor under the dividend, according to the rule. *Ex.* 1.

```
8.45)295.75(35
      25.35
      -----
       4225
       4225
       ====
```

The unit's place 5, is found to stand under 9, the place of tens in the dividend; so that 3, the first figure of the quotient, must be tens also, and 5, the next figure, units. 2. When the number of decimals in the dividend exceed those in the divisor, as, *Ex.* 2.

```
24.3)780.516(32.12
     72.9
     ====
```

Where 2, the unit's place of the multiple of the divisor, stands under 8, the place of tens of the dividend; whence 3, the first figure of the quotient, must be tens also; and 2, the next figure, units; so that the remaining figures, 12, must be decimals. This is done, more shortly, by making as many figures of the quotient decimals, as there are more decimal places in the dividend than in the divisor. 3. When there are not so many decimal places in the dividend, as there are in the divisor, cyphers must be added to the right hand of the dividend, to make them equal: thus, to divide 192.1 by 7.684, as in *Ex.* 3.

```
7.684)192.100(25
       15.368
       ------
        38420
        38420
        =====
```

Add two cyphers to make the decimals equal; and, by the above rule, the quotient 25 will be found to be integers, as 5, the place of units, stands under 9, the place of tens. 4. If after division there are not so many figures in the quotient as there ought to be decimal parts, supply this defect by prefixing cyphers to the quotient found: thus, in *Ex.* 4.

```
957)7.2540(.00758 nearly.
    6.699
    -----
     .5550
     4785
     -----
      .7650
      7650
      ====
```

The quotient by division is found to be 758; and, by the above rule, the first figure, 7, ought to stand in the decimal place of thousandths, which it is made to do by prefixing two cyphers.

Vulgar fractions are reduced to decimals of the same value, by dividing the numerator by the denominator.

Thus, $\frac{1}{2}=\frac{10}{2}=.5$, and $\frac{3}{4}=\frac{3.00}{4}=.75$, and $\frac{2}{7}=\frac{2.000000,\ \&c.}{7}=.285714$, nearly.

Decimal *scales* are those which are decimally divided.

DECIMATE, in military affairs, is to choose, by lot, one out of ten, either by way of punishment, or for the purpose of being employed upon some public work.

DECIPHERING, the art of finding the alphabet of a cypher. See Cypher, and Diplomatic Characters.

DECK *of a ship*, is a planked floor from stem to stern, upon which the guns lie, and where the men walk to and fro. Great ships have three decks, first, second, and third, beginning to count from the lowermost. Half deck reaches from the mainmast to the stem of the ship. Qarter-deck is that aloft the steerage, reaching to the round house. See SHIP.

DECLARATION, is a shewing in writing the grief and complaint of the demandant, or plaintiff, against the defendant, or tenant, wherein he is supposed to have done some wrong. And this ought to be plain and certain, both because it impeaches the defendant, and also compels him to answer thereto. It is also an exposition of the writ, with the addition of time, circumstances, &c. and must be true as well as clear, for the court will not take things in it by implication: and it sets forth the names both of the plaintiff and defendant, the nature and cause of the action, &c. and the damage received. Such a declaration in an action real is termed a count, and it is essential, that the count or declaration ought to contain demonstration, declaration, and conclusion; and in the conclusion the plaintiff ought to aver, and offer to prove his suit, and shew the damages he has sustained by the wrong done him. Declaration must be certain: containing, 1. Such sufficient certainty, whereby the court may give a peremptory and final judgment upon the matter in controversy. 2. The defendant may make a direct answer to the matter contained therein. 3. That the jury, after issue joined, may give a complete verdict thereupon. 4. No blank, or space, to be left therein.

DECLARATION *of war*, a public proclamation made by the herald at arms to the members or subjects of a state, declaring them to be at war with some foreign power, and forbidding all and every one to aid or assist the common enemy at their peril.

DECLENSION, in grammar, an inflexion of nouns according to their divers cases, as nominative, genitive, dative, &c. It is a different thing in the modern languages, which have not properly any cases, from what it is in the ancient Greek and Latin. With respect to languages, where the nouns admit of changes, either in the beginning, the middle, or ending, declension is properly the expression of all those changes in a certain order, and by certain degrees called cases. With regard to languages, where the nouns do not admit of changes in the same number, declension is the expression of the different states a noun is in, and the different relations it has; which difference of relations is marked by particles, and called articles, as *a*, *the*, *of*, *to*, *from*, *by*, &c. See ARTICLE: also GRAMMAR.

DECLINATION, in astronomy, the distance of any celestial object from the equinoctial, either northward or southward. It is either true or apparent, according as the real or apparent place of the object is considered. A great circle is supposed to pass through the two poles, and through the centre of every star. This circle is called a circle of declination. The arc of this circle included between the star and the equator measures the declination of the star. The declination of a star then is its perpendicular distance from the equator. It is north or south, according as the star is situated on the north or south side of the equator. All the stars situated in the same parallel of the equator have, of course, the same declination. The declination then marks the situation of a star north or south from the equator. Precision requires still another circle, from which their distance, east or west, may be marked, in order to give the real place. The circle of declination, which passes through that point of the equator called the vernal equinoctial point, has been chosen for that purpose. The distance of the circle of declination of a given star from that point, measured on the equator, or the arc of the equator included between the vernal equinox and the circle of declination of the star, is called its right ascension. If we know the declination and the right ascension of a star, we know its precise situation in the heavens.

The declination of any star may be easily found by observing the following rule: Take the meridian altitude of the star, at any place where the latitude is known; the complement of this is the zenith distance, and is called north or south, as the star is north or south at the time of observation. Then, 1. When the latitude of the place and zenith distance of the star are of different kinds, namely, one north and the other south, their difference will be the declination, and it is of the same kind with the latitude, when that is the greatest of the two, otherwise it is of the contrary kind.—2. If the latitude and the zenith distance are of the same kind, *i. e.* both north or both south, their sum is the declination; and it is of the same kind with the latitude. See GLOBES, *use of.*

DECLINATION *of a wall or plain for dials*, is an arch of the horizon, contained either between the plane and the prime vertical circle, if you reckon it from the east or west; or else between the meridian and the plane, if you account it from north or south. There are many ways given by authors for finding the declination of a plane, of which all those that depend upon the magnetic needle deserve to be suspected on many accounts. The common method, by finding the sun's horizontal distance from the pole of the plane, is subject to many errors and difficulties. The way therefore we would recommend, as the best for finding the declination of a plane, is by a declinator.

DECLINATOR, or Declinatory, an instrument contrived for taking the declinations, inclinations, and reclinations of planes. See Instruments, *mathematical*.

DECLINING *dials*, those which do not face directly any of the four cardinal points. See Dialling.

DECOCTION, the boiling of one or more ingredients in a watery fluid. See Pharmacy.

DECOMPOSITION, in chemistry. The substance resulting from a chemical combination is denominated a compound. The substances of which it is formed are called its constituent parts. When these are again separated, the process is denominated decomposition. See Analysis.

DECOUPLE, in heraldry, the same as uncoupled: thus, a chevron decouplé, is a chevron wanting so much of it towards the point, that the two ends stand at a distance from one another, being parted and uncoupled.

DECOY, among fowlers, a place made for catching wild fowl. A decoy is generally made where there is a large pond surrounded with wood, and beyond that a marshy and uncultivated country: if the piece of water is not thus surrounded, it will be attended with noises and other accidents, which may be expected to frighten the wild fowl from a quiet haunt, where they mean to sleep in the day-time in security. If these noises or disturbances are wilful, it has been held that an action will lie against the disturber. As soon as the evening sets in, the decoy rises, and the wild-fowl feed during the night. If the evening is still, the noise of their wings during their flight is heard at a very great distance, and is a pleasing, though rather melancholy sound.

The decoy ducks are fed with hemp-seed, which is thrown over the screens in small quantities, to bring them forwards into the pipes or canals, and to allure the wild-fowl to follow, as this seed is so light as to float. There are several pipes, as they are called, which lead up a narrow ditch that closes at last with a funnel-net. Over these pipes (which grow narrower from their first entrance) is a continued arch of netting, suspended on hoops. It is necessary to have a pipe or ditch for almost every wind that can blow, as upon this circumstance it depends which pipe the fowl will take to; and the decoyman always keeps on the leeward side of the ducks, to prevent his scent reaching their sagacious nostrils. All along each pipe, at intervals, are placed screens made of reeds, which are so situated, that it is impossible the wild fowl should see the decoyman before they have passed on towards the end of the pipe, where the purse net is placed. The inducement of the wild fowl to go up one of these pipes is, because the decoy ducks, trained to this, lead the way, either after hearing the whistle of the decoyman, or enticed by the hemp seed; the latter will dive under water, whilst the wild-fowl fly on and are taken in the purse. It often happens, however, that the wild-fowl are in such a state of sleepiness and dozing that they will not follow the decoy-ducks. Use is then generally made of a dog that is taught his lesson: he passes backwards and forwards between the reed screens (in which are little holes, both for the decoyman to see, and the little dog to pass through;) this attracts the eye of the wild fowl, who, not choosing to be interrupted, advance towards the small and contemptible animal, that they may drive him away. The dog all the time, by the direction of the decoyman, plays among the screens of reeds, nearer and nearer the purse-net; till at last, perhaps, the decoyman appears behind a screen, and the wild-fowl, not daring to pass by him in return, nor being able to escape upwards on account of the net-covering, rush on into the purse-net. Somtimes the dog will not attract their attention, if a red handkerchief, or something very singular, is not put about him.

Decoy, in military affairs, a stratagem to carry off the enemy's horses in a foraging party, or from pasture. The word is also used to denote a stratagem employed by a small ship of war to betray a vessel of inferior force into an incautious pursuit, till she has drawn her within the range of her cannon. It is usually performed by painting the stern and sides in such a manner, as to disguise the ship, and represent her either much smaller and of inferior force, or as a friend to the hostile vessel which she endeavours to ensnare, by assuming the emblems and ornaments of the nation to which the stranger is supposed to belong.

DECREE, in the civil law, is a determination that the emperor pronounces upon hearing a particular cause between plaintiff and defendant.

Decree, is a sentence pronounced by the Lord Chancellor in the Court of Chancery, and is equally binding upon the parties as a judgment in a court law. By the laws of England, a decree (notwithstanding any contempts thereof) shall not bind the goods or moveables, but only charge the person. If a decree be obtained and inrolled, so that the cause cannot be reheard, then there is no remedy but by bill of review, which must be on error appearing on the face of the decree, or on matter subsequent thereto, as a release or a receipt discovered since.

Decrees *of councils*, are the laws made by them to regulate the doctrine and policy of the church.

DECREPITATION, in chemistry, a term applied to the crackling noise of salts exposed to heat, by which they are quickly split. It takes place in those salts that have little water of crystallization, the increased temperature converting that small quantity into vapour, by which the crystals are suddenly burst. Common salt affords a good example of decrepitation, and when used as a flux should be previously decrepitated.

DECUMARIA, in botany, a genus of the Dodecandria Monogynia class and order. Natural order of Myrti. Essential character: calyx eight to twelve-leaved, superior; petals eight to twelve; capsule eight-celled, with many seeds. There is but one species, *viz*. D. barbara, climbing decumaria, a native of Carolina.

DECUSSATE, in natural history, crossed at right angles.

DEDICATION, in matters of literature, the inscribing a book, poem, play, or the like, to some person of distinction, serving both as a protection to the piece, and a mark of the author's respect for the person to whom he dedicates his work.

DEED, is a written contract, sealed and delivered. It must be written before the sealing and delivery, otherwise it is no deed; and after it is once formally executed by the parties, nothing can be added or interlined; and therefore, if a deed be sealed and delivered, with a blank left for the sum, which the obligee fills up after sealing and delivery, this will make the deed void. A deed must be made by parties capable of contracting, and upon a good consideration; and the subject matter must be legally and formally set out. The formal parts of a deed are, the premises, containing the number, names, additions, and titles of the parties. The covenants, which are clauses of agreement contained in the deed, whereby the contracting parties stipulate for the truth of certain facts, or bind themselves to the performance of some specific acts. The conclusion, which mentions the execution and date of the deed, or the time of its being given or executed, either expressly, or with reference to some day and year before mentioned.

A deed is the most solemn act of law which a man can perform with respect to the disposition of his property, and therefore no person shall be permitted to aver or prove any thing against his own deed. All the parts of a deed indented constitute in law but one entire deed; but every part has the same operative force as all the parts taken together, and they are deemed the mutual or reciprocal acts of either of the parties, who may be bound by either part of the same, and the words of the indenture may be considered as the words of either party. If the name of baptism or surname of a party to a deed be mistaken, as John for Thomas, &c. this has been held to be dangerous. But any mistake, as spelling, &c. not deviating from the substance of the deed, will not render it void. If a man get another name in common esteem than his right name, any deed made to him under such name will be valid. Every deed must be founded upon good and sufficient consideration; not upon an usurious contract, nor upon fraud or collusion, either to deceive *bona fide* purchasers, or just and lawful creditors; any of which considerations will vacate the deed, and subject the parties to forfeiture, and in some cases to imprisonment. A deed also without any consideration is void. A deed must be written upon the proper stamps prescribed by the legislature, otherwise it cannot be given in evidence.

The force and effect which the law of England gives to a deed under seal cannot exist, unless such deed be executed by the party himself, or by another for him, in his presence, or with his direction; or, in his absence, by an agent authorized so to do by another deed, also under seal; and in every such case the deed must be made and executed in the name of the principal.

A deed takes effect only from the day of delivery, and therefore, if it have no date, or a date impossible, the delivery will in all cases ascertain the date of it; and if another party seal the deed, yet, if the party deliver it himself, he thereby adopts the sealing and signing, and by such delivery makes them both his own. The delivery of a deed may be alleged at any time after the date, but, unless it be sealed, and regularly delivered, it is no deed. Another requisite of a deed is, that it be properly witnessed or attested: the attestation is, however, necessary, rather for preserving the evidence, than as intrinsically essential to the validity of the instrument.

There are four principles adopted by the courts of law for the exposition of deeds; *viz.* 1. That they be beneficial to the grantee or person in whose favour they are intended to operate. 2. That where the words may be employed to some interest, they shall not be void. 3. That the words be construed according to the meaning of the parties, and not otherwise; and the intent of the parties shall be carried into effect, provided such intent can possibly stand at law. 4. That they are to be consonant to the rules of law, and deeds shall be expounded reasonably, without injury to the grantor, and to the greatest advantage of the grantee. Deeds are further expounded upon the whole; and if the second part contradict the first, such second part shall be void; but if the latter expound or explain the former, which it may, both parts may stand.

In construction of law, the first deed and the last will stand in force; and where a deed is by indenture between parties, none can have an action upon such deed, but the person who is a party to it. In a deed-poll, however, one person may covenant with another, who is not a party, to do certain acts; for the non-performance of which he may bring his action.

Where a man justifies title under any deed, he ought to produce that deed; if it be alleged in pleading, it must be produced to the court, that it may determine whether the deed contain sufficient words to make a valid contract.

DEER. See CERVUS.

DEFAMATION, the offence of speaking slanderous words of another; and where any person circulates any report injurious to the credit or character of another, the party injured may bring an action to recover damages proportioned to the injury he has sustained; but it is incumbent upon the party to prove that he has sustained an injury, to entitle him to damages. In some cases, however, as for words spoken, which, by law, are in themselves actionable, as calling a tradesman a bankrupt, a cheat, or swindler, &c. there is no occasion to prove any particular damage, but the plaintiff must be particularly attentive to state words precisely as they were spoken, otherwise he will be nonsuited.

DEFAULT is commonly taken for non-appearance in court at a day assigned; if a plaintiff make default in appearance in a trial at law, he will be nonsuited; and where a defendant makes a default, judgment shall be had against him by default.

DEFAULT *of jurors.* If jurors make default in their appearance for trying of causes, they shall forfeit their issues, unless they have any reasonable excuse, proved by witnesses, in which case the justices may discharge the issues for default.

DEFENCE, in fortification, all sorts of works that cover and defend the opposite posts, as flanks, casemates, parapets, and faussebrays. See FORTIFICATIONS.

DEFENDER *of the Faith,* a peculiar title given to the King of England; by Pope Leo the Tenth to King Henry the Eighth, for writing against Martin Luther, in behalf of the Church of Rome, then accounted *domicilium fidei catholicæ.*

DEFERENTIA *vasa.* See ANATOMY.

DEFICIENT *numbers*, those whose parts or multiples, added together, fall short of the integer whereof they are the parts; such is 8, its parts, 1, 2, 4, making only 7. See NUMBER.

DEFILE, in fortification, a straight narrow passage, through which a company of horse or foot can pass only in file, by making a small front, so that the enemy may take an opportunity to stop their march, and to charge them with so much the more advantage, in regard that those in the front and rear cannot reciprocally come to the relief of one another.

DEFINITE, in grammar, is applied to an article that has a precise determinate signification; such as the article *the* in English, *le* and *la* in French, &c. which fix and ascertain the noun they belong to, to some particular, as *the King, le Roy;*

whereas in the quality *of King, de Roy*, the articles *of* and *de* mark nothing precise, and are therefore indefinite.

DEFINITION, the shewing the meaning of one word by several other not synonymous terms. The meaning of words being only the ideas they are made to stand for by him that uses them, the meaning of any term is then shewed, or the word is defined, when by other words the idea it is made the sign of, and is annexed to it in the mind of the speaker, is, as it were, represented and set before the view of another; and thus its signification is ascertained. This is the only end and use of definitions, and therefore the only measure of what is, or is not, a good definition.

The names then of simple ideas are incapable of being defined, because the several terms of a definition signifying several ideas, they can altogether by no means represent an idea which has no composition at all; and therefore a definition, which is properly but shewing the meaning of any one word by several others, not signifying the same each, can in the names of simple ideas have no place. Definitions which then take place in compound ideas only are of two sorts: the definition of the name, which is the explanation of what any word means; and the definition of the thing, which explains in what the nature of that thing consists.

The special rules for a good definition are these: 1. A definition must be universal, or adequate, that is, it must agree to all the particular species, or individuals, that are included under the same idea. 2. It must be proper, and peculiar to the thing defined, and agree to that alone. These two rules being observed, will always render a definition reciprocal with the thing defined, that is, the definition may be used in the place of the thing defined; or they may be mutually affirmed concerning each other. 3. A definition should be clear and plain; and indeed it is a general rule concerning the definition both of names and things, that no word should be used in either of them, which has any difficulty in it, unless it has been before defined. 4. A definition should be short, so that it must have no tautology in it, nor any words superfluous. 5. Neither the thing defined, nor a mere synonymous name, should make any part of the definition.

DEFLAGRATION, in chemistry, the act of burning two or more substances together, as charcoal and nitre. When a quantity of nitre, (nitrate of potash,) is mixed with an equal weight of sulphur, charcoal, or other inflammable substance, if the mixture is thrown into a crucible heated to redness, a very vivid combustion is instantly excited: this is deflagration, which is thus explained: nitre is a compound of nitric acid and potash: nitric acid consists of nitrogen and oxygen; the nitre, therefore, contains a large portion of oxygen, which is in so weak a state of combination, that it is separated by exposure to a red heat. When, therefore, the mixture of the nitre and of the inflammable body is thrown into the heated crucible, the oxygen of the former is disengaged; it is thus suddenly presented to the inflammable body, and hence the vivid combustion that is excited; and for the production of this, it is not even requisite to raise the temperature so high as that which would be necessary, if applied alone, to decompose the nitre, the affinity of the inflammable body to the oxygen of the nitre causing it to take place at a temperature somewhat lower. The nitrogen, or azote of the nitric acid, passes off in the state of gas; and the potash with which the acid was united remains mixed, or united with the body formed by the combination of the oxygen, and the inflammable substance.

DEFORMITY, the want of that uniformity necessary to constitute the beauty of an object. See BEAUTY.

DEGLUTITION, in medicine, the act of swallowing the food, performed by means of the tongue driving the aliment into the œsophagus, which, by the contraction of the sphincter, protrudes the contents downwards.

DEGRADATION, a punishment of delinquent ecclesiastics. The canon law distinguishes it into two sorts; the one summary, by words only; the other solemn, by stripping the person degraded of those ornaments and rights which are the ensigns of his order or degree.

DEGRADED *cross*, in heraldry, a cross divided into steps at each end, diminishing as they ascend towards the centre, called by the French *perronnée*.

DEGREE, in geometry, a division of a circle, including a three hundred and sixtieth part of its circumference. Every circle is supposed to be divided into three hundred and sixty parts, called degrees, and each degree divided into sixty other parts, called minutes; each of these minutes being again divided into sixty seconds, each second into thirds, and each third into fourths, and so on. By this means no more degrees or parts are reckoned in the greatest circle than in the least that is; and therefore, if the same angle at the centre be subtended by two concentrical arches, as many degrees are counted in the one as in the other; for these two arches have the same proportion to their whole peripheries.

Degree *of latitude.* See Latitude.

Degree *of longitude.* See Longitude and Earth.

Degree, in universities, denotes a quality conferred on the students or members thereof, as a testimony of their proficiency in the arts or sciences, and entitling them to certain privileges. The degrees are much the same in all universities, but the laws thereof, and the previous discipline or exercise, differ. The degrees are, batchelor, master, and doctor, instead of which last, in some foreign universities, they have licentiate.

In each faculty there are two degrees, batchelor and doctor, which were anciently called batchelor and master. In the arts, likewise, there are two degrees which still retain the ancient denomination, *viz*. batchelor and master.

With regard to obtaining degrees at Oxford and Cambridge, matters are nearly on the same footing, only at Cambridge the discipline is somewhat more severe, and the exercises more difficult. For the degree of batchelor of arts, besides residence in the university near four years, it is required that the person in the last year have defended three questions in natural philosophy, mathematics, or ethics, and answered the objections of three several opponents at two several times; as also that he have opposed three times. After which, being examined by the master and fellows of the college, he is referred to seek his degree in the schools, where he is to sit three days, and be examined by two masters of arts appointed for the purpose. For the degree of master of arts, the candidate is obliged three several times to maintain two philosophical questions in the public schools, and to answer the objections brought against him by a master of arts. He must also keep two acts in the batchelors' school, and declaim once. To pass batchelor of divinity, the candidate must have been seven years master of arts: he must have opposed a batchelor of divinity twice, kept one divinity act, and preached before the university, once in Latin, and once in English. For the degree of doctor, see Doctor.

Degrees, in music, are the little intervals whereof the concords, or harmonical intervals, are composed.

DEHISCENT, in natural history, gaping, notched.

DEISTS, in the modern sense of the word, are those persons in christian countries, who, acknowledging all the obligations and duties of natural religion, disbelieve the christian scheme, or revealed religion. They are so called from their belief in God alone, in opposition to Christians. The late learned Dr. Clarke, taking the denomination in the most extensive signification, distinguishes Deists into four sorts. 1. Such as pretend to believe the existence of an eternal, infinite, independent, intelligent Being, and who teach that this Supreme Being made the world, though they fancy he does not at all concern himself in the management of it. 2. Those who believe not only in the being, but also the providence of God with respect to the natural world, but who, not allowing any difference between moral good and evil, deny that God takes any notice of the morally good or evil actions of men; these things depending, as they imagine, on the arbitrary constitutions of human laws. 3. Those who, having right apprehensions concerning the natural attributes of God, and his all governing providence, and some notion of his moral perfections also, yet being prejudiced against the notion of the immortality of the human soul, believe that men perish entirely at death, and that one generation shall perpetually succeed another, without any future restoration or renovation of things. 4. Such as believe the existence of a Supreme Being, together with his providence in the government of the world, as also the obligations of natural religion, but so far only, as these things are discoverable by the light of nature alone, without believing any divine revelation. These last are the only true Deists; but as the principles of these men would naturally lead them to embrace the Christian revelation, the learned author concludes there is now no consistent scheme of deism in the world.

DELEGATES, *court of*, is so called, because the judges thereof are delegated by the King's commission, under the great seal, to hear and determine appeals in the three following cases: 1. Where a sentence is given in any ecclesiastical cause by the archbishop or his official. 2. When any sentence is given in any ecclesiastical cause in the places exempt. 3. When a sentence is given in the admiral's court, in suits civil and marine, by order of the civil law. This commission is usually filled with lords spiritual and temporal, judges of the courts at Westminster, and doctors of the civil law.

DELIVERANCE, a criminal brought to trial, to which pleading not guilty, he puts himself on God and his country; the clerk of the crown wishes him a good deliverance.

DELFT *ware*, a kind of pottery of baked earth, covered with an enamel or white glazing, which gives it the appearance and neatness of porcelain. Some kinds of this enamelled pottery differ much from others, either in their sustaining sudden heat without breaking, or in the beauty and regularity of their forms, of their enamel, and of the painting with which they are ornamented. In general, the fine and beautiful enamelled potteries, which approach the nearest to porcelain in external appearance, are at the same time, those which least resist a brisk fire. Again, those which sustain a sudden heat are coarse, and resemble common pottery. The basis of this pottery is clay, which is to be mixed with such a quantity of sand, that the earth shall preserve enough of its ductility to be worked, moulded, and turned easily; and yet that its fatness shall be sufficiently taken from it, that it may not crack or shrink too much in drying or in baking. Vessels formed of this earth must be dried very gently, to avoid cracking. They are then to be placed in a furnace to receive a slight baking, which is only meant to give them a certain consistence or hardness. And, lastly, they are to be covered with an enamel, or glazing, which is done by putting upon the vessels thus prepared, the enamel which has been ground very fine, and diluted with water.

As vessels on which the enamel is applied are but slightly baked, they readily imbibe the water in which the enamel is suspended, and a layer of the enamel adheres to their surface; these vessels may then be painted with colours composed of metallic calces, mixed and ground with sensible glass. When they are become perfectly dry, they are to be placed in the furnace, included in cases of baked earth, called seggars, and exposed to a heat capable of fusing uniformly the enamel which covers them. This heat given to fuse the enamel, being much stronger than that which was applied at first to give some consistence to the ware, is also the heat necessary to complete the baking of it. The furnace and colours used for painting this ware, are the same as those employed for porcelain. The glazing, which is nothing but white enamel, ought to be so opaque as not to show the ware under it. There are many receipts for making these enamels; but all of them are composed of sand or flints, vitrifying salts, oxide of lead, and oxide of tin; and the sand must be perfectly vitrified, so as to form a glass considerably fusible. Somewhat less than an equal part of alkaline salt, or twice its weight of oxide of lead, is requisite to effect such vitrifications of sand. The oxide of tin is not intended to be vitrified, but to give a white opaque colour to the mass; and one part of it is to be added to three or four parts of all the other ingredients taken together. From these general principles various enamels may be made to suit the different kinds of earths. To make the enamel, lead and tin are oxyded together with a strong fire; and the sand is also to be made into a frit with the salt or ashes. The whole is then to be well mixed and ground together. The matter is then to be placed under the furnace, where it is melted and vitrified during the baking of the ware. It is next to be ground in a mill, and applied as above directed.

Concerning the earth of which the ware is made, pure clay is not a proper material when used alone. Different kinds of earth, mixed together, are found to succeed better; pieces of ware made of clay alone are found to require too much time to dry, and they crack and lose their form, unless they are made exceedingly thick; an addition of marle diminishes the contraction of the clay, renders it less compact, and allows the water to escape, without altering the form of the ware in drying. It affords also a better ground for the enamel, which appears more glossy and white than when laid on clay alone. The kinds of clay which are chiefly used in the composition of delft ware, are the blue and green. A mixture of blue clay and marle would not be sufficiently solid, and would be apt to scale, unless it were exposed to a fire more intense than what is commonly used for the burning of delft ware. To give a greater solidity, some red clay is added; which on account of its ferruginous matter possesses the requisite binding quality. The proportions of these ingredients vary in different works, according to the different qualities of the earths employed. Three parts of blue clay, two parts of red clay, and five parts of marle, form the composition used in several manufactories. See Enamel.

DELIMA, in botany, a genus of the Polyandria Monogynia class and order. Natural order of Rosaceæ, Jussieu. Essential character: calyx five-leaved: corolla none; berry with two seeds. There is but one species, *viz.* D. sarmentosa, a native of Ceylon.

DELIQUESCENCE, in chemistry, a term to certain saline bodies that have become moist or liquid, by means of the water which they absorb from the atmosphere, in consequence of their great attraction of water. When the salt has, by exposure to air, become so far deliquesced as to be in a liquid state, it is said to be in the state of deliquium. Hence, alkali, reduced by this means to a liquid state, was formerly denominated oil of tartar per deliquium.

DELIRIUM, in medicine, the production of ideas not answerable to external causes, from an internal indisposition of the brain, attended with a wrong judgment following from these ideas, and an affection of the mind and motion of the body accordingly; and from these increased through various degrees, either alone or joined together, various kinds of deliria are produced.

DELIVERY, *child-birth.* See MIDWIFERY.

DELPHINUM, in botany, *larkspur*, a genus of the Polyandria Trigynia class and order. Natural order of Multisiliquæ. Ranunculaceæ, Jussieu. Essential character: calyx none; petals five; nectary cloven, produced into a horn behind; siliques three or one. There are eleven species. These are mostly hardy annuals or perennials. The lower leaves digitate or palmate: the upper less divided, and sometimes even entire. The flowers are in loose panicles at the ends of the stem and branches, of various colours, but chiefly blue.

DELPHINUS, the *dolphin*, in natural history, a genus of Mammalia of the order Cetæ. Generic character: teeth in each jaw; spiracle on the head. Shaw enumerates six species, and Gmelin four. C. phocæna, or the porpesse, is the most abundant of cetaceous animals, and is found particularly in the European seas, whence it often advances very nearly to the mouths of considerable rivers. Its general length is from five to eight feet. Porpesses are gregarious, and frequently seen frolicking on the water, and playing their uncouth gambols, more especially in boisterous and tempestuous weather. They feed principally on smaller fishes, and pursue the shoals of herrings and mackrel with apparently unwearied vigour and insatiable appetite. They are covered immediately under the skin with a fatty substance of considerable thickness, and which produces a large quantity of oil. The porpesse was formerly considered, not merely as eatable, but as a species of luxury, being served up at noble and royal tables. Such, however, are the revolutions of taste, that by the least fastidious appetite this food is at present decidedly rejected.

D. delphis, or the dolphin, has the same general habits and appearance with the preceding, but is considerably longer, measuring occasionally even ten feet. It abounds both in the Pacific and European Seas, and its appearance is in general preliminary to a tempest. It not only pursues and attacks small fish, on which indeed it subsists, but assails the whale itself, and is stated to have been seen firmly adhering to whales as they have leaped from the water. The ancients appear to have had almost a superstitious attachment to this animal, and relate various anecdotes of it, implying a peculiar susceptibility of gratitude and affection, a strong attachment to mankind, and a rapturous fondness for music. In natural history, however, the ancients were more fanciful than accurate, and, compared with the moderns, were as dwarfs to giants. The porpesse, though naturally straight, swims in a crooked form; and the dolphin is said, by Linnæus, to be crooked only when it leaps. Shaw thinks it assumes this form also in swimming. See Pisces, Plate III. fig. 5.

D. orca, grampus. This is one of the most ravenous and formidable inhabitants of the ocean. It is found both in the Atlantic and the Mediterranean, in the northern and the southern seas, and is about twelve feet broad, and twenty-four in length. It preys both upon the porpesse and dolphin, as well as upon smaller fish. It frequently attacks seals, even on the uncovered rocks, dislodging and often destroying them by its dorsal fin. But it is particularly and irreconcileably hostile to whales, which it attacks without the slightest hesitation, and often fastens on with the most persevering and destructive tenacity.

DELUGE, an inundation, or overflowing of the earth, either wholly or in part, by water.

We have several deluges recorded in history; as that of Ogyges, which overflowed almost all Attica; and that of Deucalion, which drowned all Thessaly, in Greece; but the most memorable was that called the universal deluge, or Noah's flood.

DEMAIN, or DEMESNE, signifies the king's lands appertaining to him in property. No common person hath any demains, simply understood, for we have no land, (that of the crown only excepted,) which is not holden of a superior, for all depends, either mediately or immediately, of the crown: thus, when a man in pleading would signify his land to be his own, he says that he is or was seized thereof in his demain as of fee; whereby he means, that although his land be to him and his heirs forever, yet it is not true demain, but depending upon a superior lord, and holding by service, or rent in lieu of service, or by both service and rent.

DEMAND, calling upon a man for any sum or sums of money, or any other thing due. By the several statutes of limitation, debts, claims, &c. are to be demanded and made in time, or they will be lost by law. There are two manners of demands, the one in deed, the other in law; in deed, as in every *precepe*, there is an express demand; in law, as in every entry in land, distress for rent, taking or seizing of goods, and such like acts, which may be done without any words, are demands in law.

Where there is a duty which the law makes payable on demand, no demand need be made; but if there be no duty till demand, in such case there must be a demand to make the duty.

DEMOCRACY, the same with a popular government, wherein the supreme power is lodged in the hands of the people.

The advantages of a democracy, where the people at large, either collectively, or by representation, constitute the legislature, are, liberty, or exemption from needless restrictions, equal laws, regulations adapted to the wants and circumstances of the people, public spirit, frugality, averseness from war, the opportunities which democratic assemblies afford to men of every description, of producing their abilities and councils to public observation, and the exciting thereby, and calling forth to the service of the commonwealth, the faculties of the best citizens. The evils attendant upon this form of government are, dissention, tumults, faction, the attempts of powerful citizens to possess themselves of empire, the confusion and clamour which are the inevitable consequences of assembling multitudes, and of propounding questions of state to the discussion of the people; the delay and disclosure of public councils and designs; and the imbecility of measures, retarded by the necessity of obtaining the consent of numbers; lastly, the oppression of the provinces which are not admitted to a participation in the legislative power. The late excellent Dr. Paley mentions other advantages of a democratic constitution, which, he says, ought not be forgotten; *viz.* the direction which it gives to the education, studies, and pursuits of the superior orders of the community. The share which this has in forming the public manners and national character is very important. Popular elections procure to the common people courtesy from their superiors. The satisfaction which the people, in free governments, derive from the knowledge and agitation of political subjects; such as the proceedings and debates of the senate, the conduct and character of ministers, the revolutions, intrigues, and contentions of parties: and, in general, from the discussion of public measures, questions, and occurrences. "Subjects of this sort," says the learned author of the "Principles of Moral and Political Philosophy," excite just enough of interest and emotion to afford a moderate engagement to the thoughts, without rising to any painful degree of anxiety, or ever leaving a fixed oppression upon the spirits;—and what is this but the end and aim of all those amusements, which compose so much of the business of life, and of the value of riches. See GOVERNMENT, *mixed:* CONSTITUTION, &c.

DEMONSTRATION, in logic, a series of syllogisms, all whose premises are either definitions, self-evident truths, or propositions already established.

DEMONSTRATIVE, in grammar, a term given to such pronouns as serve to indicate or point out a thing. Of this number are *hic, hæc, hoc*, among the Latins, and *this, that, these, those,* in English.

DEMURRAGE, is an allowance made to the master of a ship by the merchants, for being detained in port longer than the time appointed and agreed for his departure. The rate of this allowance is generally settled in the charter party. It is now firmly established that the claim of demurrage ceases, as soon as the ship is cleared out and ready for sailing.

DEMURRER, is a kind of pause or stop put to the proceeding of an action upon a point of difficulty, which must be determined by the court before any farther proceedings can be had therein.

He that demurs in law confesses the

facts to be true, as stated by the opposite party; but denies that by the law arising upon those facts any injury is done to the plaintiff, or that the defendant has made out a lawful excuse. As, if the matter of the plaintiff's declaration be insufficient in law, then the defendant demurs to the declaration; if, on the other hand, the defendant's excuse or plea be invalid, the plaintiff demurs in law to the plea; and so in every other part of the proceedings, where either side perceives any material objection in point of law upon which he may rest his case.

General demurrer being entered, it cannot be afterwards waved without leave of the court; but a special demurrer generally may, unless the plaintiff have lost a term, or the assizes, by the defendant's demurring.

And upon either a general or special demurrer, the opposite party avers it to be sufficient, which is called a rejoinder in demurrer, and then the parties are at issue in point of law; which issue in law, or demurrer, is argued by counsel on both sides; and if the points be difficult, then it is argued openly by the judges of the court, and if they, or the majority of them, concur in opinion, accordingly judgment is given: but in case of great difficulty, they may adjourn into the Exchequer Chamber, where it shall be argued by all the judges.

DENARIUS, in Roman antiquity, the chief silver coin among the Romans, worth in our money about seven-pence three farthings. As a weight, it was the seventh part of a Roman ounce.

DENDRITES, or *Arborizations*. This appellation is given to figures of vegetables which are frequently observed in fossil substances. They are of two kinds; the one superficial, the other internal. The first are chiefly found on the surface of stones, and between the strata and in the fissures of those of a calcareous nature. Stones of a similar kind, when very compact, sometimes also exhibit internal arborizations; such are the marbles of Hesse, of Angersburgh in Prussia, and of Baden-Dourlach on the left bank of the Rhine.

Several of these dendrites bear a striking resemblance to the poplar; while others exhibit the straight stem, pyramidal form, and pendent branches of the fir. Some specimens of dendrites, found in Switzerland, represent, in a very surprising manner, plantations of willows; and many of them are so beautiful, as really to appear the work of art. The superficial dendrites are mostly of a brown, changing gradually to a reddish yellow. The internal dendrites are of a deep black. The most esteemed dendrites are those found in agates; and more particularly in the sardonyx, cornelian, and other precious stones brought from the East, and which are commonly denominated moka stones. The Oriental agates display the most varied and beautiful forms. Sometimes they exhibit the appearance of terraces covered with different species of moss, interspersed with plants of the fern tribe, having large leaves, and the outlines exquisitely finished: the colours are likewise extremely brilliant.

DENEB, an Arabic term, signifying tail, used by astronomers to denote several fixed stars. Thus deneb elecet signifies the bright star in the lion's tail. Deneb adigege, that in the swan's tail, &c.

DENEKIA, in botany, a genus of the Syngenesia Superflua class and order. Receptacle naked; calyx imbricate: florets of the ray two-lipped. There is but a single species, found at the Cape.

DENIZEN, a denizen is an alien born, who has obtained letters patent whereby he is constituted an English subject. A denizen is in a middle state, between an alien and a natural born or naturalized subject, partaking of the nature of both. He may take lands by purchase, or derive a title by descent, through his parents or any ancestor, though they be aliens.

DENOMINATION, a name imposed on any thing, usually expressing some predominant quality. Hence, as the qualities and forms of things are either internal or external, denomination becomes, 1. Internal, which is that founded on the intrinsic form. Thus, Peter is denominated learned, on account of his learning, which is something internal. 2. External denomination, that founded on an external form. Thus, a wall is said to be seen and known, from the vision and cognition employed upon it. And thus, Peter is denominated honoured, by reason of honour, which is not so much in the person honoured, as in him who honours.

DENOMINATOR, in arithmetic, a term used in speaking of fractions. The denominator of a fraction is the number below the line, shewing into how many parts the integer is supposed to be divided. Thus, in the fraction $\frac{3}{4}$, the number 4 shews that the integer is divided into four parts. So in the fraction $\frac{a}{b}$, b is the denominator. See Fraction.

Denominator *of a ratio*, is the quotient arising from the division of the antecedent by the consequent. Thus 8 is the denominator of the ratio 40 : 5, because 40 divided by 5, gives 8 for a quotient. It is also called the exponent of a ratio. See Exponent.

DENSITY *of bodies*, is that property directly opposite to rarity, whereby they contain such a quantity of matter under such a bulk. Accordingly, a body is said to have double or triple the density of another body, when, their bulk being equal, the quantity of matter is in the one double or triple the quantity of matter in the other. The densities and bulks of bodies are the two great points upon which all mechanics or laws of motion turn. It is an axiom, that bodies of the same density contain equal masses under equal bulks. If the bulks of two bodies be equal, their densities are as their masses: consequently, the densities of equal bodies are as their gravities. If two bodies have the same density, their masses are as their bulks; and as their gravity is as their masses, the gravity of bodies of the same density is in the ratio of their bulk. Hence also bodies of the same density are of the same specific gaavity; and bodies of different density, of different specific gravity. The quantities of matter in two bodies are in a ratio compounded of their density and bulk: consequently, their gravity is in the same ratio. If the masses or gravities of two bodies be equal, the densities are reciprocally as their bulks. The densities of any two bodies are in a ratio compounded of the direct ratio of their masses, and a reciprocal one of their bulks: consequently, since the gravity of bodies is as their masses, the densities of bodies are in a ratio compounded of the direct ratio of their gravities, and a reciprocal one of their bulks.

Density *of the air*, is a property that has employed the later philosophers since the discovery of the toricellian experiment. It is demonstrated, that in the same vessel, or even in vessels communicating with each other at the same distance from the centre, the air has every where the same density. The density of the air, *cæteris paribus*, increases in proportion to the compressing powers. Hence the inferior air is denser than the superior; the density, however, of the lower air is not proportional to the weight of the atmosphere, on account of heat and cold, and other causes, perhaps, which make great alterations in density and rarity. However, from the elasticity of the air, its density must be always different at different heights from the earth's surface; for the lower parts being pressed by the weight of those above will be made to accede nearer to each other, and the more so as the weight of the incumbent air is greater. Hence, the density of the air is greatest at the earth's surface, and decreases upwards in geometrical proportion to the altitudes taken in arithmetical progression.

If the air be rendered denser, the weight of bodies in it is diminished; if rarer, increased; because bodies lose a greater part of their weight in denser than in rarer mediums. Hence, if the density of the air be sensibly altered, bodies equally heavy in a rarer air, if their specific gravities be considerably different, will lose their equilibrium in the denser, and the specifically heavier body will preponderate. See Pneumatics.

Density *of planets*. The densities of bodies being proportional to their masses divided by their bulks; and, when bodies are nearly spherical, their bulks are as the cubes of their semi-diameters; of course the densities in that case are as the masses divided by the cubes of the semi-diameters. For greater exactness, we must take that semi-diameter of a planet which corresponds to the parallel, the square of the sine of which is equal to one-third, and which is equal to the third of the sum of the radius of the pole, and twice the radius of the equator. This method gives us the densities of the principal planets as follows, that of the sun being unity:

Earth	3.93933
Jupiter	0.86014
Saturn	0.49512
Herschell . . .	1.13757

See Astronomy. Planets, *masses of.*

DENTALIUM, *tooth-shell*, in natural history, a genus of the Vermes Testacea. Generic character: animal a terebella; shell univalve, tubular straight or slightly curved, with the cavity open at both ends, and undivided. There are 22 species, some of which are found in the fossil state, in the alluvial deposit of New-Jersey.

DENTARIA, in botany, *English toothwort*, a genus of the Tetradynamia Siliquosa class and order. Natural order of Siliquosæ. Cruciferæ, Jussieu. Essential character: silique bursting elastically with the valves rolled back; stigma emarginate; calyx converging lengthwise. There are four species, of which D. enneaphylla, nine-leaved tooth-wort, is about a foot and a half in height; leaves biternate: leaflets lanceolate, serrate, acuminate, and smooth; flowers from three peduncles forming a panicle or raceme, erect, fasciled; calyx pale-green or yellowish; petals reddish-yellow, or yellowish-red; there is a gland on each side, between the longer stamens and the calyx, and one surrounding the base of each shorter stamen; in each cell are four seeds. It is a native of Hungary, Austria, Idria, Friuli, Silesia, in the woods. It flowers in April and May.

DENTELLA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Rubiaceæ, Jussieu. Essential character: corolla tubular five-cleft, with three toothed segments; calyx five-parted; stigmas two; capsule globular, inferior, two-celled, many seeded. There is but one species, *viz.* D. repens, a native of New Caledonia.

DENTIFRICE, a remedy for the teeth. Various are the compositions sold for the purpose of keeping the teeth in good preservation; they are mostly composed of earthy substances, finely powdered, and mixed with alum. Acids, though very effectual for cleansing the teeth, are decidedly mischievous. Charcoal is at present in high reputation as a dentifrice; but the sepia or cuttle fish, sold by the chemists, and finely powdered, and which are picked up on the sands on the southern coast, are much valued for this purpose.

DENTITION, the breeding or cutting the teeth in children. See INFANCY, *diseases of.*

DEOBSTRUENTS, in pharmacy, such medicines as open obstructions.

DEODAND, in our customs, implies a thing devoted or consecrated to God, for the pacification of his wrath, in case of any misfortune, as a person's coming to a violent end, without the fault of any reasonable creature; as if a horse should strike his keeper, and so kill him. In this case, the horse is to be deodand; that is, he is to be sold, and the price distributed to the poor, as an expiation of that dreadful event.

DEPARTURE, in navigation, is the easting or westing of a ship in respect of the meridian it departed or sailed from: or it is the difference of longitude, either east or west, between the present meridian the ship is under, and that where the last reckoning or observation was made. This departure, any where but under the equator, must be accounted according to the number of miles in a degree proper to the parallel the ship is under.

DEPHLOGISTICATED, a term, applied, by Dr. Priestley, to what is now called oxygen gas, when he first discovered it. It was called by Scheele, who discovered it at the same time, vital air.

DEPOSITION. Proof in the high court of chancery is by the depositions of witnesses; and the copies of such, regularly taken and published, are read as evidence at the hearing. For the purpose of examining witnesses in or near London, there is an examiner's office appointed; but for such as live in the country, a commission to examine witnesses is usually granted to four commissioners, two named on each side, or any three or two of them, to take the depositions there. And if the witnesses reside beyond sea, a commission may be had to examine them there, upon their own oaths; and if foreigners, upon the oaths of two skilful interpreters. The commissioners are sworn to take the examinations truly, and without partiality, and not to divulge them till published in the court of chancery, and their clerks are also sworn to secrecy. The witnesses are compellable by process of subpœna, as in the courts of common law, to appear and submit to examination. And when their depositions are taken, they are transmitted to the court with the same care that the answer of a defendant is sent.

DEPOT, in military affairs, any particular place in which military stores are deposited for the use of the army. In a more extensive sense, it means several magazines collected together for that purpose. It also signifies an appropriated fort, or place for the reception of recruits, or detached parties, belonging to different regiments.

DEPRESSION *of the pole.* When a person sails or travels towards the equator, he is said to depress the pole, because as many degrees as he approaches nearer the equator, so many degrees will the pole be nearer the horizon. This phænomenon arises from the spherical figure of the earth. When a star is under the horizon, it is termed the depression of that star under the horizon. The altitude or depression of any star is an arch of the vertical, intercepted between the horizon and that star. See HORIZON and VERTICAL.

DEPRIVATION, is an ecclesiastical censure, whereby a clergyman is deprived of his parsonage, vicarage, or other spiritual promotion of dignity.

Causes of deprivation: if a clerk obtain preferment in the church by simonical contract; if he be an excommunicate, a drunkard, fornicator, adulterer, infidel, or heretic; or guilty of murder, man-slaughter, perjury, forgery, &c. if a clerk be illiterate, and not able to perform the duty of his church; if he be a scandalous person in life and conversation; or bastardy is objected against him; if he be under age, *viz.* the age of twenty-three years; be disobedient and incorrigible to his ordinary; or a nonconformist to the canons; if he refuse to use the common prayer; or preach in derogation of it; do not administer the sacrament, or read the articles of religion, &c.; if any parson, vicar &c. have one benefice with cure of souls, and take plurality, without a faculty or dispensation; or if he commit waste in the houses and lands of the church, called dilapidations: all these have been held good causes for deprivations of priests.

DEPTH, in geometry, the same with altitude; though, strictly speaking, we only use the term depth to denote how much one body, or part of a body, is below another.

DEPTH *of a battalion, squadron,* &c. the number of men in a file, who stand before each other in a straight line. In the ancient armies this was very great.

DEPUTATION, a mission of select persons out of a company, or body, to a prince or assembly, to treat of matters in their name. They are more or less solemn, according to the quality of those who send them, and the business they are sent upon.

DEPUTY, one who performs an office or duty in another's right; where an office is granted to a man and his heirs, he may make an assignee of that office, and consequently a deputy.

There is a great difference between a deputy and assignee of an office; for an assignee hath an interest in the office itself, and does all things in his own name; for which his grantor shall not answer, unless in special cases: but a deputy hath not any interest in the office, but is only the shadow of an officer, in whose name he does all things. A superior officer must answer for his deputy in civil actions, if he be not sufficient; but in criminal cases it is otherwise, where deputies are to answer for themselves.

DERIVATIVE, in grammar, a word which is derived from another, called its primitive. Thus, *manhood* is derived from *man, deity* from *deus,* and *lawyer* from *law.*

DERMESTES, *leather-eater,* in natural history, a genus of insects of the order Coleoptera. Generic character: antennæ clavate, the club perfoliate, three of the joints thicker: thorax convex, slightly margined; head inflected and hidden under the thorax. Gmelin has enumerated about 90 species, in three sections. A. jaw bifid. B. jaw one-toothed. C. feelers four, clavate, the last joint larger. This genus consists principally of small insects. Their larvæ are found among skins, furs, and various animal substances of a dry kind, which they injure, and on which they live. They are exceedingly destructive to books, furniture, and collections of natural history. In the grub state they are of a lengthened oval shape, and hairy, especially towards the end of the body. The complete insect has the habit of withdrawing the head beneath the thorax when handled. D. lardarius is something less than half an inch in length, and of a dusky brown colour, with the upper half of the wing shells whitish, marked with black specks. The larva is found on dried and salted meat; and is a sad pest to museums, libraries, and preparations of natural history.

DERRIS, in natural history, a genus of the Vermes Mollusca. Generic character; body cylindrical, composed of articulations; mouth terminal: feelers two. There is only one species. D. sanguinea found on the coast of Pembrokeshire, England. Body cylindrical, gradually tapering to a point behind, composed of joints, and capable of great flexibility, covered with a membranaceous transparent coat, through which the internal parts are visible; head extended beyond the outer skin less than the anterior part of the body, to which it is connected by a membranaceous covering forming a neck. It moves by an undulatory motion of the whole body.

DERVIS, a name given to all Mohamedan monks, though of various orders.

DESCENSION, in astronomy, is either right or oblique. Right descension is an arch of the equinoctial, intercepted between the next equinoctial point and the intersection of the meridian, passing through the centre of the object, at its setting, in a right sphere. Oblique descension, an arch of the equinoctial, intercepted between the next equinoctial point and the horizon, passing through the centre of the object, at its setting, in an oblique sphere.

DESCENSIONAL *difference*, that between the right and oblique descension of any heavenly body. See DESCENSION.

DESCENT, in general, is the tendency of a body from a higher to a lower place: thus all bodies, unless otherwise determined by a force superior to their gravity, descend towards the centre of the earth: the planets too may be said to descend from their aphelion to the perihelion of their orbits, as the moon does from the apogee to the perigee. Heavy bodies, meeting with no resistance, descend with an uniformly accelerated motion, for the laws of which see MECHANICS.

DESCENT, or hereditary succession, is the title which a man on the death of his ancestor acquires his estate by right of representation, as his heir at law: and an estate so descending to the heir is in law called the inheritance.

Descent is of three kinds; by common law, by custom, or by statute. By common law, as where one hath land of inheritance in fee-simple, and dieth without disposing thereof in his life-time, and the land goes to the eldest son and heir of course, being cast upon him by the law.

Descent of fee-simple by custom is sometimes to all the sons, or to all the brothers (where one brother dieth without issue,) as in gavel-kind; sometimes to the youngest son, as in borough English; and sometimes to the eldest daughter, or the youngest, according to the customs of particular places. Descent by statute is of fee-tail, as directed by the statute of Westminster, 2. *de donis*.

DESCENT, in genealogy, the order of succession of descendents in a line or family; or their distance from a common progenitor. Thus we say, one descent, two descents, &c.

DESCENT, in heraldry, is used to express the coming down of any thing from above; as a lion en descent, is a lion with his head towards the base points, and his heels towards one of the corners of the chief, as if he were leaping down from some high place.

DESCENT, in fortification, are the holes, vaults, and hollow places, made by undermining the ground.

The descent into the moat or ditch is a deep passage made through the esplanade and covert way, in form of a trench, whereof the upper part is covered with madriers and clays, to secure the besiegers from the enemy's fire. In wet ditches this trench is on a level with the surface of the water, but in dry ones it is sunk as deep as the bottom of the ditch.

DESCRIPTION, is such a strong and beautiful representation of a thing, as gives the reader a distinct view and satisfactory notion of it.

DESCRIPTION. In deeds and grants there must be a certain description of the lands granted, the places where they lie, and the persons to whom granted, &c. to make them good. But wills are more favoured than grants as to those descriptions; and a wrong description of the person will not make a devise void, if there be otherwise a sufficient certainty what person was intended by the testator. Where a first description of land, &c. is false, though the second be true, a deed will be void: contra, if the first be true, and the second false.

DESCRIPTION, applied to botany, the natural character of the whole plant, including all the external parts. In this respect the description of the species is distinguished from the specific difference, which regards the essential or striking characters only. A perfect or complete description is not confined to the principal parts of plants, as the root, stem, leaves, and fructification; but includes, likewise, whatever is conspicuous in their external appearance: as the foot-stalks of the leaves and flower; the stipulæ, or scales; the bracteæ, or floral leaves; the glands, or vessels of secretion; the weapons of offence and defence; the buds; the complication, or folding of the leaves within the buds; and the habit or general appearance of the whole plant. The order to be observed in the description is that of nature, proceeding from the root to the stem; next the branches; then the foot-stalks, leaves, flower-stalks, and flowers.

DESERTER, in a military sense, a soldier, who, by running away from his regiment or company, abandons the service. A deserter is, by the articles of war, punishable by death, and, after conviction, is hanged at the head of the regiment he formerly belonged to, with his crime writ on his breast, and suffered to hang till the army leave that camp, for a terror to others.

DESHACHE, in heraldry, is where a beast has its limbs separated from its body, so that they still remain on the escutcheon, with only a small separation from their natural places.

DESIDERATUM, is used to signify the desirable perfections in any art or science; thus, it is a desideratum with the blacksmith, to render iron fusible by a gentle heat, and yet preserve it hard enough for ordinary uses.

DESIGN, in a general sense, the plan, order, representation, or construction, of a building, book, painting, &c.

Design, in the manufactories, expresses the figures with which the workman enriches his stuff, or silk, and which he copies after some painter, or eminent draughtsman, as in diaper, damask, and other flowered silk and tapestry, and the like.

In undertaking of such kinds of figured stuffs, it is necessary, before the first stroke of the shuttle, that the whole design be represented on the threads of the warp: we do not mean in colours, but with an infinite number of little packthreads, which being disposed so as to raise the threads of the warp, let the workman see, from time to time, what kind of silk is to be put in the eye of the shuttle, for woof. This method of preparing the work is called reading the design, and reading the figure, which is performed in the following manner: a paper is provided considerably broader than the stuff, and of a length proportionate to what is intended to be represented thereon.—This they divide lengthwise, by as many black lines as there are intended threads in the warp; and cross these lines by others drawn breadthwise, which, with the former, make little equal squares: on the paper thus squared, the draughtsman designs his figures, and heightens them with colours, as he sees fit. When the design is finished, a workman reads it, while another lays it on the simblot.

To read the design, is to tell the person who manages the loom the number of squares or threads comprised in the space he is reading, intimating, at the same time, whether it is ground or figure. To put what is read on the simblot, is to fasten little strings to the several packthreads, which are to raise the threads named; and thus they continue to do till the whole design is read.

Every piece being composed of several repetitions of the same design, when the whole design is drawn, the drawer, to re-begin the design afresh, has nothing to do but to raise the little strings, with slip-knots, to the top of the simblot, which he had let down to the bottom: this he is to repeat as often as is necessary, till the whole be manufactured.

The ribbon weavers have likewise a design, but far more simple than that now described. It is drawn on paper with lines and squares, representing the threads of the warp and woof. But instead of lines, whereof the figures of the former consist, these are constituted of points only, or dots, placed in certain of the little squares formed by the intersection of the lines. These points mark the threads of the warp that are to be raised, and the spaces left blank denote the threads that are to keep their situation: the rest is managed as in the former.

Design is also used in painting, for the first idea of a large work, drawn roughly, and in little, with an intention to be executed and finished in large. See Painting.

DESIGNING, the art of delineating or drawing the appearance of natural objects by lines on a plane.

DESPOUILLE, in heraldry, the whole case, skin, or slough of a beast, with the head, feet, tail, and all appurtenances, so that being filled and stuffed it looks like the entire creature.

DETACHMENT, in military affairs, a certain number of soldiers drawn out from several regiments or companies equally, to be employed as the general thinks proper, whether on an attack, at a siege, or in parties to scour the country.

A detachment of two or three thousand men is a command for a brigadier; eight hundred for a colonel; four or five hundred for a lieutenant-colonel. A captain never marches on a detachment with less than fifty men, a lieutenant, an ensign, and two serjeants. A lieutenant is allowed thirty and a serjeant; and a serjeant ten or twelve men. Detachments are sometimes made of entire squadrons and battalions.

Detachment, in naval affairs, is a certain number of ships of a fleet or squadron, chosen by an admiral or commodore from the others, to execute some particular service.

DETENTS, in clock-work, are those stops, which, by being lifted up or let down, lock or unlock the clock in striking. See Horology.

Detent *wheel*, or Hoop *wheel*, in a clock, that wheel which has a hoop almost round it, wherein there is a vacancy at which the clock locks.

DETERGENT. See Pharmacy.

DETERMINATE *problem*, in geometry, that which has but one, or at least a limited number of answers; as the following problem, which has but one only solution, *viz.* To describe an isosceles triangle on a given line, whose angles at the base shall be double that at the vertex. But the following hath two solutions, *viz.* To find an isosceles triangle, whose area and perimeter are given.

DETINUE, is a writ which lies where any man comes to goods or chattels, either by delivery or by finding, and refuseth to redeliver them; and it lies only for the detaining, when the detaining was lawful. In this writ the plaintiff shall recover the thing detained; and therefore it must be so certain, as that it may be specifically known. Therefore it cannot be brought for money, corn, or the like, for that cannot be known from other money or corn, unless it be in a bag or sack, for then it may be distinguishably marked.

In order therefore to ground an action of detinue, which is only for the detaining, these points are necessary: 1. That the defendant came lawfully by the goods, as either by delivery to him, or finding them. 2. That the plaintiff have a property. 3. That the goods themselves be of value. And 4. That they be ascertained in point of identity. Upon this, the jury, if they find for the plaintiff, assess the respective values of the several parcels detained, and also damages for the detention, and the judgment is conditional, that the plaintiff recover the said goods, or (if they cannot be had) their respective values, and also the damages for detaining them.

DETONATION, in chemistry, an explosion with noise, made by the inflammation of a combustible body. Decrepitation differs from detonation only as producing a fainter noise, or merely a kind of crackling sound peculiar to certain salts. Fulmination is a more quick and lively detonation, such as takes place with certain preparations of gold, silver, mercury, &c. See DECREPITATION, FULMINATION.

DETRANCHE, in heraldry, a line bendwise, proceeding always from the dexter side, but not from the very angle, diagonally athwart the shield.

DEVISE, or DEVICE, in heraldry, painting and sculpture, any emblem used to represent a certain family, person, action, or quality, with a suitable motto, applied in a figurative sense.

DEVOURING, in heraldry, is when fishes are borne in an escutcheon, in a feeding posture, for they swallow all the meat whole.

DEUTZIA, in botany, a genus of the Decandria Trigynia class and order. Essential character: calyx one-leafed; capsule three-celled; filaments three-cusped. There is but one species, *viz.* D. scabra, a tree about the height of a man, and very much branched. It is a native of Japan, where the leaves are used by joiners in smoothing and polishing.

DEW, a dense moist vapour, falling on the earth in the form of a misling rain, while the sun is below the horizon. See METEOROLOGY; VAPOURS, *ascent of.*

DEW *worm.* See LUMBRICUS.

DEWLAP, the membranous fleshy substance that hangs down from the throats of neat cattle.

DEXTANS, in Roman antiquity, ten ounces, or $\frac{10}{12}$ of their as. See As.

DEXTER, in heraldry, an appellation given to whatever belongs to the right side of a shield, or coat of arms: thus we say, bend dexter, dexter point, &c.

DEXTROCHERE, or DESTROCHERE, in heraldry, is applied to the right arm painted in a shield, sometimes naked, sometimes clothed, or adorned with a bracelet; and sometimes armed, or holding some moveable, or member used in the arms.

DIABETES, an excessive discharge of urine, which comes away crude, and exceeds the quantity of liquids drank. See MEDICINE.

DIACAUSTIC *curve*, a species of caustic curves formed by refraction. Thus if we imagine an infinite number of rays BA, BM, BD, &c. (Plate Miscell. Fig. 6.) issuing from the same luminous point B, to be refracted to or from the perpendicular M C, by the given curve A M D, and so that C E, the sines of the angles of incidence C M E, be always to C G, the sines of the refracted angles C M G, in a given ratio, then the curve H F N, which touches all the refracted rays, is called the diacaustic, or caustic by refraction.

DIACHYLON, a well known plaster, composed of a solution of litharge in olive oil: it is called emplastrum lithargyri. See PHARMACY.

DIADELPHIA, in botany, two brotherhoods; the seventeenth class in Linnæus's sexual system, consisting of plants whose flowers are hermaphrodite, and have the stamina, or male organs, united below into two sets of cylindrical filaments. See PAPILIONACEÆ.

The orders in this class are founded

on the number of stamina, considered as distinct. Some pea-bloom, or butterfly-shaped flowers, have five stamina, or male organs, as monnieria; some six, as fumatory; some eight, as milk-wort; some ten, as broom, bladder-sena, lupine, lady's-finger, vetch, and the far greater number of butterfly-shaped flowers. It is only the last order that is included in the natural family papilionaceæ; the remaining four genera are distributed among other families, to which they have, at least, an equal alliance. The names given by former botanists to the extensive class of plants in question are much more characteristic of their nature and appearance, than that of diadelphia. The figure of the flowers and fruit never varies; the latter being always of the pod-kind, the former of the butterfly shape On the other hand, the two sets of united stamina, the only classic character expressed in the Linnæan title, are never to be traced without difficulty; for one of the sets only is properly united; the other consisting of a single filament, which, in most plants, adheres so closely to its kindred set, that it cannot be separated without the application of a pin or needle for that purpose. In some, even, no separation can be effected by this means.

DIADEM, in heraldry, is applied to certain circles, or rims, serving to inclose the crowns of sovereign princes, and to bear the globe and cross, or the fleur de luces for their crest. The crowns of sovereigns are bound, some with a greater, and some with a less number of diadems. The bandage about the heads of moors on shields is also called diadem, in blazoning.

DIÆRESIS, in grammar, the division of one syllable into two, which is usually noted by two points over a letter, as aulaï, instead of aulæ, dissolüenda, for dissolvenda.

DIAGNOSTIC, in medicine, a term given to those signs which indicate the present state of a disease, its nature, and cause.

DIAGONAL, in geometry, a right line drawn across a quadrilateral figure, from one angle to another, by some called the diameter, and by others the diameter of the figure. Thus A C, (Plate IV. Miscel. fig. 7.) is called a diagonal.

It is demonstrable, 1. That every diagonal divides a parallelogram into two equal parts. 2. That two diagonals drawn in any parallelogram bisect each other. 3. A line F G, passing through the middle point of the diagonal of a parallelogram, divides the figure into two equal parts. 4. The diagonal of a square is incommensurable with one of its sides. 5. That the sum of the squares of the two diagonals of every parallelogram is equal to the sum of the squares of the four sides. This proposition is of great use in the theory of compound motions; for, in an oblique angled parallelogram, the greater diagonal being the subtense of an obtuse, and the lesser of an acute angle, which is the complement of the former, if the obtuse angle be conceived to grow till it be infinitely great with regard to the acute one, the great diagonal becomes the sum of the the two sides, and the lesser one nothing. Now two contiguous sides of a parallelogram being known, together with the angle they include, it is easy to find one of the diagonals in numbers, and then the foregoing proposition gives the other. This second diagonal is the line that would be described by a body, impelled at the same time by two forces, which should have the same ratio to each other as the contiguous sides have, and act in those two directions; and the body would describe this diagonal in the same time as it would have described either of the contiguous sides in, if only impelled by the force corresponding thereto. 6. In any trapezium, the sum of the squares of the four sides is equal to the sum of the squares of the two diagonals, together with four times the square of the distance between the middle points of the diagonals. 7. In any trapezium, the sum of the squares of the two diagonals is double the sum of the squares of two lines bisecting the two pairs of opposite sides. 8. In any quadrilateral inscribed in a circle, the rectangle of the two diagonals is equal to the sum of the two rectangles under the two pairs of opposite sides.

DIAL. Dials are of various constructions, some being horizontal, others vertical, and others moveable, so as to apply to any particular latitude at pleasure. The use of a dial is to indicate the hour, which is done by means of a wire, or by a triangular board, &c. placed at right angles to the face or index. This triangular piece is called the stile, or gnomon, and is made to point due north: it should be perfectly vertical, and the dial's face, on which the hours are marked, should be equally divided thereby; the line of 12 being in a true direction with the stile. This line of direction is called the substile: the angle contained between the summit of the stile and the face of the dial is called the elevation. All which have their planes, or faces, parallel with the horizon, are called horizontal dials; those which have perpendicular planes or faces, are called vertical dials; and such as are neither vertical nor horizontal, are called reclining dials. When erect dials do not face either the north, or the south, they are called declining dials. An universal dial is one that answers for all latitudes.

The line passing under the centre of the stile longitudinally, and marking the hour of 12, is called the meridian: in declining dials, the substile makes an angle with the meridian, in proportion to the deviation from a northerly direction: this angle is the difference of longitude. With respect to the manner of constructing, and of placing these useful instruments, we shall now proceed to give some account.

The following is the most simple dial that can be made. (Fig. 1. Plate Dialing.) Divide a circle into twenty-four equal parts, and draw, through the several points of division, rays from the centre. That point which is to be the north is to be marked XII, the next on the right XI, and thus as far as V. or IIII: those on the left of the southern point 12, are to be I, II, III, &c. in regular order, down to VIII. In the centre, whence the circle was drawn, fix a pin, equal in length to about a diameter of the circle, and be very careful that it be perfectly upright. Now, placing the dial at such an elevation as may equal the latitude of the place where it is to be used, see that the XIIth hour be on the meridional line. Thus, for the latitude of 60, the northerly part XII, would require to be raised 50 degrees from the horizon, so that the face of the dial would stand in the plane of the equator, and cause the shadow of the pin to fall on the index, thus to point out the time of day. This is called the equinoctial dial.

The following is the best mechanical method known for making common horizontal dials. (Fig. 2.) Draw two concentric circles, between which the hours are to be marked, and assuming any point for the hour of XII., let the thickness of your gnomon, or stile, be set off by two lines *a b*, *c d*, passing near the centre *e* of the circle, perfectly parallel and equidistant from the meridional line which passes exactly through the centre, and through the mid-day or XII. point. Now cross the meridional line at right angles, by the VI. o'clock line *f g*, and from the points *b* and *d*, as centres, describe the quadrants *f h*, *g i*, taking a good extent, so as to approach nearly to the hour circle, for the sake of minute division; if such be required, divide the quadrants respectively into 90 equal parts; then from *d* draw a line at $11°\frac{2}{3}$ from the line *e d*, which will give the place of I. o'clock; draw another line at $24°\frac{1}{2}$, which will give the place of II. o'clock; through $38°\frac{1}{12}$ will give the place of III. o'clock; through $53°\frac{1}{2}$ for IIII. o'clock; through $71°\frac{1}{15}$ for V. o'clock; and the line crossing your meridian will give VI. o'clock. The base of your gnomon is to be equal to a radius of the inner hour circle, having the altitude of the place you are at for its angle: thus the gnomon in this figure would have *b k*, its upper line, standing at an angle of $51°\frac{1}{2}$ from its base line *a b*; the lowest part being set on to the centre of the VI. o'clock line, even with the meridional line, and the broadest (*i e.* highest) part of the gnomon *a k*, being towards the hour of XII. The left or morning side of the hour table is made by drawing lines, at the angles already described, from the centre *f*, through its appropriate quadrant. The hours before VI. in the morning, and after VI. in the evening, are adjusted by continuing through the centres *b* and *d*, respectively, those lines which indicate their ascertained numbers: thus the line of V, P. M. continued through the centre *d*, will give the place of V., A. M.

This dial must be placed exactly horizontal, and its XII. o'clock point, *i e.* the meridional line, must be precisely northward. The most certain mode of laying the meridian truly north is by observation of the polar star; or by taking an observation at XII. at noon, by means of a quadrant, when the exact moment of the sun's utmost altitude for the day being ascertained, the shadow thrown upon a plane, by means of a thin cord sustaining a heavy plumb, will give a correct northern line, either on the dial plate, already so far prepared on its base, or on any other level surface, from which a true parallel may be taken. With respect to adjusting by aid of a compass, it cannot be recommended: those instruments are often faulty, and when they are not so, the variation is not always exactly laid down.

To construct a horizontal dial by means of a terrestrial globe, elevate the pole to the latitude of the place, and bringing the nearest meridional line to the brazen meridian, set the index to XII. uppermost. Now turn the globe until the index comes exactly to I. which will be effected by a movement of 15° measured on the equator; each hour making a change of 15° on the sun's place thereon; (for 24 hours multiplied by 15 make a total of 360°, equal to a whole circle.) The place where the meridional line moves to should be marked, for that will give the place of I. o'clock; move on 15° more, to find where the meridional line cuts the equator, for the place of II. o'clock; and thus in succession will all the hours' places be indicated by the meridian at each change of 15° on the horizon; always measuring close to the meridian, or following the hour hand on the index. If the latter be marked with halves and quarters of hours, the corresponding divisions may be made on the equator, as the meridian by which you are governed passes on, taking 7½° for a half hour, and 3¾° for a quarter; but such is seldom required, except in very large dials; the eye usually judging, with tolerable precision, of the quantity covered by the shade of the gnomon.

To set this off on paper, measure the number of degrees between the several parts of the meridian, noted down as stations of the governing meridional line, when passed on 15° at each movement. This being done from XII. to VI. will establish a measurement that may be imitated on any scale, observing to draw the VI. o'clock line correctly, and to give a proper length of base, as well as a due latitudinal angle to the gnomon. The method suggested by Mr. Ferguson, of filling up the interior of the horizon after drawing forth the globe, is prolix, and suits but few persons: whereas, the knowledge of how many degrees are included in each interval, respectively, proves a sufficient guide. Those intervals will be found to correspond with what have been directed in describing the second figure.

To make an erect dial directly south. Fig. 3. On this the sun can shine only from VI. A. M. to VI. P M.; therefore, only the intermediate hours need be noted. Elevate the pole as before directed, but, in lieu of placing XII. to the north, place it to the south of your dial plate, which in this kind is most conveniently made an oblong, projected vertically below the VI. o'clock line. Proceed to find the places of the hours as before shewn, trace them through their centres to the opposite parts of the hour circle, for on that they are to stand. The gnomon is to make an angle equal only to the co-latitude of the place: thus, if you are in 51½°, the co-latitude (being the amount required to complete to 90°) would be 38½°.

Or you may proceed as follows: on the meridional line *a b*, as it points downwards from the foot, or lowest part of the gnomon, measure off at pleasure any distance, as *a c*, for the size of your dial; at *c* erect the perpendicular C D, and make the angle C A D equal to the elevation of the equator; then make a second triangle C D E, the angle at D being equal to that at A. Through E draw G H at right angles with A E. Carry on E B equal to E D, and with that distance as a radius, describe the quadrant E F from B as a centre. Measure off the proper angles from the point B, through the several parts of the quadrant, which is divided off into six equal parts; these will fall upon the prolonged line G H, and give points thereon, through which lines being drawn from the centre A of the VI. o'clock line to the hour frame, the places of the several hours will be given. The gnomon is fixed at A, equal to A D E; being conformable to the co-latitude; or it may be simply a wire fixed at C, equal in length to C D, but perpendicular to the face of the dial; some use large angular iron rods. This kind of dial is often seen on the sides of country church-steeples facing the south.

To make an erect dial facing the north. Invert the whole of that just described, making the gnomon point upwards instead of downwards, and causing all the lower points to be transferred from left to right, and from right to left. This kind of dial will shew the hours before VI. A. M. and after VI. P. M. When such is wanted, the best way is to set up a stout post, with the planes of two dials back to back, they pointing due south and due north, respectively; thus, as the pin retires from one, it will set upon the other.

We shall now instruct the reader how to make those scales, which are indispensable towards the attainment of perfection in this pleasing branch of study.

The lines useful in dialling are, 1, a line of chords; 2 a line of latitudes; 3, a line of sines; and 4, a line of hours. They are all derived from the quadrant of a circle, as will be shewn in fig. 4.

Describe a circle and divide it into four equal parts by the lines A B and C D, intersecting in the centre E. Draw the chords A C, C B, B D. Now divide the two segments or quadrants, A D and C B, each into nine equal parts; either of which contains ten degrees. Placing one leg of your compasses at B for a centre, draw the several arcs from the quadrant subtended by the chord C B, so that they may fall upon that chord, which being numbered according as the several arcs correspond with the division on the quadrant, will give a line of chords gradually diminishing from B towards C: all the intermediate degrees or the measures of 10° each, thus obtained, may be removed in the same manner from the quadrant, if it be graduated accordingly.

It will be proper to observe, in this place, that the chord of 60° is the radius of a circle whose quadrant is subtended by 90° of the same scale: hence a line of chords is easily made upon any circle, so that any part of that circle may be cut off at pleasure. This is essential in every branch of mathematics; but in dialling it is indispensable to be known: the reader will have observed, that in forming the horizontal dial, the hour lines are drawn thrugh particular points, so as to make the required angles. As he may be at a loss how to effect this on many occasions, we shall give an example in fig. 5, whereby every doubt or difficulty will be removed.

Let it be required to cut off an angle of forty degrees from the quadrant, which appertains to a circle for which we have not a line of chords in readiness. On the base line A B measure sixty degrees from any line of chords you may have at hand: it may either exceed or be less than your base line; we will suppose the former: in this case the base line must be prolonged to the measurement of 60° from your scale, which will carry it on to C. With that 60°, as a radius, and from A, as a centre, describe the quadrant C D, concentric with the quadrant E B, from which you would cut off 40°. Now measure 40 degrees on your line of chords, and, placing one foot of the compasses at C, carry the measurement to F, which will cause the angle F A C to measure 40°, and the line F A will, at C, cut off 40 degrees from the quadrant E B. For an angle does not vary by prolongation; therefore, if the exterior quadrant is cut at 40°, the interior quadrant, being concentric therewith, must correspond with that division.

We now proceed to the opposite quadrant, which is not subtended by a chord, but is divided into nine equal parts of ten degrees each. Draw from the several points of division on the quadrant eight lines, all parallel with E A, and falling on the radius E D; this gives a line of sines which is of very extensive use in various branches of mathematics. From A draw eight lines, passing through the several points ascertained on the line of sines, to the quadrant B D: these will cut the chord subtending that quadrant, and give thereon a line of latitudes, of equal length with the line of chords, but very differently divided.

The remaining quadrant C A is to be divided into six equal parts, *viz.* of 15° each: make the chord C F A, and draw its parallel tangent G H. Through the several points of division on the quadrant, draw lines from the centre E to the line G H, which will then represent a line of hours: one of the extremes will be XII, the other will be VI; the several intermediate places of I, II, III, IV, and V, being ascertained by the various lines proceeding from E.

The 6th figure shews part of a dial, constructed by means of the lines of latitudes and of hours. Having set off the parallels for the substile, and drawn the line of VI o'clock, set off the latitude of your place from A towards B; taking the measurement from the line of latitudes. Then measure the whole extent of your line of hours, and, placing one leg of your compasses at B, let the other fall wherever it may reach on the line C A. Divide the line B C according to the measures on your line of hours; and from A draw lines through the points of division to the hour circle, which will thus be truly intersected at the horal points. We have before stated, that by dividing the quadrant C A, in fig. 4th, more minutely, that is, by dividing each of the six portions into four, the halves and quarters of hours may be shewn.

Having already shewn the modes of constructing those dials which are in ordinary use, we must refer the more curious reader to Ferguson's "Lectures," for a great variety of dials, which could not be introduced into this work without greatly augmenting the volume. He will there find the modes of constructing dials by logarithms, and by trigonometry; together with many items relating to the more abstruse parts of our subject. We shall briefly add, that the following general principle governs the formation of all dials. Take the words of that great luminary of mechanics, the late James Furguson, F. R. S.

"If the whole earth were transparent and hollow, like a sphere of glass, and had its equator divided into 24 equal parts by so many meridian semicircles, one of them being the geographical meridian of any given place, say London; and if the hours of XII. were marked on the equator, both on that meridian, and on its opposite one, and all the rest of the hours on the rest of the meridians, those meridians would be the hour-circles of London: then if the sphere had an opaque axis, terminating at its poles, the shadow of that axis would fall upon every particular meridian and hour, when the sun came to the plane of the opposite meridian; and would, consequently, shew the time at London, and at all the other places on the meridian of London."

DIALECT, an appellation given to the language of a province, in so far as it differs from that of the whole kingdom. The term, however, is more particularly used in speaking of the ancient Greek, whereof there were four dialects, the Attic, Ionic, Æolic, and Doric, each of which was a perfect language in its kind, that took place in certain countries, and had peculiar beauties. In Great Britain, besides the grand diversity of English and Scotch, almost every country has a dialect of its own, all differing considerably in pronunciation, accent, and tone, although one and the same language.

DIALIUM, in botany, a genus of the Diandria Monogynia class and order. Essential character: calyx none; corolla five-petalled; stamina at the upper side of the receptacle. There is but one species, *viz.* D. indum, a tree with alternate pinnate leaves, having seven ovate oblong, acuminate, petioled, even leaflets, a hand in length. Flowers panicled, nodding. Native of the East Indies.

DIALECTICS, in the literary history of the ancients, that branch of logic which taught the rules and modes of reasoning.

DIALING *lines* or *scales*, are graduated lines placed on rulers, or the edge of quadrants and other instruments, to expedite the construction of dials. They are, 1. A scale of six hours, which is only a double tangent, or two lines of tangents each of 45°, set together in the middle, and equal to the whole line of sines, with the declination set against the meridian altitudes in the latitude of the place. 2. A line of latitude, which is fitted to the hour-scale, and is made by this canon. As the radius : to the chord of 90° : : so are the tangents of each respective degree of the line of latitudes : to the tangent of other arcs. And then the natural sines of these arcs are the numbers, which, taken from a diagonal scale of equal parts, shall graduate the divisions of the line of latitudes to any radius. The lines of hours and latitudes are general for pricking down all dials with centres. See Dial.

The other scales are particular, and give the several requisites for all upright declining dials by inspection. They are, 1. A line of chords. 2. A line for the substile's distance from the meridian. 3. A line for the stile's height. 4. A line of the angle of 12 and 6. 5. A line of inclination of meridians.

DIALOGUE, in matters of literature, a conversation between two or more persons, either by writing, or by word of mouth.

DIALYSIS, in grammar, a mark or character, consisting of two points, ¨, placed over two vowels of a word, in order to separate them, because otherwise they would make a diphthong, as mosaïc, &c.

DIAMETER, in geometry, a right line passing through the centre of a circle, and terminated at each side by the circumference thereof. The chief properties of the diameter are, that it divides the circumference of a circle into two equal parts: hence we have a method of describing a semicircle upon any line, assuming its middle point for the centre. The diameter is the greatest of all chords. For finding the ratio of the diameter to the circumference, see Circle.

Diameter *of a conic section*, or *transverse diameter*, is a right line passing through the centre of the section, or the middle of the axis. The diameter bisects all ordinates, or lines drawn parallel to the tangent at its vertex. See Conic Sections.

Diameter, *conjugate*, is a diameter, in conic sections, parallel to the ordinates of another diameter, called the transverse or parallel to the tangent at the vertex of this other.

Diameter, *of any curve*, is a right line, which divides two other parallel right lines in such manner, that, in each of them, all the segments or ordinates on one side, between the diameter and different points of the curve, are equal to all those on the other side. This is Newton's sense of a diameter.

But, according to some, a diameter is that line, whether right or curved, which bisects all the parallels drawn from one point to another of a curve. So that in this way every curve will have a diameter: and hence the curves of the second order have, all of them, either a right-lined diameter, or else the curves of some one of the conic sections for diameters. And many geometrical curves of the higher orders may also have, for diameters, curves of more inferior orders.

DIAMETER *of a sphere*, is the diameter of the semicircle by whose rotation the sphere is generated; in which sense it is the same with axis.

DIAMETER *of gravity*, in any surface or solid, is that line in which the centre of gravity is placed. See CENTRE.

DIAMETER, in astronomy. The diameters of the planets are either apparent or real; the apparent diameters are such as they appear to the eye; and being measured by a micrometer, are found different in different circumstances and parts of their orbit. See ASTRONOMY.

DIAMOND. The diamond has always been regarded as the most valuable of the gems, and, consequently, as the most valuable production of the mineral world; a superiority which it derives from its very high lustre, its transparency, and hardness. The first quality arises from its greater refractive power, which is such as to cause all the light to be reflected which falls on it at an angle of incidence greater than 24½ degrees; and it is capable of being rendered still more brilliant by its surface being cut into facets, which multiply the reflections of light. From its hardness, too, its lustre remains uninjured: this hardness is such, that it can be cut, or rather worn down, only by rubbing one diamond against another, and is polished only by the finer diamond powder.

This substance is found in India, in the districts of Visapore and Golconda, and likewise in Bengal, and in Brazil in South America. It is not found in its original situation, but in the beds of streams, or in a loose ferruginous sand beneath the soil. The Brazilian diamonds are inferior in transparency and purity to the Oriental.

The diamond is found crystallized, being either in perfect crystals, or in fragments often encrusted with a hard coating. The usual form is an octahedron, composed of two four-sided pyramids joined by the base, the faces being somewhat convex. Of this form there are some modifications; the angles being replaced by triangular faces, so as to give rise to a dodecahedron of twenty-four faces, likewise a little convex. These are the crystallizations of the Oriental diamond. The Brazilian is generally a dodecahedron, with rhomboidal faces. These crystalline forms are often imperfect, probably from the attrition which they have suffered, and frequently the fragments are altogether indistinct.

The diamond is colourless, or tinged of various shades of white or grey, and sometimes also, though more rarely, of brown, green, yellow, blue, and red, frequently with darker coloured spots. It is generally transparent, though not perfectly so, and has the property of single refraction; its fracture is lamellated, and it can be split by striking it in the direction of the plates. Its specific gravity is from 3500 to 3600.

The diamond is phosphorescent, or, when it has been exposed to the light, is luminous in the dark. It is rendered electrical by rubbing, the electricity being positive.

From the qualities of the diamond it was long ranked with the other gems, and considered as analogous to them in its chemical construction. Newton, by a happy application of a physical principle, conjectured that it was an inflammable substance. Transparent bodies, which are uninflammable, refract light nearly in the ratio of their densities, while those which are inflammable have refractive powers which are greater than their densities: and the diamond having this great refractive power led Newton to conclude, that it "probably is an unctuous substance coagulated." (Optics, Book II. Prop. 10.) In 1695 experiments had been made at Florence, which proved the diamond to be dissipated by the intense heat in the focus of the powerful burning lens of Tschirnausen. Afterward, in experiments made at Vienna, it was found, that in the heat of a furnace, diamonds lost weight, and, if exposed for a sufficient length of time, entirely dissappeared, while the ruby and other gems, exposed to the same heat, remained unaltered. At a later period Darcet exposed diamonds to heat, enclosed in balls of porcelain clay, in various ways, and always found that they were dissipated by exposure to a strong heat. These facts at the same time appeared in contradiction to the common practice of the jewellers who expose diamonds which are foul to a strong heat, imbedded in charcoal, to make them clear. An observation of Macquer first threw light on this subject. He took notice, that while the diamond was exposed to a strong heat under a muffle, and while it was losing weight, it was luminous, and appeared to burn, a fact which he verified by subsequent experiments. It cannot be doubted, therefore, that in the experiments of Darcet air had been admitted to the diamonds, from rents in the porcelain clay balls in which they were inclosed, and that in the method of jewellers they are more effectually protected from the action of the air, by the charcoal dust with which they are surrounded.

Still a degree of uncertainty was attached to the subject, and to remove this, Lavoisier, associating with him in the investigation Macquer and Cadet, undertook some experiments. They first ascertained, that in close vessels the diamond does not evaporate: having exposed $19\frac{5}{8}$ grains in a luted earthen retort, connected with a glass receiver, and the jointing secured, to a very strong heat, the loss of weight amounted only to about two grains; yet the heat applied was much higher and continued much longer, than would have been necessary to dissipate the entire quantity of diamond in the open air; and repeating the experiment of the jewellers, they found, that when carefully imbedded in charcoal powder, from which the air was excluded, the most violent heat produced no change in the diamonds submitted to trial. They were therefore disposed to conclude, that the dissipation of the diamond, when heated in the open air, was owing to its combustion. (Memoirs de l'Acad. des Sciences, 1772, p. 350.) Facts similar to these were established by a second series of experiments performed by Darcet and Rouelle. And Lavoisier, in another memoir, demonstrated more decisively the combustibility of the diamond, and discovered the product of its combustion. When suddenly heated by a lens, he found it to decrepitate, and to be thrown into small fragments; when heated more slowly, it was dissipated without this decrepitation. When heated by a lens, in a glass vessel placed over water, it was still dissipated, and in the first experiment no sensible product was obtained; in a second he observed, that when the heat was less powerful, the surface of the diamond became black, and was sensibly covered with a thin coating of charcoal. In a subsequent experiment, he found that the air of the vessel in which the experiment was made was diminished in volume to the extent of about eight cubic inches in 60; on pouring into this residual air lime water it became milky, as it would have done from exposure to air in which charcoal had been burnt; and by subjecting it to different trials, this milkiness was found to be owing to the presence of carbonic acid, which of course had been produced during the combustion of the diamond. The same results were obtained on heating the diamond in a glass vessel containing common air, placed over quicksilver. Lavoisier drew the conclusion, that the diamond is a combustible body; and that, as objects of chemistry, there exists a great analogy between it and charcoal.

Some years afterwards Guyton shewed that the diamond is consumed when heated with the nitrate of potassa, and affords carbonic acid. This experiment was repeated with more precision by Mr. Tenant. He exposed to a strong red heat, for an hour and a half, in a gold tube, two grains and a half of small diamonds with a quarter of an ounce of nitrate of potassa. The salt was decomposed, and, on examining the residuum, the potassa was found to have attracted carbonic acid, while the diamonds were entirely consumed. The quantity of carbonic acid was attempted to be ascertained, by adding to the solution of the residuum in water a solution of muriate of lime: a precipitate of carbonate of lime was formed; from this the carbonic acid was disengaged by muriatic acid, and it occupied a space equal to about 10.1 ounce measures of water. This, according to Mr. Tennant's calculation, was about the quantity that ought to have been obtained from two grains and a half of charcoal combined with oxygen; and he therefore concluded that the diamond is charcoal, and differs from that substance only in its crystallized form.

Guyton at length investigated the subject with that precision, which was necessary to fix our opinion as to the nature of the diamond. The diamond, an imperfect octahedron, was placed on a small porcelain crucible, elevated in a jar filled with oxygen gas, ascertained to be pure, placed over mercury. The concentrated solar rays were thrown on the diamond by a large lens: it appeared at first farinaceous, and was afterwards sensibly blackened on its surface: the appearance of combustion was extremely faint, and when it had begun, did not continue if the solar heat was withdrawn. Afterwards, when a more powerful lens was employed, the combustion was more evident; the diamond first became black, and of a coally appearance; an instant after it became brilliant, and at some points appeared to boil; it gradually diminished, and the application of the solar heat was repeated at different times until it was entirely consumed. The quantity of carbonic acid which had been formed was ascertained by introducing a solution of barytes in water, and the unexpected result obtained, that the quantity was much greater than what would have been formed by the combustion of the same weight of charcoal as of diamond. Twenty-eight parts of charcoal in burning combine with 72 of oxygen, and form 100 of carbonic acid; while the same weight of acid, according to Guyton's experiment, is formed from the combustion of 17.88 of diamond, which combine therefore with 82.12 of oxygen. Guyton concluded, therefore, that it is not merely by its colour, weight, hardness, transparency, and other sensible qualities, that the diamond differs from charcoal; neither does the difference depend on the state of aggregation, nor are the distinctive properties of charcoal owing to the two hundreth part of residue which it leaves in the form of ashes, or to the small quantity of hydrogen which it may contain; but to its oxydation, diamond being the simple base of which charcoal is the oxide.

A striking fact with regard to the oxygenizement of the diamond, is the high temperature which is requisite to its taking place. It appears, from Guyton's statement, to be charred at about the temperature of 18 or 20 of Wedgwood's scale, (3417 or 3677 of Fahrenheit's) and at about 30 (4977°) it burns with a feeble flame; nor does it even in oxygen gas produce as much heat as to support its own combustion. This is no doubt owing to the very strong cohesion exerted between its particles. (Memoir by Guyton, Annales de Chimie, tom. 31; or Abstract of it in Nicholson's Journal, 4to. viii. p. 298.)

The appearances attending the combustion of the diamond have been observed with perhaps more accuracy by Sir George Mackenzie, and the temperature requisite has been stated by him as less high. A diamond cut and polished, when introduced into a muffle previously heated red hot, soon acquired the same redness as the muffle, but in a few minutes more became distinguished by a bright glow, and began to consume. A piece of plumbago placed beside it exhibited a similar luminous appearance, but it began at a lower temperature. When the air was excluded from the muffle, both lost their brightness; but it returned on the admission of the air, and was much increased by blowing on them with a bellows. To ascertain at what temperature the combustion of the diamond took place, one of the pyrometrical pieces of Wedgwood was placed with it in the muffle. When both were perfectly red throughout, the pyrometer was withdrawn, and indicated 13° of Wedgwood's scale. They were replaced, and the heat increased until the glow appeared; it was kept at this as equal as possible until the diamond was consumed; the pyrometrical piece then indicated 14°, and in another diamond the heat requisite to produce the glow and consume it, was 15°. These experiments are evidently the most accurate that have been made to ascertain this point; and indeed the temperature assigned by Guyton was rather from conjecture than experiment. Although they shew that a less elevation of temperature is requisite for the combustion of the diamond than was supposed, they still prove it to be much higher than that which is requisite for the combustion of charcoal.

Sir George Mackenzie, likewise, repeated and confirmed an experiment of the French chemists, in which a piece of soft iron was converted into steel by being heated with diamonds, in the same manner as it would have been by being heated in the usual manner with charcoal powder; and his experiments are more satisfactory, as having been made with diamond in its purest state. (Nicholson's Journal, 4to. vol. iv. p. 103.)

The diamond is scarcely acted on by any other agent than by oxygen, at an elevated temperature. Bergman states an experiment, from which it would appear to be capable of being partially oxyded by sulphuric acid; this acid, when poured on the diamond powder, previously freed from impurities by digestion with nitro-muriatic acid, and evaporated to a small quantity, becoming black, and depositing small pellicles, which take fire on the approach of flame, and are consumed. The other acids, according to his observation, exert no sensible action on it; nor does it appear from the experiments made with the soda (the mixture of soda and of diamond powder being exposed to a very strong heat) that it had suffered any chemical change from the action of the alkali; for though a minute portion of earthy matter appeared to be produced, this might probably be derived from the various agents which were employed in the experiments. Essays, vol. ii. p. 118.)

Diamond, in the glass trade, an instrument used for squaring the large plates or pieces; and, among glaziers, for cutting their glass.

These sorts of diamonds are differently fitted up; that used for large pieces, as looking-glasses, &c. is set in an iron ferrel, about two inches long, and a quarter of an inch in diameter; the cavity of the ferril being filled up with lead, to keep the diamond firm: there is also a handle of box, or ebony, fitted to the ferril, for holding it by.

Diamond, in heraldry, a term used for expressing the black colour in the achievements of peerage. Guillim does not approve of blazoning the coats of peers by precious stones instead of metals and colours; but the English practice allows it. Morgan says the diamond is the emblem of fortitude.

DIANÆ *arbor*, or arbor *lunæ*, in chemistry, the beautiful crystallizations of silver dissolved in nitrous acid, to which some quicksilver is added; and so called from their resembling the trunk, branches, leaves, &c. of a tree. This elegant arrangement, however, of the particles of silver is not peculiar to this state or menstruum, since copper filings dropped into the solution of silver in aqua fortis is found to have the same effect, when viewed by the miscroscope: nay, the silver ores are frequently found ramified in the same manner.

DIANDRIA, the name of the second class in Linnæus's sexual system, consisting of hermaphrodite plants, which, as the name imports, have flowers with two stamina or male organs. The orders in this class are three, derived from the number of styles or female parts. Most plants, with two stamina, have one style, as jessamine, lilac, privet, veronica, and bastard alaternus. Vernal grass has two styles; pepper three.

DIANTHERA, in botany, a genus of the Diandria Monogynia class and order. Natural order of Personatæ. Acânthi, Jussieu. Essential character: corolla ringent; capsule two-celled, bursting with an elastic nail; stamina each a pair of alternate anthers. There are twelve species, of which D. Americana is a low herbaceous plant, with a perennial root, which sends out several weak stalks about four inches long. The leaves are hairy, sessile, and of a dark green colour, and an aromatic odour. The flowers are produced from the side of the stalks in small spikes, and are in shape and colour very like those of clinopodium. They come out in July, but rarely produce seeds in England. It is a native of Virginia. This species is also called Justicia Americana, and Justicia pedunculosa; the last specific name given from the long peduncles which support the flowers.

DIANTHUS, in botany, a genus of the Decandria Digynia class and order. Natural order of Caryophyllei. Essential character: calyx cylindric, one leafed; with four scales at the base; petals five, with claws; capsule cylindric, one celled. There are thirty species. These beautiful plants are chiefly herbaceous; some few however are suffruticose. Most of them are hardy, and perennial or biennial: some of the smaller wild sorts only are annual; stalks annual, from one to three feet in height; leaves opposite, narrow, entire; flowers terminating, many, aggregate, some solitary, or several together, but distinct. This numerous genus includes the sweet-williams, carnations, and pinks, with their several varieties; for a full and complete account of which we refer the reader to Martyn's edition of Millar's botany.

DIAPASON, in music, a musical interval, by which most authors, who have wrote upon the theory of music, use to express the octave of the Greeks. See Octave.

The diapason is the first and most perfect of the concords; if considered simply, it is but one harmonical interval, though if considered diatonically, by tones and semi-tones, it contains seven degrees, *viz.* the three greater-tones, two lesser tones, and two greater semi-tones.

The interval of a diapason, that is, the proportion of its grave sounds to its acute, is duplicate, *i. e.* as 2 : 1.

DIAPENSIA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Preciæ. Convolvuli, Jussieu. Essential character: corolla salver-shaped; calyx five-leaved, imbricate, with three other leaflets; stamens placed on the tube of the corolla; capsule three-celled. There is but one species, *viz.* D. lapponica, a native of the mountains of Lapland, among stones covered with moss; also in Norway.

DIAPERED, or Diapre, in heraldry, the dividing of a field in planes, like fret-work, and filling the same with variety of figures. This chiefly obtains on bordures which are diapered or fretted over, and the fret charged with things proper for bordures. Baron renders it *variatus*, which is not sufficient to express the several things of which it is variated.

DIAPHANOUS, an appellation given to all transparent bodies, or such as transmit the rays of light.

DIAPHORETICS, among physicians, all medicines which promote perspiration.

DIAPHRAGM, in anatomy, a large, robust, musculous membrane or skin, placed transversely in the trunk, and dividing the thorax from the abdomen. See Anatomy.

DIARRHŒA, in medicine, is a frequent and copious evacuation of liquid excrement by stool. See Medicine.

DIASTOLE, among physicians, signifies the dilatation of the heart, auricles, and arteries; and stands opposed to the systole, or contraction of the same parts.

Diastole, in grammar, a figure of prosody, whereby a syllable naturally short is made long: such is the first syllable of Priamides in the following verse of Virgil.

Atque hic Priamides : nihil ô tibi, amice, relictum.

This figure is used either out of mere poetic license, without any necessity for so doing, or through necessity, for the sake of the verse; as when three or more short syllables follow each other in hexameter verse.

DIATESSARON, among ancient musicians, a concord or harmonical interval, composed of a greater tone, a less tone, and one greater semi-tone: its proportion in numbers is as 4 : 3. The word diatessaron has been of late used by several authors for a harmony of the four gospels.

DIBBLING, in agriculture, a mode of setting corn, or other seeds, practised with advantage in places where labour is cheap; it is chiefly used for putting wheat crops into the ground. The practice of dibbling was first introduced into Norfolk, about 25 years ago. The method of dibbling is this: when the land is ploughed and rolled, a man with an iron dibble of about three feet long in each hand, walking backwards, makes two rows of holes in each furrow, at about four inches distance from each other, and an inch or two deep. The dibbler is followed by two or three women, or children, who drop two or three grains into each hole. The field is afterwards bush-harrowed. The usual quantity of seed is from a bushel and a half to two bushels per acre, and the expense of labour about ten shillings. An experienced dibbler, with three active attendants, will plant half an acre a day, making six holes in every foot length.

DICE, among gamesters, certain cubical pieces of bone or ivory, marked with dots on each of their faces, from one to six, according to the number of faces.

Sharpers have several ways of falsifying dice: 1. By sticking a hog's bristle in them so as to make them run high or low as they please. 2. By drilling and loading them with quicksilver; which cheat is found out by holding them gently by two diagonal corners; for, if false, the heavy sides will turn always down. 3. By filing and rounding them. But all these ways fall far short of the art of the dice makers; some of whom are so dextrous this way, that sharping gamesters will give any money for their assistance.

DICERA, in botany, a genus of the Polyandria Monogynia class and order. Essential character: petals four or five, obovate, trifid; nectary four or five emarginate corpuscles; anthers two horned. There are two species; D. dentata, is an elegant tree, bearing at the extremities of the branches abundance of leaves, which are alternate, oval, bluntish, smooth, petioled, with a double gland at their base; flowers on very minute pedicles, nodding; stamens sixteen when there are four, and twenty when there are five petals; pistil single; fruit an oval berry, with a hard stone in it. It is preserved in its unripe state in the manner of olives. It is a native of New Zealand. D. serrata, agrees in the structure of the flower with the preceding, but differs in the fruit. This is also a native of New Zealand.

DICHONDRA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: calyx five-leaved; corolla rotate, inferior: capsule dicoccous. There is but one species, *viz.* D. repens, a native of Peru, Jamaica, and New Zealand.

DICKSONIA, in botany, so called in

honour of Mr. James Dickson, a genus of the Cryptogamia Filices class and order. Natural order of Filices, or Ferns. Generic character: fructifications kidney-shaped, lying under the edge of the frond at the lower surface; outer valve formed of the substance of the leaf itself; inner membranaceous; involucre double, one from the surface, opening outwards; the other from the inflated margin of the frond, often embracing the former, opening inwards. There are thirteen species, D. arborescens, tree dicksonia, was found by Sir Joseph Banks in the island of St. Helena. It flowers most part of the winter. And C. culcita, shining leaved dicksonia, is found in the island of Madeira, where it is called feila brom. The inhabitants make pillows and cushions of the roots. It is supposed (Phil. Trans. 1698) that this plant and the Scythian Lamb are one and the same, though they come from countries so remote.

DICOTYLEDONS, plants whose seeds have two side-lobes, and consequently rise with two seminal leaves. Most plants are of this kind. See COTYLEDONS.

In the lip and masqued flowers, the didynamia of Linnæus, and in plants whose seed-vessel is of the apple, cherry, or pod kind, the seed leaves rise unaltered; that is, without any farther extension or developement than when they make part of the seed. In the mallow, and the cross-shaped flowers, they appear double; in buck-wheat they are rolled up; in cotton, folded or plaited; in salt-wort and all the pot-herbs, they are spiral, or twisted like a screw.

DICRANIUM, in botany, a genus of the Cryptogamia Musci class and order. Capsule ovate, oblong; fringe simple, of sixteen broadish, inflected, cloven teeth. This is a very numerous genus, divided into two sections; A. teeth of the fringe unconnected at the base; B. teeth of the fringe connected at the base.

DICTAMNUS, in botany, English *fraxinella*, a genus of the Decandria Monogynia class and order. Natural order of Multisiliquæ. Rutaceæ, Jussieu. Essential character: calyx five-leaved; petals five, patulous; filaments having glandulous dots scattered over them; capsule five, conjoined. There are two species, of which D. albus, fraxinella, has a perennial root, striking deep into the ground, and the head annually increasing in size; stalks many, two or three feet high; flowers in a long pyramidal loose spike, or raceme, nine or ten inches long; calyx deeply five-cleft; segments lanceolate, obtuse, the three upper red, the two lower green; corolla large and handsome; the natural colour pale purple, with dark purple veins, varying to white. The whole plant, especially when gently rubbed, emits an odour like that of lemon-peel; when bruised it has something of a balsamic scent: this scent is strongest in the pedicles of the flowers, which are covered with glands of a rusty red colour, exuding a viscid juice or resin, which exhales in vapour, and in a dark place may be seen to take fire. Fraxinella is a native of Germany, France, Spain, Austria, and Italy. It flowers with us about the end of May, or early in June; the seeds ripen in September. For its beauty and fine scent it deserves a place in every good garden.

DICTIONARY, a collection, or catalogue of all the words of a language, art, science, &c. with their explanations, ranged in alphabetical order.

DIDELPHIS, the *opossum*, in natural history, a genus of Mammalia of the order Feræ. Generic character: fore-teeth small and rounded; upper, ten, small and rounded; intermediate, two, longer; lower, eight, intermediate two broader, and very short; tusks long; grinders denticulated; tongue fringed with papillæ; abdominal pouch, in most species, containing the teats.

These animals first became known to Europeans on the discovery of America, and excited their particular attention by a deviation in their structure from that of all other known quadrupeds. This singularity consists in the female's possession of a bag or pouch in the lower part of the abdomen, which is opened and closed at pleasure, and to which her young resort for shelter and security in a variety of dangers. Some females possess, according to Gmelin, two or three of these pouches, and the male is stated also, in the same author, occasionally to have one. These animals live in the woods, burrowing in the earth, and, by means of a prehensile tail, are alert in climbing trees. Their general motion is slow, and their food consists of insects, worms, and vegetables, young birds, and particularly poultry. They are by no means peculiar to the Western continent, but are to be found in various other parts of the world. According to both Shaw and Gmelin, there are twenty-one species, of which the following are most deserving of attention: for the spotted opossum, see Mammalia, Plate IX. fig. 1.

D. virginiana, the Virginian opossum. The size of this animal is little inferor to that of the domestic cat; its tail is covered with a scaly skin, the divisions of which give it the resemblance of a small snake, and the animal has the faculty of coiling it with great tenacity round any object, and of thus increasing its means of defence and attack, and its facility of movement among the branches of trees. The teats of the female are inclosed in that astonishing receptacle which distinguishes almost every species of this animal; and immediately after their birth the young are introduced by their parent to that cavity, or resort to it from an impulse of their own. After first emerging from it, on attaining a certain degree of growth and vigour, they have repeated recourse to it on alarms of danger, and are securely kept, and even carried about in it, by the dam, till all ground of apprehension ceases. In some species this cavity does not exist, and nature has substituted for it a sort of furrow. The Virginian opossum is gentle and inoffensive in its manners, but has a rank and disagreeable smell. It is well known to almost every farmer, that this animal, when overtaken or captured by hunters, will feign itself dead, and may be carried a considerable distance without exhibiting any appearance of life. The female produces four or five at a birth, and prepares a sort of nest for herself, of grass, near the root of a tree. She has the power of closing her pouch, and preserving it closed so completely, as to render it a matter of great difficulty to open it. D. marsupialis, the Amboyna opossum, is found in the warmer climates of South America, as well as in some countries of the East. It is bred with rabbits in India, and passes, indeed, under the name of the Aroe rabbit. It is not only considered as fit for food, but regarded as a considerable delicacy. This species is much larger than the last. D. lemurina, or the New Holland bear. The length of this animal's body is about a foot and a half, and that of its tail about a foot. It is, perhaps, the most elegant species of the genus. In its manners, or mode of subsistence, it resembles the other species; it is frequently perceived, however, to sit like a squirrel, with its body erect, and holding its food in its hands. Its fur is extremely rich, soft, and thick. D. petaurus, or the great flying opossum of New Holland, is nearly two feet in length to the beginning of its tail, which is nearly two feet more. By an expansile membrane reaching on each side of its body, from the fore to the hind legs, it is enabled to leap to an extraordinary distance, and has thus gained the designation by which it is distinguished. Its fur is of the most exquisite fineness, and for the greater part of a sable or deep-grey brown colour, extremely brilliant. See Mammalia, Plate IX. fig. 2. D. sciurea, or the squirrel opossum. This and the last species are considered by Shaw as the two most beautiful quadrupeds in New South Wales. Its general appearance extremely resembles that of a squirrel. Its fur is, if possible, more soft and valuable than that of the flying opossum. Its abdominal pouch is rather beyond the usual proportion. This animal reposes by day, but during the night ranges in full activity.

DIDELTA, in botany, a genus of the Syngenesia Polygamia Frustranea class and order. Natural order of Compound Flowers. Corymbiferæ, Jussieu. Essential character: calyx expanding; outer leafy; receptacle honey-combed, dividing into parts which retain the seeds; down chaffy, many-leaved. There are two species, D. carnosa, succulent-leaved didelta, has an herbaceous stem, very much branched, erect, round, nearly eighteen inches high; leaves alternate, sessile, spreading, acute, attenuated at the base, quite entire, woolly above, beneath one-nerved, veinless, two or three inches long, six or eight lines broad; in the stove permanent; flowers solitary, terminating on long peduncles, yellow; annual, but in the stove it will last some years, becoming shrubby, which is often the case with annual plants. It is a native of the Cape; also D. spinosa; where they flower about July.

DIDUS, the *dodo*, in natural history, a genus of birds of the order Gallinæ. Generic character: bill large, and at the middle of the upper mandible bending inwards, marked with two oblique ribs, and considerably hooked at the tip; nostrils situated in the middle of the bill, and obliquely near the edge; legs short, thick, and in the upper part feathered; feet cleft; toes three forward and one backward; no tail. There are three species D. ineptus, or the hooded dodo, is nearly three feet long, and inhabits the islands of Bourbon and France. Its pace is slow; its body round and fat; its weight, occasionally, fifty pounds; and though sometimes eaten, according to Herbert, is considered as indifferent food. Its head appears to be covered with a black cowl, and, altogether, its figure is singularly curious and grotesque. In Mr.

Grant's history of the Mauritius, however, this bird is stated to be no longer found in that island or Bourbon: and most probably is to be classed among those species which have been destroyed through the ease with which they were taken: on uninhabited islands, however, it is added, the hooded dodo may possibly yet be found. The observation of Mr. Grant, with respect to the dodo, must be supposed to apply to all those of the species, of which, indeed, the one above-mentioned is given upon much better authority than attaches to the other two. Latham thinks it not improbable that these two differed from the first only in age or sex. Dr. Shaw, in the Naturalist's Miscellany, figures a foot of the dodo found in the British Museum. See Aves, Plate VI. fig. 2.

DIDYNAMIA, in botany, the name of the fourteenth class in Linnæus's method consisting of plants with hermaphrodite flowers, which have four stamina or male organs, two of which are long, and swo short.

DIETETICS, the science or philosophy of diets; that which teaches us to adapt particular foods to particular organs of digestion, or to particular states of the same organs; so that the greatest possible portion of nutriment may be extracted from a given quantity of nutritive matter; or a sufficient portion may be obtained with the least possible quantity of organic action and exhaustion. In this sense, the science of dietetics embraces a knowledge as well of the organs and economy of digestion, as of the substances to be digested; and under this division we shall treat of it in the sketch before us.

The organs of digestion differ exceeding in different classes of animals; but in all, even in zoophytes and infusory worms, there is one which answers the purpose of a stomach, the most important of all the digestive organs. In the more perfect animals, the salivary glands, the pancreas, and the liver, are all said to concur with the stomach, and, perhaps, the smaller intestines, in the process of digestion; and according to Cruikshank, about a pint of gastric, or stomach secretion, half a pint of saliva, half a pint of pancreatic juice, and twenty ounces of bile, are poured into the human stomach in the period of every twenty four hours: while the same process is aided by a considerable quantity of solvent fluid, of a different kind, secreted through the whole length of the internal surfaces of the intestines. Yet as some doubts have been entertained as to the relative contributions of these different viscera; and as in different classes of animals they vary in every possible mode of deficiency, till at length, in the lowest orders, we find nothing but the stomach itself left to maintain the entire economy; more especially as we cannot at present enter into the question of the relative importance of the rest; we shall confine our observations almost exclusively to the stomach, and shall only glance at the collatitious viscera, as we may perceive it absolutely necessary.

If we look back into antiquity, we shall find that the earliest opinion on the cause of digestion was that of putridity. It was by this process that both Hippocrates and Empedocles supposed the food when taken into the stomach, to be reduced to a proper state for the support of the animal system. Galen and his disciples conceived an idea, that it was brought about by heat. Van Helmont, whose wild conjectures can only be accounted for by the spirit and enthusiasm of alchemy which raged in his time, attributed digestion to the vital energy of the soul, which resided, as he thought, in the stomach.

Grew and Santarelli were of opinion, that the spirits which are poured forth from the nerves of the stomach served for the concoction of the food. Boerhaave, who has in reality only attempted to reconcile the variety of opinions that had been proposed before him, supposes there are two principal agents in this vital function, *viz.* the different fluids that are collected in the stomach, and the mechanical action of that organ; the secondary agents, according to him, are heat, air, the nervous fluid, the remains of the food, and an incipient fermentation, opposing it in the extensive sense in which it was considered before him. With respect to the gastric fluid, his ideas appear to be indeterminate and unsettled: he, however, conceived that its action on the food was merely as a simple diluent, like water, when heated to the same temperature. He had no suspicion of its being a solvent, or that it was capable of acting upon the more tenacious and hard substances that were taken in as food. According to Pringle and Macbride, digestion is carried on by a complete fermentative process. The food, divided by mastication, and penetrated by the saliva, begins, as soon as it enters the stomach, to be agitated by that intestine motion which always accompanies fermentation; this motion is excited by the warmth of that viscus, by the old remnants of the food, by the gastric fluid, and more particularly by the saliva, which is above all adapted to produce and promote this process. They supposed that the first effect of this intestine commotion is to raise the solid parts of the aliment to the surface of the gastric liquor, where they will be for some time sustained by the air bubbles, which, on their ceasing, must fall down again, and be thoroughly incorporated with the fluids of the stomach. This mixture is rendered still more complete by the peristaltic motion, the alternate pressure of the diaphragm and abdominal muscles, and the continual pulsation of the adjacent large vessels: in this state the food passes into the small intestines, where the fermentative motion produces still greater changes by the assistance of the bile and pancreatic juices; it is then converted into chyle. According to the opinion of Haller, the gastric juice is more or less acid in different animals; its action on the food very much resembles that of water, in which a little salt has been dissolved, which, from experience, is known to possess a very great resolvent power; and the consequence is, that an incipient fermentation takes place, which reduces the aliments to a pultaceous mass. In animals that feed on seeds, this process is assisted by trituration. These, with many other fanciful opinions, took place in their turn, when Cheselden by chance happened to conjecture right, *viz.* that digestion was performed by some unknown menstruum. This conjecture was confirmed by Reaumur and Spallanzani, who have proved the menstruum to be the gastric juice, by a number of experiments, a general view of which it will be necessary to give.

Spallanzani made his experiments by introducing certain substances, such as raw vegetables, &c. enclosed in small perforated tubes, and causing animals to swallow them; he then either destroyed the animal, in order to examine it, or waited until it was vomited up. The animal kingdom may be divided into three kinds; containing stomachs muscular, intermediate, or membranous; the last class is infinitely more numerous than the two former. Of animals with muscular stomachs, such as fowls, turkeys, ducks, geese, doves, pigeons, &c. the food is seeds, such as wheat, barley, pease, &c.; when it is taken spontaneously by these birds, it remains some time in the craw, where it is macerated and becomes softer; it is then conveyed into the stomach or gizzard, which is composed of very strong muscles, capable of grinding not only the grain it receives, but is of such force as even to reduce small pieces of glass, and blunt the points of needles: by this means the food is triturated and reduced very small; it is then converted, by the gastric juice it meets with in this viscus, into a pultaceous mass, called chyme. Spallanzani found, that the gastric juice of this class digests flesh, and that the animals are for the most part both frugivorous and granivorous. He found it dissolved raw flesh, when bruised, in about two days; but when entire, four and sometimes five days were necessary: it dissolves grain only when bruised; hence, in the gallinaceous class, trituration and the gastric fluid in the gizzard, although Reaumur was of opinion it contained no menstruum, mutually assist each other; the former, by breaking down the aliments in a mechanical way, prepares it for the latter, which penetrates it, destroys its texture, dissolves its particles, and disposes them to change their nature and become animalized. Spallanzani thinks that this gastric fluid traced in the gizzard proceeds chiefly from the œsophagus; the chyme he found to be a semi-fluid pultaceous mass, of a whitish yellow colour; the transparency of this gastric juice, in a state of purity, is little inferior to water; it is fluid, and a little bitterish and saline; it retains, out of the body, when warm, the power of dissolving animal and vegetable substances; but it must be fresh, for if kept in vessels, particularly if open, it loses its efficacy; it must not have been used for experiments; and likewise a heat equal to that of the bird, is necessary, otherwise it has no more effect than water.

The ruminating animals of the third class, such as sheep, oxen, &c. very much resemble this class of birds in their manner of digesting substances: in both, the gastric fluid requires an agent capable of breaking down the food, before it can dissolve it. The hay and grass, in the ruminating tribe, descend immediately into the first and second stomachs, in nearly the same state as when they first brouzed; here they are softened by the juices, as seeds are in the craws of birds with gizzards; but as the stomachs of these quadrupeds have no triturating power, and the aliment requires trituration, it ascends, in consequence of a gentle stimulus to vomit, into the cavity of the mouth, where, by means of rumination, it is put into the same state, previous to being digested by the gastric fluid, as happens to the food in the stomachs of granivorous fowls, after they have been properly triturated by the gastric muscles.

Animals with intermediate stomachs, such as ravens, crows, herons, &c. have muscular stomachs, which are by no means equal in force to the stomachs of the first class, but much more so than those of the third class. These animals possess the privilege of returning substances they are incapable of digesting, at least every nine, and in general every two or three hours; they are omnivorous. Their gastric juice does not dissolve whole seeds, they therefore bruise them with their beak and feet, and they are dissolved in twenty-four hours; it soon dissolves flesh and cartilage, but not bone. The fluid in the œsophagus, Spallanzani found inconsiderable as a menstruum, when compared with that of the stomach, since the first was six hours in dissolving two parts of flesh, and the second one hour only in dissolving six parts; consequently, the œsophagal liquor in the craws of the gallinaceous is different from that in this class. The resemblances between the gastric fluids of these two classes may be reduced to five: 1st. These fluids, besides being alike in colour, are always salt and bitter, which bitterness proceeds from the bile regurgitating through the pylorus into the stomach. 2dly, They are the immediate agents of digestion, both in the muscular and intermediate stomachs, independently of trituration. 3dly, The fluids act in the stomachs of these two classes of birds in the same manner, in the solution of the food; they first soften, and next convert the surface into a jelly, then produce the same effect on the intermediate parts, insinuating themselves gradually into its substance until it is completely dissolved. 4thly, They do not entirely lose their solvent power as soon as taken out of the stomach, provided they be heated to a proper degree. 5thly, The origins whence these fluids spring are nearly the same, *viz.* the follicular glands with which their organs abound. With respect to the differences, they are in part reducible to the inferior efficacy of the gastric fluid in muscular, to that of the same fluid in intermediate stomachs. The gastric juice of the first is incapable of dissolving the same aliment that the latter readily dissolves; likewise, the food, which each kind of gastric juice decomposes and digests, is sooner subject to this change from that which belongs to intermediate stomachs: hence, artificial digestion succeeds much sooner with the first than the second. The same inefficacy that the gastric juices of birds with muscular stomachs shews in the solution of aliments of a firm texture, extends also to their œsophagal juices in the solution of soft substances, notwithstanding the latter are tolerably well decomposed by the œsophagal juice of birds with intermediate stomachs. Another very striking difference is, the prodigious force of trituration in muscular stomachs, and the weakness of the other, which greatness of strength was necessary in birds whose food is of considerable firmness, as seeds.

Animals with *membranous* stomachs, such as frogs, newts, snakes, fishes, ruminating animals; carnivorous birds and beasts, as the eagle, falcon, man, dog, cat, &c. this class is infinitely more numerous than the two former: it comprehends nearly all the quadrupeds, fishes, reptiles, birds of prey, and the greater part of insects.

From Spallanzani's experiments it appears, that carnivorous birds do not dissolve vegetables, and throw up the indigestible part every twenty-four hours; that nature in these animals, whose digestion depends on the gastric juice alone, without any previous mastication or trituration, has provided them with a much larger quantity of it than the other classes; that digestion is in proportion to the quantity of this fluid; that the gastric juice of the ruminating class has no effect in dissolving plants, unless they have been previously macerated, and ground by the teeth; that its colour in sheep is green, and yellow in cows; that owls digest flesh and bones, but not grain; that their gastric juice evaporates sooner than water; that that of the eagle dissolves bread and bone; its colour is cineritious, and it digests animal and vegetable matters out of the body; that a wood-pigeon may be brought by degrees to live on flesh; that the owl and falcon do not digest bread; that the gastric juice of the dog dissolves the enamal of the teeth; and that trituration is necessary in the ruminating order and man, which is produced by the teeth, as in gallinaceous fowls by the gizzard; but in other animals, as in the, frog, newt, serpents, and birds of prey, trituration does not contribute to digestion: hence, in every order of animals, the gastric juice is the principal cause of digestion, and it agrees in every class in many properties, and differs in others. In the frog, the newt, scaly fishes, and other cold animals, it produces digestion in a temperature nearly equal to that of the atmosphere. In warm animals it is incapable of of dissolving the aliment in a degree of heat lower than that of these animals. In warm animals the food is digested in a few hours, whereas in the opposite kind it requires several days, and even weeks, particularly in serpents; likewise, the gastric juice of the gallinaceous class can only dissolve bodies of a soft and yielding texture, and previously triturated; whilst, in others, as serpents, the heron, birds of prey, and the dog, it decomposes substances of great tenacity, as ligaments and tendons; and even of considerable hardness, as the most compact bone: man belongs to this class, but his gastric juice seems to have no action on the hardest kind of bones. Some species likewise are incapable of digesting vegetables, as birds of prey; but man, the dog, cat, crows, &c. dissolve the individuals of both kingdoms alike, and are omnivorous, and in general their gastric juices produce these effects out of the body: hence, the dissolving power of this fluid depends on the difference of the nourishment, and by some authors it has been said to be the cause of hunger, and of the difference in the choice of the particular aliment; by which power the carnivorous only enjoy flesh; the granivorous and ruminating, only vegetable aliments, and no flesh; but man and the omnivorous, both vegetable and animal substances. It is, however, asserted by Carradori, as decided, that nocturnal birds of prey are capable of digesting vegetables: it results from his experiments, that they also support themselves very well with this nourishment, in spite of their repugnance to it. If this be the case, the opinion is erroneous, that the gastric juice of these birds has only an affinity with animal substances; and what he has established, *viz.* that carnivorous animals find a nutriment in the products of plants, was already rendered probable by the discovery of Fourcroy, of the existence of gluten, albumen, and gelatin, in the vegetable tribes. Spallanzani, however, proves the insufficiency of Carradori's experiments, as the owl died when confined to vegetable food. The time, moreover, requisite for digestion is different in different animals; in many it does not exceed five or six hours, and in some it is much shorter.

From the numerous experiments of Gosse of Geneva upon digestion, and the action which the gastric juice has upon different substances, great light has been afforded us upon this interesting subject. He informs us, that in about one hour and a half after the food is taken into the stomach, it is changed into a pultaceous mass; the gastric juice, likewise, renders it fluid without altering its nature; and when digestion is properly carried on, there is no appearance of acidity or alkalescence; the food does not ferment, and the process of digestion is not completed, until the space of between two and three hours has elapsed. The chyme which arises from aliments taken either from the animal or vegetable kingdom is the same; they both are by the gastric fluid converted into the same substance, which is in consequence, most probably, of their both containing gelatin, &c.: if, however, the digesting solvent is not in sufficient quantity, or is in a diseased state, the acetous fermentation will take place in vegetable, and the putrid in animal matter; hence milk, vegetable matter containing sugar, wine, and even spirits, will degenerate, when left to their spontaneous changes in the stomach, to a very strong acid, and sooner, sometimes, than out of the body, perhaps from the heat, &c.; all oily substances likewise become rancid, and flesh meat putrid, producing acid and putrid eructations, which is never the case in a state of healthy digestion; whilst, in many animals, the digestion is finished before the acetous or putrid fermentation can begin.

Substances insoluble, or that were not digested in the usual time in the stomach. Animal substances: 1. Tendinous parts. 2. Bones. 3. Oily or fatty parts. 4. Indurated white of egg. Vegetable substances: 1. Oily or emulsive seeds. 2. Expressed oils of different nuts and kernels. 3. Dried grapes, and the skins of fish. 4. Rind of farinaceous substances. 5. Pods of beans and pease. 6. Skins of stone fruits. 7. Husks of fruits with grains or seeds. 8. Capsules of fruit with grains. 9. Ligneous stones of fruits. 10. The gastric juice does not destroy the life of some seeds; hence bitter-sweet, hemp, misletoe, and other plants which sometimes grow upon trees, are produced by the means of the excrements of birds, the kernels of the seeds being defended from the menstruum by exterior covering. Substances partly soluble, or parts of which were digested. Animal substances: 1. Pork dressed various ways. 2. Black puddings. 3. Fritters of eggs, fried eggs and bacon. Vegetable substances: 1. Salads of different kinds, rendered more so when dressed. 2. White of cabbage, less soluble than red. 3. Beet, cardoons, onions, and leeks. 4. Roots of scurvy grass, red and yellow carrots, succory, are more insoluble in the form of salad than any other way. 5. The pulp of fruit with seeds, when not fluid. 6. Warm bread, and sweet pastry, from their producing acidity. 7. Fresh and dry figs. By frying all the substances in butter or oil they become still less soluble. If they are not dissolved in the stomach, they are, however, in the course of their passage through the intestines. Substances soluble or easy of digestion, and which are reduced to a pulp in an hour, or an hour and a half. Animal substances: 1. Veal, lamb, and in general the flesh of young animals, are sooner dissolved than that of old. 2. Fresh eggs. 3. Cows' milk. 4. Perch boiled with a little salt and parsley; when fried or seasoned with oil, wine, and white sauce, it is not so soluble. Vegetable substances: 1. Herbs, as spinach, mixed with sorrel, are less soluble; celery, tops of asparagus, hops, and the ornithogalus of the Pyrenees. 2. Bottom of artichokes. 3. Boiled pulp of fruits, seasoned with sugar. 4. Pulp or meal of farinaceous seeds. 5. Different sorts of wheaten bread, without butter, the second day after baking, the crust more so than the crumb, salted bread of Geneva more so than that of Paris without salt; brown bread, in proportion as it contains more bran, is less soluble. 6. Rapes, turnips, potatoes, parsnips not too old. 7. Gum arabic; but its acid is soon felt: the Arabians use it as food. Substances which facilitate the menstrual power of the gastric juice are, sea-salt, spices, mustard, scurvy grass, horse radish, radish, capers, wine, spirits in small quantities, cheese, particularly when old, sugar, various bitters. Substances which retard the gastric power are water, particularly hot, and taken in large quantities. It occasions the food to pass into the intestines without being properly dissolved. All acids, astringents, twenty-four grains of Peruvian bark, taken half an honr after dinner, stop digestion. All unctuous substances, kermes, corrosive sublimate.

Gosse likewise observed, that employment after a meal suspended or retarded digestion, as well as leaning with the breast against a table; and that repose of mind, vertical position, and gentle exercise, facilitate it. It likewise appears, that from the soluble power of this fluid digestion goes on after death, but it is far less considerable than in the living animal; that in fishes it retains its property of digesting flesh, but in an inferior degree to that of birds; and that in some animals heat is necessary to this power, which acts independent of the vital power.

Hunter attributes to the action of the gastric juice, the erosions found in the stomachs of those who have died suddenly, in which sometimes the great curvature of that organ is entirely consumed; he often found them on opening dead bodies; the edges of the wounds appearing like half-digested food.

Such is the stupendous power of that fluid which is perpetually secreting by the stomach in a state of health, in order to comminute and dissolve into a pultaceous mass the alimentary substances which are introduced into it. Here, however, the action of the gastric juice, and perhaps of the stomach itself, ceases: for whatever is found in the stomach is chyme, or this pultaceous and uniform mass alone. We have no chyle, except by regurgitation from the smaller intestines. The stomach is therefore altogether a preparatory organ, and it appears to be the action of the different fluids secreted from the collatitious viscera, the saliva, the pancreatic juice, and the bile, (we confine ourselves to the more perfect animals) that are alone able to convert this comminuted chyme into the saccharine fluid, called chyle, as it descends through the pylorus, or inferior orifice of the stomach, into the duodenum, in which the process of chylification is chiefly performed, and amidst the folds or *valvulæ conniventes* of which the lacteals are most numerously seated.

Yet it is not every thing the stomach is capable of dissolving, that the secondary action of the chylopoïetic viscera is capable of converting into food, or of converting with equal facility; nor is it every substance, as we have already seen, containing the real principle of aliment, that the stomach itself is capable of dissolving in the same period of time, or with the same degree of ease.

Hence the necessity of attending to what we have made the second branch in our present tract on dietetics, the nature of different alimentary substances, and especially of the common principle on which the aliment of all them may perhaps depend.

Regarding this subject on a comprehensive scale, we have much reason to suppose that there is no substance whatever, either in animal, vegetable, or mineral existence, but contains a basis, from which some animal or other is capable of extracting nutriment. Nor is this much to be wondered at, since we have already observed, that in different classes of animals the organs of digestion vary in every possible manner, in regard to their presence or deficiency; and more especially since we know that the fluid secreted by the stomach itself, the only organ that is universal, is equally discrepant in its powers and qualities in animals of different structure; being in some naturally acid, in others alkaline, and in others again insipid or neutral. And hence we not only discern the truth, but can trace the real cause of the fact long ago observed by Lucretius, iv. 640.

Tantaque in hiis rebus distantia, differitusque est,
Ut, quod aliis cibus est, aliis fuat acre venerum.

"————So vast, at times,
The strange discordance, that which poisons this,
To that proves healthful, and prolongates life."

GOOD.

We can hence see the reason why many of the serpent tribe should convert a wholesome nutriment into a venomous secretion; why the euphorbia, or spurge, so noxious to man, and most quadrupeds, should be greedily devoured by several of the insect tribes; why the cicuta, which proves poison to the human race and the horse, should be luxuriously feasted upon by goats and quails, while the horse, on the contrary, feeds with pleasure on the aconite, or bane-berry, which the goat will not touch.

A thousand such peculiarities might be advanced, if it were necessary; but these alone are sufficient to prove, that every created substance possesses the basis of a nutriment for some order of animals or other: and that all that seems necessary, with respect to those generally esteemed the most poisonous, is a peculiar power in the stomach to select the parts that are nutritious from those that are baneful, and to secrete these alone into the system.

These observations apply to food generally. We now proceed to observe, that even the same foods, under certain states of the stomach, to which they are naturally appropriate, will not universally produce the same beneficial results. Two questions, hence, naturally arise. What are those states of the stomach, in which its appropriate foods have for the most part a tendency to prove injurious instead of salutary (for the digestion of every aliment must do either the one or the other)? And of what nature are those substances, which, under almost every circumstance, form an exception to the rule of disease, and may still be swallowed ed with benefit?

It is clear then, in the first place, that the states of the stomach here referred to are morbid states: morbid either from idiopathic, or symptomatic affection: and secondly, that as in all such cases the common action of the stomach must be debilitated, and consequently its secreted or gastric juice partake of the debility, or be extruded in a much weaker and more dilute state, those aliments only can be usefully employed, which are both capable of being digested with a small portion of gastric energy, and at the same time capable, when digested, of affording a very large portion of the nutritive principle.

It also happens, and that not unfrefrequently, that in the preparation of such foods, we can add such accessary qualities as may tend to oppose the morbid affection of the stomach, or the temperament generally, and thus acquire a double advantage, by imprinting upon our aliment a medicinal character: as when in flatulencies we make spices a part of the regimen recommended; in scorbutic affections, acids; and in acidities, animal oils. But such accessaries are rather medicines themselves than foods, and have scarcely a right to be regarded otherwise.

What then are those states of the stomach, either original, or dependent, which render it necessary to deviate from the general license of nature, and to restrict those who are thus morbidly affected to medicinal diets or regimens?

To catalogue and treat individually of the whole of these would require the space of a quarto volume: we must confine ourselves therefore to the chief of such affections, and, in discussing these few, endeavour to make our rules so comprehensive, as to be a general directory to the rest.

The principal diseases then, whether local or constitutional, in which the human stomach becomes so affected as to render it a proper subject of medicinal diet, are, acidity, flatulency, heart-burn; impletion; chronical sick-head-ache and hypochondriasis; hepatic affection from hot climates; hepatic affection from hard drinking.

OF ACIDITY, *and its concomitants or effects.*

It is difficult to determine whether acidity of the stomach depends at all times on the introduction of acid by the mouth; or whether the gastric fluid be sometimes secreted in a vitiated state. A great variety of acids are occasionally introduced into the human stomach with food or medicine; and that acid, which is the product of fermentation, is frequently formed in the stomach from the spontaneous changes of vegetable matter in cases of imperfect digestion, and where food is taken in so large quantity that it is impossible for any stomach to dissolve it: from the latter cause, principally, the acid so perpetually troublesome to the stomachs of children appears to arise; and the cardialgia of adults may justly be supposed most frequently to have the same origin: it is constantly to be observed, however, that in obstructions of the liver or gall-ducts, symptoms of cardialgia occur, and that in cases of sick-head-ache and of hypochondriasis, where the strictest attention has been paid to rules of diet, the patient is not relieved till acid be evacuated from the stomach, either by vomiting or purging: hence it appears probable that the gastric fluid is in itself vitiated in some diseases, having acquired the properties of an irritating acid, and being bereft of its solvent power; and that a due secretion of the bile is always requisite to the correction of acid in the stomach, both as neutralizing the acid matter, and as stimulating the intestines to expel any uncombined acid, which may resist its effects, or prove more than it is adequate to neutralize.

The symptoms attending acidity in the stomach are, flatulency; cardialgia; nausea; vomiting; costiveness; or purging with discoloured fæces; foul bowels; head-ache; paleness sometimes alternating with flushing; increased pulse; a tongue coated with a white or brownish fur; increased heat, particularly on the skin of the abdomen; loss of appetite; sense of weight, pain and oppression; rigors; langour, particularly about the eyes, with discoloration round the eye-lids; stupor, and convulsions, or a dilated pupil so as to resemble hydrocephalus. These symptoms occur according to the magnitude and duration of the attack, in conjunction with the constitution of the patient.

In all common acidities in the stomach, evacuation from the bowels is always necessary, whether the attack be accompanied with costiveness or purgation. For this purpose calomel is generally highly serviceable. From its nature and the smallness of the quantity requisite to produce the requisite effect, it may be taken without being tasted, and it commonly produces no nausea or vomiting, when a fluid purgative would instantly have this effect, from its irritation on the already irritated stomach, and from the sympathy of that viscus with the organs of taste and smell, when offended by such medicine: the mode of operation of calomel, and its quickness of action, also highly contribute to render it eminently useful; it instantly excites copious mucous secretion from the glands of the stomach, which contributes to dilute and wash away the offending acid, and a considerable portion of this medicine quickly passing the pylorus augments the secretion of bile, the natural corrector of acid; and that of the pancreas producing further dilution. It may be given in doses from one grain to five, or even in larger quantity, according to the age and strength of the patient, and repeated as occasion may require. In an hour or two after its exhibition, the stomach will bear some directly purgative matter, which should be given, to insure the passage of the calomel through the bowels, and to increase the purgative effect. Rhubarb will hereafter be of great advantage, intermixed with some aromatic powder or pungent water, as mint or peppermint; though the neutral salts will better agree with some constitutions. Absorbents we cannot recommend so largely as they have often been recommended, especially the calcareous earths, for it often happens that the insoluble compound formed by the union of chalk and the acid in the stomach increases the load and irritation in the bowels. In slight or recent cases, they are chiefly useful, and to be depended upon.

The morbid matter being removed or destroyed, strict attention to diet is next of very considerable consequence. Whatever is light and easy of digestion, and especially whatever at the same time contains in itself a considerable portion of the nutritive principle, and counteracts acescency, is the bill of fare to be rigidly adhered to. If there be thirst, barley water may be taken plentifully; rice gruel is preferable to decoctions of oatmeal, as being less ready to ferment, and containing more demulcent mucilage. As more solid food, rice itself may be habitually resorted to, with light animal food of any kind, and varied in whatever way the patient may prefer. Cardialgia, or heart-burn, flatulence, and hence tympanites, or enlargement of the belly, are often mere symptoms, dependent upon that debilitated state of the stomach that predisposes it to a morbid secretion, or renders it ineffectual to digest the common aliments that are introduced to it, or even to resist the acetous fermentation to which they are too often inclined. Whatever, therefore, of medicine or regimen will tend to remove this state of the stomach, will tend at the same time to destroy these distressing symptoms, which are but its concomitants or dependants. Worms, again, may be regarded as another result of the same debilitated action; for, whether in children or adults, they will never be found to exist either in the stomach or intestines, while these are in a state of perfect health, and thoroughly competent to a secretion of their appropriate fluids. These, however, like the acidity of the stomach, must first be discharged from their station, before we can expect any great degree of benefit from an habitual regimen.

To the diet already recommended, we may then add gentle tonics and cordials, especially wine and palatable spices. Soda water will also generally be a beverage of very essential advantage, both from the carbonic acid gas and from the alkali it contains, the one proving gently tonic to the stomach, and the other correcting the superabundant acid: and it is commonly necessary to continue the use of rhubarb, or some other purgative, with alkaline and slight bitter medicines, for a length of time, where the complaint shews a disposition to return.

IMPLETION OF THE STOMACH.

This disease is of two kinds: the one from temporary satiety, which is easily removed by emetics and purgatives; but which, from not being removed in due time, not unfrequently produces stupor and apoplexy. The other, and which chiefly belongs to our present consideration, from habitual abstinence, from exercise, accompanied with an habitual proclination of the body, as occurs in the trade of shoe-makers, or of tailors, or the occupation of writing clerks, or accomptants, as well as of literary people in general. Some years ago, from the pressure of their stays, women were frequent sufferers in the same way: in the present fashion of their dress they are far less subject to it, though it occasionally happens to those who sit long stooping to needlework.

By this proclination of the body, the thoracic and abdominal viscera are unduly compressed together for many hours in every day: the margin of the ribs is forced upwards, so as to drive the stomach against the diaphragm, and to impede the passage through the pylorus; while all the adjoining organs, the blood vessels and excreting ducts, partake of the general injury from the compression, and hereby concur to excite affections of the lungs, or permanent disease in the large vessels near the heart, as well as more extensive and deeply seated mischief in the stomach.

The symptoms indicating disease of the stomach from this cause are, nauseous taste in the mouth, with furred tongue, pain in the region of the pylorus, and sense of weight and the pain increased on pressure at the pit of the stomach: there is always costiveness; from the want of free passage through the pylorus, the stomach becomes loaded with viscous matter: the countenance is pale, wan, and sallow, and very shortly blackness appears under the eye-lids, and frequently a jaundiced tint appears, from obstruction to the free secretion or passage of the bile, and all the common dyspeptic symptoms occur.

It is obvious, in all these cases, when the occupation of the patient will allow of avoiding that posture, which is the sole cause of his malady, that this is all which is necessary to prevent its return: from the force of habit, however, directions to this effect are seldom sufficiently obeyed: where the case has been of long standing, or there have been frequent repetitions of the attacks, and the lungs, liver, and other viscera, some or all of them become affected, the treatment must be adapted to the state of those parts: riding on horseback daily will do much service; and many a working tradesman, having lately entered into some corps of volunteers, has learned to carry his person better, and been afterwards free from this complaint; whilst, before he had the drill-serjeant's assistance, it was difficult to make him stand erect at any time.

The overfilled stomach, which brings the patient into an apoplectic state, is a case which requires the instantaneous exhibition of the most powerful emetics. A strong solution of vitriolated zinc is the most proper medicine for this purpose; it is preferable to any form of antimony, because the latter, even in a very large dose, will commonly have no emetic effect at all in the torpid state of the stomach, which is here the alarming symptom, but the patient will be thrown by it into a violent debilitating perspiration, and the time for relieving his stomach and saving his life will be lost for ever. As soon as the stomach is relieved, and the efforts to vomit have ceased, a large dose of some purgative medicine, and especially of the mercurial class, may be advantageously exhibited: and the exhaustion of the power of the stomach must afterwards be attempted to be recovered by a regimen of warm and acrid stimulants, especially horse-radish, mustard, garlic, and onions; with the occasional use, as well in the former, as in the present consequence of the impletion, of gum pill with aloes, or a very small quantity of calomel.

HYPOCHONDRIASIS AND SICK HEAD-ACH: *the disease of erudition and study.*

The elegant and accurate Aretæus expresses himself to the following effect, in his very valuable chapter on diseases of the stomach.

"The stomach is a grand seat of pleasurable feelings and of disquietude. When its action is perfect, firmness and elasticity of fibre in conjunction with a ruddy complexion indicate health, and the digestion is easy. On the contrary, when the stomach is disquieted, there is an aversion to food; not only when it is placed on the table, but to the very thought of it, and dejection of mind is the consequence of insuffıcent nourishment; nausea, anxiety, collections of fluid in the stomach, and cardialgia, ensue, and sometimes increased flow of saliva and vomiting. Though the whole body suffers while the stomach remains empty, yet greater suffering is produced when necessity has required food to be taken, and it is masticated with aversion, and swallowed with still greater disgust, and pain more intolerable than hunger ensues, and the pain between the shoulders increases; dimness of sight, tingling of the ears, and heaviness of the head, take place, with torpor of the limbs, feebleness of the extremities, and sensations of palpitation about the præcordia; patients feel themselves agitated, and as it were driven to and fro like reeds or trees by a gust of wind; they are sleepless, though heavy and ready to fall asleep in a state resembling coma; they are meagre, pale, languid, deprived of strength, inactive, inanimate, and indolent, but they are suddenly excited to anger: their situation much resembles that of melancholia, with which disease they frequently become affected."

Aretæus proceeds to state the causes of the affection he has described; it attacks those, he says, who from necessity have lived on thin and spare diet, and those of laborious and patient erudition, who are so absorbed in the precepts and practice of philosophy, as to hold in contempt a plenty and variety of nourishment; they never change the scene, or take exercise, or indulge in any relaxation of mind; their love of learning detaches them from every other consideration, from their country, their parents, their kindred, from themselves, for the whole of their lives; pale and wan at all times, in youth they have all the infirmities of age; their mind, from exhaustion, becomes enervated and cloudy, and they seldom indulge in cheerfulness, and laughter and mirth are strangers to them.

Such is a faint and very indifferent sketch of the admirable picture drawn by Aretæus, so far as it applies to modern hypochondriasis, as proceeding chiefly from undue mental labour and exertion. To persons of this character it does not often happen, that the symptoms they experience are the sole result of poor feeding from necessity: yet it certainly does occur to hypochondriacs, to have their complaints aggravated from want of regular meals, and many persons fall into this disease, in a great measure, from never thinking of taking any sustenance till their very late hour of dinner; and when the disease has prevailed for some time, they frequently form rules of diet for themselves, or derive them from the advice of all whom they may have occasionally consulted, and they very commonly attend more to the cautions they have received against the *lædentia*, than to any encouragement as to the *juvantia*; depend for restitution of health on avoiding all that has been pointed out to them as wrong, and will scarcely believe that much benefit is to be derived from a good light meal, or from taking at intervals any small quantity of exhilarating nourishment.

Most of the symptoms already enumerated under acidity of the stomach make their appearance in the present disease, though varied in every diversity of combination: in addition to which there is generally costiveness, and a peculiar affection of the head, a dead heavy pain, sometimes exacerbated to acute distress, and always accompanied with that idiopathic nausea of the stomach, which is well characterised by the name of sick-headache.

The affection of the mind in hypochondriasis is curable, or may be very much palliated, by due care and attention to the digestive process; persons thus affected are always disposed to view only the gloomy side of objects: according to the different circumstances and situations in life of each individual, he becomes oppressed with the fear of disease, of poverty, of death, of fatuity, of loss of memory, or has other groundless fears of misery awaiting him; such paroxysms will sometimes occur several times every day, and are often found to depend on indigestion and flatulency, which being removed by the means to be pointed out in the plan of treatment, these ideas of apprehended evils will gradually subside, or, at least, be very considerably diminished.

In all cases of this kind, whether of original affection of the primæ viæ, or symptomatic of chlorosis, or any other affection, little good can be done, without unremitting attention to the regularity of evacuation from the bowels, which is essentially necessary to the subduing of acid, when habitually formed in the stomach, and towards gaining any ground in the removal of pain, flatulency, and every other dyspeptic symptom; and the means of attempting to effect this regularity in different persons, and in the same person at different times, must be exceedingly varied; now and then a case occurs with an habitually lax state of the bowels, and only rhubarb is requisite as a purgative, joined with light aromatics, but commonly we have to contend with constipation, and rhubarb by itself does mischief. When the stomach and bowels are loaded and foul, powerful doses of mercurial purgatives are occasionally necessary, particularly in those whose blood-vessels are full, and whose energies are considerable. When this state of the system is indicated by labouring action of the heart, which is perceived by the patient, or by vertigo, depending upon repletion of the blood-vessels, it is to be relieved by cupping: and if the secretion of the bile be deficient or irregular, the repetition of a grain of calomel daily, or every other day, for a week or two, persisted in, will be frequently found of great utility.

Yet it often happens that the bile, though duly secreted, is an insufficient stimulus to the intestines, either from its being neutralized by the acid which passes from the stomach to the duodenum, or from the bowels being in a state too permanently torpid to be excited by it. In such cases the repeated use of calomel, as a stimulus to the liver, cannot fail to be injurious: the intestinal canal itself should be chiefly attended to, and purgatives of a liquid kind, or those easily rendered liquid, should be employed in its stead. About a tea-spoonful of the tincture of senna, rendered more grateful to the stomach by the admixture of a little tinct. of lavend. or of ginger, and taken at bed-time, without any admixture of water, will often cause a more easy night's rest, and operate mildly in the morning; this is very useful in preventing the necessity of the too frequent repetition of more bulky or violent cathartics. On the same principle, electuary of senna and the various domestic preparations of that drug and of other mild laxatives have their uses; for it is always to be remembered, that violent purging is not the intention to be accomplished, but only permanent regularity of evacuation. The aid of clysters should sometimes be obtained, particularly when there appears to be a large collection of indurated fæces in the colon: this is sometimes evident from a hardness in the track of this intestine, which may be felt in the umbilical and left iliac regions; and this congestion alone has not unfrequently produced strong hypochondriac symptoms.

Yet injections, too long and habitually indulged in, are, of themselves, apt to produce costiveness; and are one grand cause of that constitutional constipation, to which a great part of the French nation are so subject.

Aloes would be a convenient medicine, but that the diseased now under consideration, from a general torpidity of alvine action, are peculiarly disposed to hæmorrhoids; a malady which is almost always increased, instead of being meliorated by aloetic purgatives. Magnesia is seldom useful, whether alone or in combination. Calcareous earths often produce febrile heat, and augment the impediments to digestion. In some cases, however, of very chronic acidity, and when the bowels are tolerably free, considerable advantage may be derived from lime-water prepared with oyster-shells, as a purer form of calcareous earth than that which is dug out of a chalk-pit, and from bark prepared with lime-water. The addition of natron, or aq. kali, to bark or other bitters, is sometimes advantageous, particularly if the case be complicated with glandular affection; in the same manner soda-water is beneficial, and from the tonic power of the light carbonic acid it contains; the good effect of ammonia taken into the stomach, may depend in some measure on its alkaline nature, but seems principally to be produced by its grateful stimulus, both in the form in which it is taken, and after it may have been combined into a neutral ammoniacal salt, by union with any acid it may meet with. Nothing, however, can be more capricious than the stomach in hypochondriacs, and in all those diseases where acidity habitually prevails: it is particularly to be noticed that vitrolic acid, with bark or without it, is often essentially useful, and this, where acidity in the stomach is continual; the utility of this acid is certainly in defiance of all chemical reasoning, and may depend upon its astringency, whereby it probably prevents the secretion of acid fluid into the stomach, or of such fluid as is ready to become acid, and in some measure on its power of preventing fermentation. Tonics for the most part are necessary, but it is almost impossible to lay down any form of them to be pursued for any length of time; the stomach is commonly soon disgusted with any individual preparations, and it is often very difficult to suit its variation of aptitude by the most judicious changes of medicine, which, however, must always be attempted, since there is not any case of disease which is so frequently aggravated by neglect.

Steel is a doubtful medicine. Where the head is chiefly affected, it is sure to do harm. And even in cases in which we may conceive that some chalybeate water, as that of Tunbridge, or some chemical preparation of steel, may be employed, it will be necessary to discontinue their use for some time, on the first approach or return of the affection of the head. When the spasm affects the voluntary muscles of the body, the trial of steel is indicated, and its use appears sometimes considerably to contribute to the prevention of the return of dyspeptic symptoms and of pain in the stomach, as well as to the general tone and strength.

The spasms about the hypochondria very frequently cannot be relieved without opium, and in this case also the solid form of it is the best, as it is applied constantly by gradual solution to the parts immediately affected, and produces much less injury to the stomach and to the system than if given in a fluid state. Yet in neither way should we have recourse to it but when impelled by the supreme command of dire necessity; for at best it is but a temporary remedy, and the irritability generally returns with augmentation from its use. In cases of less extremity, the fetid gums, in the form of pills, camphor, æther, and Hoffman's anodyne liquor, will be often found highly serviceable, and will prove innocent of the baneful effects of opium. Flatulency is often much relieved by increasing the muscular action of the stomach and intestines; and mustard, horse-radish, and other such stimuli, are useful, either in the forms in which they are served at table, or the mustard-seed may be taken whole, or the officinal and other preparations of horse-radish may be employed. In cases of sick-head-ache opium must, as much as possible, be avoided; to increase the power of the stomach and regulate the bowels are here the principal objects.

With regard to external remedies, blisters and other applications, soliciting a discharge, are commonly very unnecessary torments, and are very seldom justly applicable. Frictions on the hypochondria with volatile liniments often give very considerable relief. Cold bathing has been advised, but generally seems to disagree with persons of a sedentary constitution, especially if advanced in years.

Upon air and exercise much has been written; and some things have been written erroneously. The air of large cities is indisputably injurous to all debilitated invalids; and to hypochondriacs a pure air is peculiarly to be recommended. Yet seclusion is so baneful, that the good effects of a purer air will be more than counterbalanced, if an hypochondriac shut himself up constantly by his fire-side in his country study, or retire from society into indolence and apathy. Cold piercing winds are severely felt, and should be avoided: at the same time the propriety of hypochondriacs accustoming themselves to bear the open air as much as circumstances will allow, must ever be impressed upon them: and proper warmth of clothing, particularly about the feet, must be worn.

Exercise, short of fatigue, is essential; and even a little fatigue must be endured by those, who, from long sedentary occupation, have lost the habit of exertion; riding on horesback, or in a carriage, sailing, rowing, are all useful; also moderate walking, bowling, or working with a spade in the garden, and other exercise out of doors attended with some labour. It is to be observed, however, of sick-head-ache, that its attacks are frequently induced by the motion of a carriage, boat, or ship, and that exercise on foot or horseback is best for such invalids: friction about the hypochondria with a flannel or flesh-brush is often serviceable, and to be recommended, when the debility of the patient prevents other kinds of muscular action. The military exercise, as practised by our volunteers for a short time every day, is also, where it can be adopted, of very high advantage.

The plan of diet in this disease is a point of much delicacy and management: the same mode will seldom answer for any two distinct cases. In general, the patient is to be nourished with whatever aliment he can digest, and an equal and uniform reservation as to spices is by no means necessary, provided that they seem to improve rather than to injure digestion; his appetite for a moderate quantity of almost any variety of food is to be indulged, provided no derangement of the stomach ensue from it, and the *juvantia* and *lædentia* are to be made out from observation in each case; vinegar and native vegetable acid commonly are prejudicial, yet very frequently ripe fruit is beneficial. In general every thing that is oily or empyreumatic must be avoided: mustard, horse-radish, and the like, are often useful in the prevention of flatulency: sometimes in long cases of hypochondriasis, where vomiting has been a tiresome symptom, the yolks of eggs boiled hard have been digested, and the vomiting in a short space of time has ceased: in these cases it is probable that the stomach is in an habitual state of contraction, as it has been sometimes actually found on dissection, and mustard or horse-radish, by increasing its muscular action, would have been injurious, whilst any easily digestible substance nearly solid, from not occupying much space, would be retained, and gradually distend the stomach, or, from causing the muscular effort produced in vomiting to cease, give opportunity to the stomach to recover its natural dimensions; eggs, however, prepared in any way that has been contrived, will not always agree, even when this state of stomach is to be suspected; but will at times be almost immediately rejected, or produce much disturbance, when a small quantity of gelatinous or mucilaginous food, or even of light meat, will be digested.

It is by no means justifiable to prohibit light suppers peremptorily; since, in point of theory, we know that digestion and the absorption of chyle proceed more regularly during sleep than at any other time; and, in point of fact, we know equally that hypochondriacs are often benefitted by light suppers. Thus much is certain, that the meals should always be light and sparing, and consequently frequent; and that, if suppers be indulged at all, the hour of dinner should be much earlier than is customary in the present day.

With respect to drinks, malt-liquor ought but seldom to be allowed. Soda-water, with wine, commonly forms a most excellent beverage. It is rarely proper to require any large quantity of diluting drink to be taken. Coffee generally agrees better than tea; and sometimes cocoa, or even chocolate, if its oily quality do not offend the stomach, is very proper for breakfast, or in the forenoon.

Opium, for the mere purpose of procuring sleep, should never be allowed. Much, in this respect, is to be accomplished by regularity in the hours of rising and going to bed, and especially by opposing all propensity to sleep in the day time.

The mind in hypochondriasis cannot be properly regulated without the best efforts of the patient himself, but he will for the most part be induced to use them, on the representation of a medical man of intelligence and good humour, that it is impossible for him to accomplish any plan he has in view, and that he must always be a burthen to himself and his connections, till he makes the search after cheerfulness and health his primary pursuit; he must make himself alive to the scene which passes before him, and his family may commonly be instructed in some methods of diverting his attention from dismal reflections on himself, and from unremitting application to any favourite topic, and gently to remind him of the harm he is about to do himself, when he seems ready to give way to any excess of passion. His resort to public places will be beneficial, when he can be brought to attend to what is going forward there, and by such attentions his pursuit of health will daily become less irksome and laborious; and by the same means he must be brought to unbend his mind in the society of his equals, and to attend to the proper times of exercise, food, and rest.

HEPATIC AFFECTION, *catenating with affection of the stomach, and produced by hot climates or hard drinking.*

We have already sufficiently commented upon the general nature of the bile, and the importance of its due and healthy flow towards the proper action of the stomach, and the whole of the intestinal canal. Now it is clear, that if the organ which secretes this important fluid be perpetually irritated by a stimulus of any kind whatever, it will first become inflamed, and suppurate, if the inflammation be very great and progressive; and secondly, it will become wholly exhausted and torpid, if the stimulus be not sufficient to produce inflammation.

The stimuli of hot climates and of hard drinking, especially when the beverage consists largely of alcohol, have both a tendency to produce each of these effects, though not in an equal degree; and consequently not merely to injure the liver itself, but to derange the entire process and economy of digestion.

In general, those who are affected by a diseased state of the liver in warm climates return to their native homes before inflammation sufficient to excite suppuration has taken place; and hence in our own country we seldom meet with cases of this kind; but if the same persons do not return home in time, or if they be actually prevented from returning at all, suppuration will be a frequent consequence of the disease they are labouring under, and it is therefore a result which is by no means ucommon in the East and West Indies.

Commonly, as the case appears to us, on the arrival of the patient in Europe, the morbid excitement of the liver has only produced an enlargement of its parenchyma by the effusion of coagulable lymph; which is often re-absorbed by a recovery of healthy action in the lymphatics of the affected viscus, and especially by gently stimulating them through the medium of mercury. In the meanwhile, however, the stomach and the whole of the digestive economy suffers severely, and much attention is necessary to the nature and regulation of the diet.

The excitement produced by hard drinking has a worse tendency, and is often succeeded by a worse result to the stomach, liver, and indeed all the chylypoietic viscera, than that produced by hot climates. For, though in the former case we have seldom morbid action enough to produce suppuration, we have enough to excite scirrhus, in conjunction with torpidity, and consequently to render the organs almost incapable of recal to a healthy and harmonious state by any kind of regimen, or plan of medicine, whatever. While, at the same time, the villous membrane of the stomach, from perpetual exposure to the acrimony of alcohol, becomes abraded of the mouths of its secerning vessels, and rendered often polished and glabrous throughout its whole surface, like a sheet of glass; whence the stomach is just as incapable of secreting gastric juice, as the liver is of secreting bile.

The symptoms chiefly indicatory of an affection of the liver, from a long residence in hot climates, are costiveness, often alternating with diarrhœa, or dysentery; strong spasmodic pains about the epigastrium, and hypochondria; flatulence, and at times cardialgia. There is also a general languor and depression, altogether intolerable and insuperable to the patient. If he indulge in activity, he sinks into a state of increasing debility, and if he attempt any moderate exertion he is overcome by fatigue, or suffers from cold or from some new symptoms, the consequences of accidentally increased action; and unless some effectual, but moderate and permanent, means of relief be afforded, he dies of some symptomatic disease which ensues, or sinks exhausted by the primary affection of the stomach and other viscera concerned in digestion. Such are the most striking features of disease originating from this state of the abdominal viscera, when it is severe and permanent. In the more common attacks, a great number of symptoms are very troublesome: nausea, cardialgia, eructation, faintness, sense of weight, and oppression in the epigastric region, which is tender to the touch, and pain between the shoulders. In almost every case, the appetite is exceedingly fastidious; if food be not taken, flatulency and sense of languor increase, and the spasm becomes severe; and after eating, all the symptoms of dyspepsia occur, and the pain very often is aggravated.

Those who, during their residence in a hot climate, have been attacked by acute inflammation of the liver, not terminating in suppuration, are frequently found, on their return to Europe, as we have already observed, to have the liver enlarged from the deposition of coagulable lymph in the progress of the inflammation, and in its termination by resolution; in the same manner as the testicle, and particularly of the epididymis, which remains for a long time enlarged after the inflammation called hernia humoralis: it is seldom, however, that these symptoms will not yield to a judicious and persevering mode of medical practice.

In affections of the stomach and other chylopoietic organs from hard drinking, the chief of the same symptoms will be found to occur: but those peculiarly attendant upon this last disease, perpetual loss of appetite, nausea, and vomiting, when the stomach is empty; an almost constant pain at the pit of the stomach; a general tremulation of the muscles, and especially those of the hands and arms, so that nothing can be held steady; vertigo, and frequent fainting fits.

In the case of enlarged liver, from the deposit or accumulation of coagulable lymph, mercury should be administered so freely and reiteratedly, as to produce immediate and permanent action on the liver, and rather by inunction on the abdomen than by the mouth; or perhaps by both at the same time. Yet the exhibition of mercury in large quantities, and so as to excite ptyalism, has of late years become too indiscriminate; and excepting in the individual case now alluded to, its admission in this unrestrained manner will be generally doubtful, and often unquestionably injurious. In all other cases, when its use is at all indicated (and it is seldom that it is not indicated) it should be administered in small doses, seldom exceeding the quantity of half a grain of calomel once or twice a day: and the plan thus begun should be persevered in for weeks or months—in effect, till a radical cure be obtained, if it be obtainable at all. Into the rationale of this progressive system, we cannot fully enter at present: it may not, however, be amiss to observe, that in every case the chylopoietic organs have a much better chance of being restored to a sound and healthy state by progressive gentleness than by sudden violence; that the permanent solicitation of a comparatively mild stimulus will eventually accomplish what a more forcible system can never produce; and that hence the latter should be reserved for mere cases of decided extremity.

Aperient medicines are almost always necessary, from the great irregularity of the bowels, and generally an habitual propensity to costiveness. Dr. Stone has lately opposed the use of castor oil, which has hitherto been in great vogue, as well from the inaccuracy with which it is generally expressed, as from its acting chiefly on the large, and but little or not at all on the small, intestines. But after all, the patient must determine for himself; for though it may disagree with many constitutions, it will often occur in others, that there is no aperitive that completes its purpose so pleasantly. When castor oil does not agree, a little rhubarb, in combination with neutral salt, in the proportion of a scruple or half a dram of the former, and a dram of the latter, dissolved in mint water, may be resorted to, or the neutral salt alone in double the quantity now prescribed.

Where we have reason to suspect schirrosity of the liver, purgatives are of more consequence than in any other case: and here the more drastic kinds are to be preferred; as jalap, colocynth, and scammony.

Peruvian bark seldom agrees with the stomach in any stage of this disease; but bitter tonics will usually sit easy, and often afford considerable relief. If the pain be violent, opium must necessarily be had recourse to, but never otherwise.

When the sense of sinking in the stomach is distressing, and particularly when this symptom occurs with cardialgia, the best stimulus is the compound spirit of ammonia, in camphor mixture, or in some other light vehicle: this is much less injurious to the digestive organs than æther, or any other strong spirituous preparation, or than aromatic confection, or any other spice in large quantity; and it is frequently useful in conquering the patient's habit of taking high-seasoned dishes; it is sometimes not only useful, but necessary, to be gradual in breaking this habit, and it is commonly best to allow a few glasses of generous wine, requesting the patient at the same time to avoid all spirituous liquor; a little wine is often well applied, as it stimulates him to take food which he would not otherwise touch, and enables him to digest it more easily. Here the diet cannot be too plain and simple: rice is one of the best vegetables, whether in gruel or in a solid form, and should be duly intermixed with animal food, either roasted or boiled, at the patient's option.

Bath water in moderation, and with strict attention to the state of the bowels, often proves an excellent restorative. Soda water is one of the best beverages that can be prescribed. Much walking usually induces dropsy, and should therefore be avoided; moderate exercise, however, is of high importance, and it may be varied with great advantage by riding on horseback, in a carriage, and short excursions on the water.

There are several other diseases, which are also dependant on a vitiated state of the digestive organs, and are peculiarly the objects of dietetic medicine. But, in general, they will be found of less consequence, and more easily subdued: they will be characterised by the slighter symptoms attendant upon those already noticed, and will yield to the common plan of medical regimen prescribed for their cure.

DIFFERENCES, in heraldry, certain additaments to coat armour, whereby something is added or altered, to distinguish younger families from the elder.

Of these differences Sylvanus Morgan gives us nine; *viz.* the label for the first son; the crescent for the second; the mullet, for the third; the martlet, for the fourth; the annulet, for the fifth; the fleur-de-lis, for the sixth; the rose, for the seventh; the eight-foil, for the eighth; and the cross-moline, for the ninth.

Again, as the first differences are single for the sons of the first house or descent, the sons of the younger house are differed by combining or putting the said differences upon each other. As the first differences are the label, crescent, &c. for the first house, the difference for the second house is the label on the crescent for the first of that house; for the third brother of the second house, a mullet on a crescent, &c.

DIFFERENTIAL *calculus*. See CALCULUS.

DIGESTER, an instrument to dissolve solid animal substances, in a manner somewhat similar to that performed by the stomach. The vessel was invented by Papin: hence it is usually called "Papin's Digester." After putting meat into it, together with a sufficient quantity of water, a lid is closely screwed on, so as to admit no external air. By a moderate fire the meat will, in the course of six or eight minutes, be reduced to a perfect pulp: by augmenting the heat of the fire, or extending the time of digestion, the hardest bones may be converted into a jelly. To these machines there is also a safety valve, which should always be kept in good order; for if by any means it is put over the fire, and the valve incapable of opening, the most fatal consequences may happen from the immense power of confined steam.

DIGESTION, in animal economy. An important distinction exists between animals and vegetables, in the mode in which they receive their nourishment. Vegetables are constantly absorbing matter from the soil; it immediately passes into the sap vessels, and is soon changed by respiration and secretion. Animals, on the contrary, with very few exceptions, take in food at intervals, and retain it in their stomach for a considerable time, where it undergoes a chemical change, which constitutes the function of digestion, the first step in the general process by which animal matter is formed. See PHYSIOLOGY.

DIGESTION, in chemistry, an effect produced by the continued soaking of a solid substance in a liquid, with the application of heat.

DIGIT, DIGITUS, in astronomy, the twelfth part of the diameter of the sun or moon, is used to express the quantity of an eclipse. Thus an eclipse is said to be of six digits, when six of these parts are hid.

DIGIT is also a measure taken from the breadth of the finger. It is properly three-fourths of an inch, and contains the measure of four barley-corns laid breadthwise.

DIGITS, in arithmetic, signify any integer under 10, as 1, 2, 3, 4, 5, 6, 7, 8, 9.

DIGITALIS, in botany, English *foxglove*, a genus of the Didynamia Angiospermia class and order. Natural order of Luridæ, Linnæus. Scrophulariæ, Jussieu. Essential character: calyx five-parted: corolla bell-form, five-cleft, bellying; capsule ovate, two-celled. There are twelve species. These are large plants, with alternate leaves and flowers in spikes at the ends of the stem and branches. D. purpurea, purple fox glove, is biennial; the stem is from three to six feet high, upright, leafy, round, pubescent; leaves alternate, acute, veiny, and wrinkled underneath; flowers in a long spike, nodding, imbricate, all directed the same way; peduncles one-flowered, pubescent, thickest at top; calyx also pubescent; corolla purple, the bellying part sprinkled on the inside with spots like little eyes; filaments a little broader at top, crooked at bottom; anthers large, cloven almost to the base, yellowish, and frequently spotted; stigma bifid; nectary a gland, surrounding the base of the germ; seeds dark brown, truncate at both ends. It is a native of Denmark, Germany, Switzerland, Britain, in sandy and gravelly soils; near London it grows plentifully. It flowers from June to August.

DIGITATED, among botanists, an appellation given to compound leaves, each of which is composed of a number of simple foliola, placed regularly on a common petiole; though, strictly speaking, there must be more than four foliola to make a digitated leaf.

DIGNITARY, in the canon law, a person who holds a dignity, that is, a benefice, which gives him some pre-eminence over mere priests and canons. Such is a bishop, dean, archdeacon, prebendary, &c.

DIGNITY, as applied to the titles of noblemen, signifies honour and authority. As the omission of a name of dignity may be pleaded in abatement of a writ, so may it be, where a peer or nobleman, who has more than one name of dignity, is not named by that which is most noble.

DIGYNIA, the name of an order or secondary division in each of the first thirteen classes, except the ninth, in Linnæus's method; consisting of plants, which, to the classic character, whatever it is, add the circumstance of having two styles or female organs.

DILAPIDATION, is where an incumbent of a church living suffers the parsonage-house or out-houses to fall down, or be in decay, for want of necessary rereparations; or it is the pulling down or destroying any of the houses or building belonging to a spiritual living, or destroying of the woods, trees, &c. appertaining to the same; for it is said to extend to committing or suffering any wilful waste, in or upon the inheritance of the church.

DILATATION. See Expansion.

DILATRIS, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: calyx none; corolla six-petalled, hirsute; filaments one less than the other; stigma simple. There are three species, all natives of the Cape.

DILEMMA, in logic, an argument consisting of two or more propositions, which divides the whole into all its parts, or members, by a disjunctive proposition, and then infers something concerning each part, which is finally refered to concerning the whole.

DILL. See Anethum.

DILLENIA, in botany, so named in honour of J. J. Dillenius, professor of botany at Oxford, a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Magnoliæ, Jussieu. Essential character: calyx five-leaved; petals five-cleft; capsule many-seeded; connate, filled with pulp. There are seven species. These are very handsome trees, natives of the East Indies; the leaves are large, and of a leathery substance; the flowers are axillary or terminating, and frequently very large.

DIMENSION, in geometry, is either length, breadth, or thickness; hence a line hath one dimension, *viz.* length; a superficies, two, *viz.* length and breadth; and a body, or solid, has three, to wit, length, breadth, and thickness.

DIMINUTION, in rhetoric, the exaggerating of what you have to say by an expression that seems to diminish it.

DIMINUTIVE, in grammar, a word formed for some other, to soften or diminish the force of it, or to signify a thing is little in its kind. Thus cellule is a diminutive cell, globule of globe, hillock of hill.

DIMORCARPUS, in botany, a genus of the Octandria Monogynia class and order. Calyx five-cleft; corolla five petalled; berries two, one-seeded, large. One species, found in China.

DIMORPHA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: petals one large convolute, in place of the keel; standard and wings none. There are three species, natives of the woods and banks of rivers of Guiana.

DIOCESE, the circuit of every bishop's jurisdiction. For this realm hath two sorts of divisions; one into shires or counties, in respect to the temporal state; and another into provinces, in regard to the ecclesiastical state; which provinces are divided into dioceses. The provinces are two, Canterbury and York; whereof Canterbury includes twenty-one dioceses, or sees of suffragan bishops; and York three, besides the bishopric of the Isle of Man, which was annexed to the province of York by king Henry the Eighth.

DIODIA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Stellatæ. Rubiaceæ, Jussieu. Essential character: corolla one-petalled; funnel-form; capsule two celled, two-seeded. There are six species, most of them natives of the West-Indies.

DIODON, in natural history, a genus of fishes of the order Cartilaginei. Generic character; jaws bony and undivided; aperture of the gills linear; body covered on all sides with long moveable spines; no ventral fins. There are three species according to Gmelin, and five according to Shaw.

D. hystrix, or the sea porcupine, as it is termed popularly, grows to nearly two feet in length, and inhabits the Indian and American seas. In some of the West India islands it is used for food, but, in general, is little valued. Its resemblance to the porcupine and hedge-hog, and likewise to the sea-urchinus, is considerable, both in appearance and manners. It possesses the faculty of raising and depressing its spines at pleasure, and likewise of flattening its body, or extending it to a globular form, and is often fished for with a rod and line, merely for the sake of the curious spectacle it exhibits by these violent alternations. On first perceiving the hook, it appears agitated by the extreme of rage. Its spines are erected with the utmost intenseness, and its body is swelled to the form of a ball, and thus, for a considerable time, it moves rapidly in various directions, as if surprised and maddened by the failure of all its efforts at revenge and extrication. Being at length exhausted, its spines are levelled, and the air is expelled from its body, which, from the form of a globe, assumes that of a wafer. Its strength, however, is partially renewed before it is drawn on shore, and it exhibits again all the intensity and fierceness of its agitation in the repetition of the symptoms above described, in which state it is thrown upon the land, and there suffered for some time to remain, till the languors of death prevent the possibility of injury, and extinguish at once its resentments and vitality. See Pisces, Plate IV. fig. 1.

DIŒCIA, two houses. The name of the twenty-second class in Linnæus's sexual method, consisting of plants, which, having no hermaphrodite flowers, produce male and female flowers on separate roots. These latter only ripen seeds, but require, for that purpose, according to the sexualists, the vicinity of a male plant, or the aspersion of the male dust. From the seeds of the female flowers are raised both male and female plants. The plants then, in the class diœcia, are all male or female; not hermaphrodite, as in the greater number of classes; or with male and female flowers upon one root, as in the class monœcia of the same author.

DIOMEDEA, the *albatross*, in natural history, a genus of birds of the order Anseres. Generic character: bill strong, bending in the middle, and hooked at the end of the upper mandible; the lower mandible truncated; nostrils oval, wide, prominent, and covered with a large convex guard; tongue hardly perceivable; toes three, and all placed forward. There are four species, of which we shall notice, the

D. exulans, or the wandering albatross. This bird is an inhabitant of not only many countries between the tropics, but also beyond them, both to the north and south. It is found in Kamtschatka, and is particularly abundant at the Cape of Good Hope. Its weight is from twelve to twenty-eight pounds; its length is occasionally four feet, and its extent, from wing to wing, ten. Its sounds are harsh, and thought not a little to resemble the braying of an ass. Its arrival at Kamtschatka is regarded as an infallible presage of the speedy arrival of shoals of fish, and upon these, however emaciated when it arrives, it fattens within a very short time. It feeds, indeed, with uncommon voracity, and will often attempt to swallow a fish of four pounds weight; the tail, however, of the fish protrudes from the mouth of the bird till the head is digested, and in the interval, the bird is so unwieldy and defenceless, that it is easily destroyed by the natives. It quits Kamtschatka in August, never having been certainly known to build there. In Patagonia and the Falkland Islands its nest is made on the ground, with earth, a foot in height and of a circular figure. While the female sits, the male is incessant in his assiduities to provide for her subsistence, and both are so tame as to permit any person to push them from their nest, and deprive them of their eggs, without the slightest resistance. The hawk is perpetually vigilant for the removal of the female, during which it darts on her nest, and purloins her treasure. The grey gull takes a more daring aim, and assails the albatross itself, attacking it beneath, to prevent which, that bird, when in danger from this gull, flies immediately to the water, and seldom leaves the surface for distant flights, unless in the seasons of its migration. The nests of the albatross, when vacated by them, are immediately occupied by the penguin. Albatrosses have been seen by voyagers at the distance of 600 leagues from land. For the albatross, see AVES, Plate VI. fig. 3.

DIONÆA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Gruinales. Essential character: calyx five-leaved; petals five; capsule one-celled, gibbous, containing many seeds. There is but one species, *viz.* D. mucipula, Venus's fly-trap, a native of North Carolina, in swampy places.

DIOPHANTINE *problems*, are certain questions relating to square and cubic numbers, and to right-angled triangles, &c. the nature of which were first and chiefly treated of by Diophantes in his algebra.

In these questions it is chiefly intended to find commensurable numbers to answer indeterminate problems; which often bring out an infinite number of incommensurable quantities. For example, let it be proposed to find a right-angled triangle, whose three sides x, y, z, are expressed by rational numbers; from the nature of the figure it is known that $x^2 + y^2 = z^2$, where z denotes the hypothenuse. Now it is plain that x and y may also be so taken, that z shall be irrational; for if $x = 1$, and $y = 2$, then is $z = \sqrt{5}$.

Now the art of resolving such problems consists in ordering the unknown quantity or quantities in such a manner, that the square or higher power may vanish out of the equation, and then, by means of the unknown quantity in its first dimension, the equation may be resolved without having recourse to incommensurables. *e. g.* let it be supposed to find x, y, z, the sides of a right-angled triangle, such as will give $x^2+y^2=z^2$. Suppose $z=x+u$, then $x^2+y^2=x^2+2\times u+u^2$; out of which equation x^2 vanishes, and $x = \frac{y^2-u^2}{2u}$: then assuming y and u equal to any numbers at pleasure, the sides of the triangle will be $y, \frac{y^2 \times u^2}{2u}$ and the hypothenuse $x + u = \frac{y^2 \times u^2}{2u}$; if $y = 3$, and $u = 1$, then $\frac{y^2-u^2}{2u} = 4$, and $x+u= 5$. It is evident that this problem admits of an infinite number of solutions.

DIOPSIS, in natural history, a genus of insects of the order Diptera. Generic character: head with two inarticulate filiform horns, bearing the eyes and antennæ. There are three species, *viz.* D. ichneumonea, which resembles the ichneumon, and is found in Guinea. D. nigra, described by Illiger, found on the coast of Sierre Leone. D. brevicornis, peduncles of the eyes not longer than the distance between their bases, they are brown; head, posterior spines, and feet pale yellow; poisers white; thorax fuscous; lateral spines and abdomen black; fore thighs much thickened, with the shanks brown, and pale yellow joints; wings fasciated near the apex.

The last species of this truly singular genus of insects we had the good fortune to discover, early in the month of May last, on the banks of the Wissahickon, within a few miles of Philadelphia: it had perched upon the leaf of the swamp cabbage (Pothos Fœtida) and is now in the collection of the writer of this article.

DIOPTRICS, the science of refractive vision, or that part of optics which considers the different refractions of light in its passing through different mediums, as air, water, glass, &c. and especially lenses. See OPTICS.

DIOSCOREA, in botany, English *yam*, a genus of the Dioecia Hexandria class and order. Natural order of Sarmentaceæ. Asparagi, Jussieu. Essential character: male, calyx six-parted; corolla none. Female, calyx six-parted; corolla none; styles three: capsule three-celled, compressed; seeds two, membranaceous. There are fifteen species. These plants have usually tuberous perennial roots, with twining stems from right to left; flowers axillary, in spikes or racemes, Several of these species are natives of the East and West Indies, where they are cultivated for food.

DIOSMA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Rutaceæ, Jussieu. Essential character: corolla five-petalled; nectaries five on the germ; capsule three or five conjoined: seeds veiled. There are nineteen species. These are all shrubs, bearing the resemblance of heaths. The leaves are either opposite or scattered, frequently crowded and linear, sometimes having the edge underneath dotted. The flowers are in corymbs, or heads, at the ends of the branches. The calyxes of some are glandulous and dotted. They are natives of the Cape of Good Hope.

DIOSPYNAS, in botany, a genus of the Polygamia Dioecia class and order. Natural order of Bicornes. Guaiacanæ, Jussieu. Essential character: hermaphrodite; calyx four-cleft; corolla pitcher-shaped, four-cleft; stamina eight; style four-cleft; berry eight-seeded. Male, calyx, corolla, and stamina of the other. There are nine species, of which D. lotus, European date plum, is a small tree, six feet high, with spreading branches: leaves ovate lanceolate, quite entire, large, alternate, smooth, with oblique prominent ribs; flowers pale, terminating, solitary, with a large leafy calyx four or five parted, flat, permanent; berry round, half an inch in diameter, yellow, lanuginose, one-celled, containing eight oblong compressed bony seeds, with very little pulp. The broad-leaved variety grows up into very large trees in the southern parts of Caucasus. It is also found abundantly on the whole coast of the Caspian Sea.

DIP, of the horizon, is an allowance made in all astronomical observations of altitude for the height of the eye above the level of the sea.

DIPHTHONG, in grammar, a double vowel, or the mixture of two vowels pronounced together, so as to make one syllable.

DIPHYSA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: calyx half five-cleft; legume with a bladder on each side; seeds hooked. There is but one species, *viz.* D. carthaginensis, a small tree about ten feet in height, approaching to the arborescent mimosas. It is common every where about Carthagena in New Spain, flowering in August and September.

DIPLOMA, an instrument or licence given by colleges, societies, &c. to a clergyman to exercise the ministerial function, or to a physician to practise the profession, &c. after passing examination, or admitting him to a degree.

DIPLOMATIC *letters*. The art of reading letters written in cypher must be founded on the knowledge of the art of writing according to this method of concealment. In examining a piece in newly invented characters, we should endeavour to ascertain whether the number of the characters correspond, or nearly so, with the ordinary number of alphabetical letters. We may sometimes detect a weakness in the writer of having selected his most simple marks, either for the vowels or the first letters of the alphabet, and his complex marks for the consonants, or the letters most remote from *a, b, c,* &c. We must observe which of the characters, whether taken singly or combined, occur the oftenest in the whole specimen; and of these probably the most frequent will represent *e, a, i, o*; *e* being much more common than the rest of the vowels, but *u* and *y* are even less frequent than many of the consonants.

Endeavour next to ascertain the beginning and ending of words, which are sometimes distinguished by spaces or points, or the insignificant marks or nulls interposed; but, however it be done, you must expect these signs to occur after every few letters, and the frequency of their occurrence may serve as some guide.

When you have found out the distinction between words, take particular notice of the order, number, frequency, and combination of the letters in each word; and first examine the characters of which the shortest monosyllables are composed. Remember, 1. That no word can be without a vowel: a word of one letter must therefore be a vowel, or a consonant with an apostrophe. 2. That the vowels are more frequently doubled at the beginning of words than the consonants: indeed the latter are only doubled at the beginning of Spanish and Welsh words. 3. That the vowels mostly exceed the consonants in short words; and when the double consonants are preceded by a single letter, that letter is a vowel. 4. That the single consonant which precedes or follows double consonants is *l, m, n,* or *r*. 5. That the letter *q* is always followed by *u*; and when two different characters occur, the latter of which is often joined with other letters, but the former never found alone, nor joined with any than the latter, those characters stand for *qu*, which two, except in a few Scotch names, are always followed by a vowel. 6. That, although every language has something peculiar in its structure, the foregoing observations will apply with little variation to all the European languages.

In the English let it be remarked, that *and* and *the* are more often found than any other words; *h* is frequently preceded by *w*, *c*, *s*, and *t*; *y* is seldom used in the middle of a word; the double letters *ll* and *ss* appear frequently at the end of words; *ed*, *ty*, *ly*, *ing*, and *tion*, are very common terminations; *em*, *in*, *com*, and *con*, are frequent prepositions; *a*, *i*, and *o* may stand alone; *o* is often followed with *r*; *e* is much more frequent in the beginning and end of words than in the middle; and in English the *e* is continually employed, as in *yes*, *yet*, *her*, *never*, *me*, *we*, *he*, *the*, *she*, *they*, *ye*, *fee*, *see*, *be*, *ever speed*, *need*, *deference*, *excel*, *excess*, &c. Though this will not hold good in Latin, as *e* and *i* are equally frequent in the latter, and next to these *a* and *u*; but *o* not so common as any of them: and yet in the Spanish and Italian the *o* occurs very frequently. When you meet with a character doubled in the middle of a word of four letters, it will be necessary to consider what words of four letters are so spelled. It is probable the vowels *e* or *o* are these; as *meet*, *feel*, *good*, *book*, *look*, &c. In polysyllables, where a double character appears in the middle of a word, it is for the most part a consonant; and if so, the preceding letter is always a vowel.

Observe also, that *i* in English never terminates a word, nor *a* or *u*, except in *flea*, *sea*, *you*, or *thou*: again, by comparing the frequency of the letters, you will generally find *e* occurs the oftenest; next *o*, then *a* and *i*; but *u* and *y* are not so often used as some of the consonants, especially *s* and *t*. Among the vowels *e* and *o* are often doubled; the rest scarce ever; and *e* and *y* often terminate words; but *y* is much less frequ ent, and consequently easily distinguished.

To find out one consonant from another, you must also observe the frequency of *d*, *h*, *n*, *r*, *s*, *t*; and next to these, *c*, *f*, *g*, *l*, *m*, *w*; in a third rank may be placed *b*, *k*, *p*, and lastly *q*, *x*, *z*. This remark, however, belongs to English; for in Latin common consonants are the *l*, *r*, *s*, *t*; next *c*, *f*, *m*, *n*; then *d*, *g*, *h*, *p*, *q*; and lastly *b*, *x*, *z*. But the difficulty is to come at the knowledge of three or four letters; therefore, where a word of four letters has the first and fourth the same, it it most likely to be *that*: to discover which look for another of four letters, beginning with the two first, and ending with two others, and it will probably prove to be *this*; and more especially if you find another, with three letters, beginning with the two first; for in that case it must be *the*. Now, having found out in any part of the cypher these three words, *that*, *this*, and *the*, place them over the characters which you know to be *t*, *h*, *a*, *i*, *s*, *e*, and then consider what letters are deficient, and what words, from the number of letters that composed them, they are most likely to be. You will thus find such ready and surprising intimations from the above six letters previously discovered, that you will soon be in possession of the whole alphabet.

When words of two letters appear of the same characters, differently placed, it is most likely one is *on* and the other *no*: so *of*, and *for*, and *from*, discover and ascertain each other; and *th* are very often used in the beginning of English words, as *the*, *that*, *this*, *then*, *these*, *their*, *thirst*, &c. &c.

Besides these peculiarities, Mr. Falconer points out the following, as applicable to the English.

Beginning a word,	is regularly followed by
A	most of the letters.
B	*a*, *e*, *i*, *l*, *o*, *r*, *u*, *y*.
C	*a*, *e*, *h*, *i*, *l*, *o*, *r*, *u*.
D	*a*, *e*, *i*, *o*, *r*, *u*.
E	most of the letters.
F	*a*, *e*, *i*, *l*, *o*, *r*, *u*, and sometimes *y*.
G	*a*, *e*, *h*, *i*, *l*, *n*, *o*, *r*, *u*, *y*.
H	vowels only.
I	most of the letters.
K	*a*, *e*, *i*, *n*.
L	vowels only.
M	vowels only.
N	vowels only.
O	most of the letters.
P	*a*, *e*, *h*, *i*, *l*, *o*, *r*, *s*, sometimes *t*, *u*, *y*.
Q	only by *u*, and *qu*, by *a*, *e*, *i*, *o*.
R	*a*, *e*, sometimes *h*, *i*, *o*, *u*, *y*.
S	*a*, *c*, *e*, *h*, *i*, *k*, *l*, *m*, *n*, *o*, *p*, *q*, *t*, *u*, *w*, *y*.
T	*a*, *e*, *h*, *i*, *o*, *r*, *u*, *w*, *y*.
U	sometimes *d*, and *g*, *l*, *m*, *n*, *p*. sometimes *r*, *s*, *t*, *x*.
V	vowels only.
W	*a*, *e*, *h*, *i*, *o*, *r*, *y*.
X	sometimes *a* or *e*.
Y	*e*, sometimes *i*, *o*.
Z	*e*, sometimes *o*.

It would be two prolix in us to give an equally minute account of the particularities of other languages; but the inquisitive reader will find them very well specified in the "Cryptographia Denudata" of D. A. Conard, 8vo. Lug. Bat. 1739, and in the latter part of Breithaupt's "Ars Decifratoria, sive Scientia occultas Scripturas solvendi et legendi," Helmst. 12mo. 1737.

To excercise the English scholar, we here subjoin one example of plain cyphering, in which two figures answer to each letter: 39. 38, 31, 21, 35. 35, 14, 20, 18, 21, 19, 20, 35, 34. 20, 38, 39, 19. 32, 35, 31, 35, 18. 22, 39, 20, 38. 13, 31, 14, 24. 20, 38, 39, 14, 37, 19. 31, 19. 20, 15. 20, 38, 35. 13, 31, 14, 31, 37, 39, 14, 37. 15, 36. 20, 38, 35. 31, 36, 36, 31, 39, 18. 18, 35, 17, 21, 39, 19, 39, 20, 35. 36, 15, 18. 24, 15, 21. 20, 15, 11, 14, 15, 22. 18, 35, 13, 35, 13, 32, 35, 18. 20, 38, 31, 20. 15, 14. 14, 15. 31, 33, 33, 15, 21, 14, 20. 24, 15, 21. 36, 31, 39, 12. 20, 15. 13, 35, 35, 20. 13, 35, 31, 20. 14, 39, 14, 35. 20, 15, 13, 15, 18, 18, 15, 22. 14, 39, 37, 38, 20. 36, 15, 18. 22, 35. 13, 21, 19, 20. 14, 15, 20. 14, 15, 22. 34, 35, 12, 31, 24. 20, 38, 35. 19, 21, 18, 16, 18, 39, 25, 35. 15, 36. 20, 38, 35. 33, 31, 19, 20, 12, 35. 22, 38, 35, 14. 20, 38, 39, 14, 37, 19. 31, 18, 35. 39, 21, 19, 20. 18, 39, 16, 35. 36, 15, 18. 35, 23, 35, 33, 21, 20, 39, 15, 14.

By practising the foregoing rules, the student will find that this method of secret writing in plain cypher may, with as much ease, if not as much speed, be decyphered as written.

In all cases, begin first to decypher the single characters and shortest monosyllables; mark down on a separate paper any corresponding signs and letters you discover, and count the different characters throughout the piece, in order to compare their frequency, &c. It will generally, if not always happen, that the most frequent is *e*.

In the whole of the preceding instructions it may be observed, that the suppositions of a single alphabet, and of the spaces between the words being discoverable, or the nulls, few have been made throughout. But it may happen that the spaces may have been very artfully concealed; that the nulls may be at least as many as the significant characters; and that both the one and the other, being more numerous than the letters of an alphabet, may be intermixed, not only at the ends but in the body of all short words, and made to recur by a system of periodcial change which shall ease the writer of the burthen of their number, and nevertheless prevent the decypherer from having any considerable portion of similar writing to operate upon. When these and other difficulties are opposed to the exercise of the rules above laid down, the decypherer will have an opportunity of exercising his natural or acquired sagacity; and though the advantage may be on the side of the writer, yet the patience and continued trials of the decypherer will, in actual business, be often rewarded by discoveries, at which he himself will look back with surprise.

DIPLOMATICS, a word derived from diploma, in this instance signifying the King's letters patent, for the immediate expediting of an ambassador or envoy to a foreign court. The art of diplomatics has been cultivated with great assiduity by every nation in Europe for very many years past, and men experienced in political history, of engaging manners, and possessing a considerable share of duplicity, have always been selected by each to practise it. The principal aim of the *corps diplomatique* (as the French term ambassadors) is, to discover the movements and intentions of their brethren, and to conceal their own; in order to accomplish this purpose, artifice, bribery, deceit, and prevarication, are more frequently necessary than open and manly conduct. This art has produced changes in states surprising and calamitous, and often counteracted the hostile intentions of neighbouring nations; nor was it ever better understood and practised than at the present moment, as the sudden friendships, and unexpected enmities, of the courts of Europe daily evince.

DIPPING, among miners, signifies the interruption, or breaking off, of the veins of ore; an accident that gives them a great deal of trouble before they can discover the ore again.

Dipping *needle*. See Magnetism.

DIPSACUS, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Aggregatæ. Dipsaceæ, Jussieu. Essential character: calyx common, many leaved; proper superior; receptacle chaffy. There are four species; these are biennial, tall, herbaceous plants, prickly, terminated by rough heads of flowers; the leaves are sometimes connate at the base, forming a basin. D. fullonum, cultivated teasel, is reared in great quantities in the West of England, for raising the nap upon woollen cloths, by means of the crooked awns or chaffs upon the heads, which, in the wild sort, are straight. For this purpose they are fixed upon the circumference of a large broad wheel, which turns round while the cloth is held against them.

DIPTERA, in natural history, an order of insects in the Linnæan system. This order contains such insects as are furnished with two wings only; such as flies, gnats, and a variety of other insects. Under each wing is a clavate poiser or balancer, with its appropriate scale. There are two sections, 1. A. with a proboscis and sucker, containing the following genera, *viz.*

Conops	Musca
Diopsis	Tabanus
Empis	Tipula

and B. with a sucker, but no proboscis: of this there are also six genera, *viz.*

Asilus	Hippobosca
Bombylius	Oestrus
Culex	Stomoxys.

DIPTERYX, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: calyx two upper segments winged; legume ovate, compressed, one-seeded. There are two species, *viz.* D. odorata, Coumarouna, and D. oppositifolia, Taralea. These are both tall trees; about sixty feet high; very much branched at top; the leaves are large, alternate, and pinnate; the leaflets are perfectly entire, two or three on each side, affixed alternately on the midrib; the flowers are borne in racemes; which are axillary and terminal; their colour is purple, streaked with violet. The almonds are fragrant, and are put by the Creoles into chests, in order to drive away insects, as well as for the sake of their smell. They are both natives of South America.

DIPUS, the *jerboa*, in natural history, a genus of Mammalia, of the order Glires. Generic character: two front teeth in the upper and in the under jaw; fore legs very short, hind legs very long; clavicles in the skeleton; tail long and tufted at the tip. Shaw enumerates six species, and Gmelin ten.

D. sagitta, or the Egyptian jerboa of Pennant, is about the size of a rat, and was known to the ancients by the name of the two-footed mouse. It is to be met with in various parts of Africa, and in the eastern provinces of Siberia. In its posture and movement it greatly resembles a bird. It stands on its hind feet, and rarely applies its fore feet to the ground, employing them almost exclusively in applying food to its mouth, in the same manner as the kanguroo. It inhabits subterraneous apartments prepared by itself, or found accommodated for its purpose, and reposes in them during the greater part of the day, choosing the night for excursion and food. It is, in the tropical climates, susceptible of cold, feeds upon various vegetables, such as it can procure amidst the barren and sandy wilds, which it prefers for its habitation, and burrows with such extreme facility, that, in a state of confinement, it will, in no long time, work a passage through a wall of brick. M. Sonnini considers the jerboa as constituting a link between quadrupeds and birds. The beginning of the connection between the former and the latter is considered by Shaw as formed by the jerboa, and the last link as completed in the bat. In the sand and ruins about Alexandria the jerboa is very frequently to be found. It is, however, extremely shy, retiring on the slightest alarm to its habitation, and the common mode of destroying them among the Arabs, as related by Sonnini, is by stopping up all the accesses to their residence but one, and watching their egress at that. In Egypt they are used as food. M. Sonnini kept several in a cage for a considerable time, feeding them on walnuts and other fruits. They appeared extremely fond of basking in the sun, and indeed, in the sunshine, were often extremely alert and playful. They were mild in their dispositions even in feeding, shewing no tendency to quarrelsomeness, or ferocity; but, on the other hand, they exhibited little or no susceptibility of gratitude or attachment, of joy or fear, and their manners were characterised by a cold and stupid indifference. See Mammalia, Plate IX. fig. 5.

D. Canadensis, is an inhabitant of North America, particularly the northern states. This is the smallest species of the jerboa, being about the size of a mouse. General Davies had several specimens in his possession, and his account of this curious animal is to be found in the fourth volume of the transactions of the Linnæan Society. In company with several other gentlemen, the General caught one of these jerboas, in a large field, after an hour's chase, during which the little creature took the extraordinary leaps of from three to five yards in almost uninterrupted succession, sinking, however, at length, under fatigue from such wonderful exertions. Its food could not be ascertained by the General, who offered it a great variety, no article of which it appeared at all disposed to touch, and the day after its seizure it died, overwhelmed, probably, by its extreme efforts to escape from its pursuers. It is sometimes found dormant, and in this state, probably, passes the winter in the rigorous climate of Canada. A specimen of it in this state was brought to the General, after having been found by a labourer, whose spade struck against a substance, about the size of a cricket ball, which, on examination, was found to inclose a jerboa, completely rolled up, and in a state of torpor. The ball was found about a foot and a half under the surface of the ground, was perfectly smooth internally, and about an inch in thickness. This case, which was composed of clay, was somewhat mutilated by the accidental blow of the workman, but was deposited by the General, with its contents, in his room, in a small box supplied with some cotton, in hopes that, as the warm season advanced, the animal would revive from its suspended vitality. This hope, however, was not gratified. As the jerboa is not seen in Canada from October till May, it may be concluded that it passes the winter in this curious envelope. See Mammalia, Plate IX. fig. 6.

DIRCA, in botany, a genus of the Octandria Monogynia class and order. Natural order of Vepreculæ. Thymeleæ, Jussieu. Essential character: calyx none; corolla tubulous, with an obscure border; stamina longer than the tube; berry one-seeded. There is only one species, *viz.* D. palustris, marsh-leather wood, a native of North America.

DIRECTION, in mechanics, signifies the line or path of a body's motion, along which it endeavours to proceed, according to the force impressed upon it.

DIRECTOR, in commercial polity, a person who has the management of the affairs of a trading company: thus we say, the directors of the India company, South-sea company, &c.

Director, in surgery, a grooved probe, to direct the edge of the knife or scissars, in opening sinuses, or fistulæ, that by this means the subjacent vessels, nerves, and tendons, may remain unhurt.

DIRGE, in music, a solemn and mournful composition performed at funeral processions. The dirge was in very general use with the ancients, and was numerously filled both by voices and instruments.

DIRIGENT, or *directrix*, a term in geometry, signifying the line of motion, along which the describent line or surface is carried in the genesis of any plane or solid figure.

DIS, an inseparable particle prefixed to divers words, the effect whereof is either to give them a signification contrary to what the simple words have, as *disoblige*, *disobey*, &c. or to signify a separation, detachment, &c. as *disposing*, *distributing*, &c.

DISA, in botany, a genus of the Gynandria Diandria class and order. Natural order of Orchideæ. Essential character: spathe one valved; petals three, two parted, gibbous at the base. There are four species. These are all natives of the Cape.

DISABILITY, an incapacity in a man to inherit or take a benefit which otherwise he might have done, which may happen four ways; by the act of the ancestor, by the act of the party, by the act of law, and by the act of God. 1. Disability by the act of the ancestor; as, if a man be attainted of treason or felony: by this attainder his blood is corrupt, and himself and his children disabled to inherit. 2. Disability by the act of the party himself; as, if one make a feoffment to another who then is sole, upon condition that he shall enfeoff a third before marriage, and before the feoffment made, the feoffee takes a wife; he hath by that disabled himself to perform the condition according to the trust reposed in him, and therefore the feoffer may enter and oust him. 3. Disability by act of law, is when a man by the sole act of the law is disabled, as an alien born, &c. 4. Disability by the act of God, is where a person is of non-sane memory, and in cases of idiocy, &c. But it is a maxim in our law, that a man of full age shall never be received to disable his own person.

DISANDRA, in botany, a genus of the Heptandria Monogynia class and order. Natural order of Pediculares, Jussieu. Essential character: calyx seven-leaved; corolla seven-parted, flat; capsule two-celled. There are two species, *viz.* D. prostrata, trailing disandria, and D. africana; the former a native of Madeira, the latter of Africa.

DISC, in astronomy, the body and face of the sun and moon, such as it appears to us on the earth; or the body or face of the earth, such as it appears to a spectator in the moon, &c. The disc in eclipses is supposed to be divided into twelve equal parts, called digits: in a total eclipse of the luminaries, the whole disc is obscured; in a partial eclipse, only a part thereof.

DISCORD, in music, a dissonant and inharmonious combination of sounds, so called in opposition to the concord. Among various other discords are those formed by the union of the fifth with the sixth, the fourth with the fifth, the seventh with the eighth, and the third with the ninth and seventh.

DISCOUNT, a compensation for the advance of money which is not due till after a certain period. The person advancing the money, had he retained it, might have made in the given time a certain rate of interest; therefore, if he advances it for the use of another, it is equitable that he should be allowed the same gain as he would have made by retaining it in his own hands during the time for which it is lent. Thus, if a person is entitled to 100*l.* at the end of a year, and has occasion for the money immediately, the sum that ought to be given as an equivalent thereto, allowing 5 per cent. interest, is 95*l.* 4*s.* 9¼*d.*; for the discount of is 4*l.* 15*s.* 2¾*d.* which is then retained, will, if improved at 5 per cent. interest, amount at the end of the year to 5*l.* and consequently the lender having then 105*l.* will have made the same gain as he would have made by retaining the money. This is the true principle of discount, according to which the tables published by Mr. Smart are computed; but in commercial transactions, the general mode is, to deduct from the sum to be discounted, the simple interest on that sum for the time for which it is advanced. Thus, if 100*l.* is payable at the end of six months, the discount deducted is 2*l.* 10*s.* being the half of a year's interest; or, if 100*l.* is payable at the end of one month, the discount deducted is 8*s.* 4*d.* being the twelfth part of a year's interest. By this means, although the legal rate of interest to be received for money lent is restricted to 5 per cent. the person who employs his money in discounting makes a greater rate of interest, and the shorter the periods are for which he discounts, the greater his annual gains. In discounting bills of exchange, the days of grace are included in the time the bill has to run, the discount being calculated to the day on which the money is receivable.

Discounting of bills of exchange is one of the modes in which bankers employ the money placed in their hands; they generally discount at 5 per cent. but in time of peace, when the current prices of the public funds are high, they are often willing to discount at 4½ or 4 per cent. The bank of England, and other public banks, likewise employ very considerable sums in discounting: the bank of England never discount any bills which have more than 65 days to run.

Discount is likewise used for certain customary allowances made by manufacturers, and wholesale dealers, to those who purchase goods of them in order to sell retail. In some trades this discount is merely in lieu of credit, in others it is made on all goods sold, whether for immediate payment, or on credit; and is very different on different articles, being on some not more than 1 or 2 per cent. while on others it amounts to 50, and sometimes more than 60 per cent.

DISCRETE, or *Disjunct Proportion*, is when the ratio of two or more pairs of numbers or quantities is the same, but there is not the same proportion between all the four numbers. Thus, if the numbers 3 : 6 : : 8 : 16 be considered, the ratio between 3 : 6 is the same as that betwen 8 : 16, and therefore the numbers are proportional; but it is only discretely or disjunctly, for 3 is not to 6 as 6 to 8; that is, the proportion is broken off between 8 and 3, and is not continued as in the following continual proportionals, 3 : 6 : : 12 : 24.

DISCRETE *quantity*, such as is not continuous and joined together. Such is a number, whose parts being distinct units, cannot be united into one continuum; for in a continuum, there are no actual determinate parts before division, but they are potentially infinite.

DISCUSSION, in matters of literature, signifies the clear treating or handling of any particular point or problem, so as to shake off the difficulties with which it is embarrassed: thus we say, such a point was well discussed, when it was well treated of and cleared up.

DISEASE, in medicine, the state of a living body, wherein it is deprived of the exercise of any of its functions, whether vital, natural, or animal. See MEDICINE.

DISGUISE, a counterfeit habit. Persons doing unlawful acts in disguise are, by our statutes, sometimes subjected to great penalties, and even declared felons. Thus, by an act, commonly called the black act, persons appearing disguised and armed in a forest, or grounds inclosed, or hunting deer, or robbing a warren or a fish-pond, are declared felons.

DISH, among miners, denotes a wooden measure, wherein they are obliged to measure their ore: it is kept by the bar-master, and contains about 672 solid inches.

Disjunctive *proposition*, in logic, is that where, of several predicates, we affirm one necessarily to belong to the subject, to the exclusion of all the rest, but leave that particular one undetermined. Such is the major of the following disjunctive syllogism.

The world is either self-existent, or the work of some finite, or of some infinite being.
But it is not self-existent, nor the work of a finite being.
Therefore it is the work of an infinite being.

DISPATCH, a letter sent abroad by a courier on some affair of state, or other matter of importance. The business of dispatches lies upon the ministers of state and their clerks.

DISPENSARY, a charitable institution, very common in London and some other large towns of Britain. They are supported by voluntary subscriptions, and each has one or more physicians, surgeons, and apothecaries, who attend, or ought to attend, at stated times, in order to prescribe for the poor, and if necessary to visit them at their own habitations. The poor are supplied with medicines gratis. Where these institutions are managed with care, they are of the utmost importance to society, it being unquestionably more for the comfort of the sick to be attended at their own houses, than to be dragged from their families to an hospital.

DISPENSATORY, denotes a book containing the method of preparing the various kinds of medicines used in pharmacy. Such are the London, Edinburgh, and Dublin pharmacopæias.

DISPLAYED, in heraldry, is understood of the position of an eagle, or any other bird, when it is erect, with its wings expanded or spread forth.

DISPOSITION, in rhetoric, the placing words in such an order as contributes most to the beauty, and sometimes even to the strength, of a discourse. See Rhetoric.

DISSECTION, in anatomy, the cutting up a body with a view of examining the structure and use of the parts. See Anatomy.

DISSEISIN, is a wrongful putting out of him that is seized of the freehold, which may be effected either in corporeal inheritances, or incorporeal. Disseisin of things corporeal, as of houses and lands, must be by entry and actual dispossession of the freehold. Disseisin of incorporeal hereditaments cannot be an actual dispossession, for the subject itself is neither capable of actual bodily possession, or dispossession, but is only at the election and choice of the party injured, if, for the sake of more easily trying the right, he is pleased to suppose himself disseised. And so also even in corporeal hereditaments, a man may frequently suppose himself to be disseised, when he is not so in fact, for the sake of entitling himself to the more easy and commodious remedy of an assize of novel disseisin, instead of being driven to the more tedious process of a writ of entry.

DISSENTERS, in church history, are a numerous body of people in this country, who made their first appearance in Queen Elizabeth's time, when, on account of the extraordinary purity which they proposed in religious worship and conduct, they were reproached with the name of Puritans. They increased in numbers by the act of uniformity, which took place on Bartholomew's day 1682, in the reign of Charles II. By this act 2000 ministers of the establishment, refusing to conform to certain conditions, were obliged to quit their livings, and hence arose the name of Non-conformists. The descendants of these are known by the name of Protestant Dissenters: they may be considered in general as divided into the denominations of Presbyterians, Independents, and Baptists, which see.

The principles, on which Dissenters separate from the Church of England, are the same with those on which she separates herself from the Church of Rome; these are, the right of private judgment; liberty of conscience; and the perfection of scripture as a christian's only rule of faith and practice. Dr. Taylor, speaking of the Dissenters who were ejected in 1662, says, "They were men prepared to lose all, and to suffer martyrdom itself, and who actually resigned their livings, rather than desert the cause of civil and religious liberty, which, together with serious religion, would, I am persuaded, have sunk to a very low ebb, had it not been for the noble stand which these worthies made against imposition upon conscience, profaneness, and arbitrary power. They had the best education England could afford, most of them were excellent scholars, judicious divines, pious, faithful, and laborious ministers, undaunted and courageous in their master's work, standing close to their people in the worst times, diligent in their studies, solid, affectionate, powerful, awakening preachers, aiming at the advancement of real vital religion in the hearts and lives of men, which flourished wherever they had influence."

Before the revolution, many statutes were in force against Dissenters, but by William I. stat. 1. cap. 18. commonly called the "Toleration Act," it is enacted that none of the acts made against persons dissenting from the Church of England (except the Test Acts 25 Charles II. cap. 2. and 30 Charles II. stat. 2. cap. 1.) shall extend to any person dissenting from the Church of England, who shall at the general sessions of the peace, to be held for the county or place where such person shall live, take the oath of allegiance and supremacy, and subscribe the declaration against popery, of which the court shall keep a register; and no officer shall take more than 6d. for registering the same, and 6d. for a certificate thereof, signed by such officer. Provided that the place of meeting be certified to the bishop of the diocese, or to the archdeacon of the archdeaconry, or to the justices of the peace at the general or quarter sessions; and the register or clerk of the peace shall register on record the same, and give certificate thereof to any one who shall demand the same; for which no greater fee than 6d. shall be taken; and provided that, during the time of meeting the doors shall not be locked, barred, or bolted.

Dissenters chosen to any parochial or ward offices, and scrupling to take the oaths, may execute the office by deputy, who shall comply with the law in this behalf. But it seems they are not subject to fine, on refusing to serve corporation offices; for they may object to the validity of their election, on the ground of their own non-conformity.

DISSONANCE, in music, the effect which results from the unison of two sounds not in accord with each other.

DISSYLLABLE, among grammarians, a word consisting only of two syllables: such as nature, science, &c.

DISTAFF, an instrument about which flax is tied in order to be spun.

DISTANCE, in general, an interval between two things, either with regard to time or place. Dr. Berkley, in his essay on vision, maintains, that distance cannot of itself and immediately be seen, for, distance being a line directed endwise to the eye, it projects only one point in the fund of the eye, which point remains invariably the same, whether the distance be longer or shorter. But Mr. M'Laurin observes, that the distance here spoken of is distance from the eye; and that what is said of it must not be applied to distance in general. The apparent distance of two stars is capable of the same variations as any other quantity or magnitude. Visible magnitudes consist of parts into which they may be resolved, as well as tangible magnitudes, and the proportions of the former may be assigned as well as those of the latter: so that it is going too far to tell us, that visible magnitudes are no more to be accounted the object of geometry than words; and that the ideas of space, and things placed at a distance, are not, strictly speaking, the object of sight; and are not otherwise perceived by the eye than by the ear.

DISTANCE, in navigation, the number of minutes or leagues a ship has sailed from any given place or point.

DISTANCE, in astronomy. The distance of the sun, planets, and comets, is only found from their parallax, as it cannot be found either by eclipses or their different phases: for from the theory of the motions of the earth and planets, we know, at any time, the proportion of the distances of the sun and planets from us; and the horizontal paralaxes are in a reciprocal proportion to these distances. See ASTRONOMY.

DISTANCE *of the eye*, in perspective, is a line drawn from the eye to the principal point. See PERSPECTIVE.

DISTANCES *accessible*, in geometry, are such as may be measured by the chain, &c.

DISTANCES *inaccessible*, are such as cannot be measured by the chain, &c. by reason of some river, or the like, which obstructs our passing from one object to another. See MENSURATION.

DISTICH, a couplet of verses making a complete sense. Thus hexameter and pentameter verses are disposed in distichs.

DISTILLATION, a chemical process, which consists in separating bodies which are volatile from those which are more fixed, by the application of heat. All bodies which are susceptible of the elastic or vaporous form, at the same time that they are not decomposed, or otherwise changed in their properties, are capable of being separated from other matter by distillation.

The process employed for distilling liquid bodies from other matter is simply called distillation; that, on the contrary, used to separate solid bodies, by giving them the elastic form, is termed sublimation.

The apparatus employed for the first process are of several varieties, suited to the nature of the volatile body. That employed for the distillation of water, alcohol, and the various essential oils, is called a still. It is chiefly made of copper, and ought to be so constructed, that as great an evaporable surface as possible may be exposed. Those employed in the Scotch distilleries are in the form of an erect cone, the base of which is about four times the altitude. The vapour which comes from the still is condensed in two ways. The first is the oldest and most simple method, but not the most effective. The head, or capital of the still, is so formed, as to have a vessel or cavity on the outside, containing cold water; the inside is in the form of a cone, and sometimes of a dome, round the base of which is placed a channel, terminating in an inclined beak, or tube, to convey the liquid arising from the condensed vapour. When the vapour rises up against the conical, or dome-like surface, the external water causes it instantly to condense, and the drops run down the surface into the channel, from whence they pass into the delivering tube, and thence into the receiver. The other method of condensation consists in letting the vapour pass through a spiral tube, fitted into the inside of a tub, which is filled with cold water, and so contrived that the product of the distillation shall have no communication with the external water. This tub, which is called a worm tub, should be supplied with cold water at the bottom, while the warm water, caused by the condensation of the vapour, should be made to run off at the top.

The apparatus employed for distilling bodies more easily condensible consist of two parts, one called the retort, containing the substance to be distilled, and the other the receiver, because it receives the substance raised from the retort. In the distillation of bodies which afford permanent gases as well as condensible matters, in addition to the receiver, a number of connected vessels are employed, constituting what, from its inventor, is called a Woulfe's apparatus, in which, what is not condensed, or absorbed in the first bottle, passes forward to the second, and so on to the third and fourth, till at length the absolutely incondensable part is received into a vessel called a gasometer. Before the invention of this apparatus, this kind of distillation was attended with great danger, both to the apparatus and the operator, the receiver being very liable to burst, and the fumes being intolerably suffocating. Both these inconveniencies are completely obviated by the invention of the Woulfe's apparatus. Sometimes an apparatus called an alembic is used for distillation; it is generally of glass, and is used for experiments in the small way; it consists of a bottle holding the substance to be distilled, having a dome-like head, furnished with a channel similar to that of the common stile; indeed, it differs only from it in not having cold water on the outside. There are various modes of applying heat in distillation, depending upon the nature of the apparatus employed, as well as upon the substance to be distilled. The common still, which, being of metal, is immediately exposed to the naked fire, since from its tenacity, and its property of conducting heat with facility, it is not liable to crack, which is not the case with glass and earthen ware. If the vessel holding the substance to be distilled be of the latter kind, it is essential to apply the heat very gradually and uniformly, and after the process, to suffer it to cool in a similar manner. This is effected in different ways; the most common of which is the sand bath, which consists of a vessel of iron filled with fine dry sand. The retort, or other vessel, is imbedded in the sand previous to the application of the fire; the inferior conducting power of the sand does not allow the heat to approach the retort, but in that gradual way which will insure its safety from cracking. The heat must also be more uniform, since any sudden increase, or diminution of the fire, will not so immediately affect the retort.

In experiments in the small way, the lamp will answer every purpose of the sand bath, as the sliding rest containing the retort admits of its being placed at any given distance from the flame. In addition to this, the Argand lamp can be adjusted by the rack to almost any degree of intensity below its maximum. Another method of defending the retort from the too rapid effect of the heat consists in coating the outside with a mixture of horse dung and clay, or loam. When a limited degree of heat is required in distillation, recourse is had to a bath of some liquid, whose boiling point will give the degree of heat required, such as water, oil, or mercury. If, for instance, it were required to separate any substance from water more volatile than that liquid, it would be necessary to employ a water-bath, in which to place the retort, keeping the water in the bath below its boiling point.

The laws of distillation, however, are so modified by other circumstances, as to render some of the preceding rules in some measure exceptionable. If the different bodies subjected to distillation had no chemical affinity for each other, it is probable that each substance would put on its elastic form only at that temperature, at which it would, in a separate state, be converted into vapour. But we frequently find, that one volatile substance will carry along with it other bodies of considerable fixity. From the affinity which water has to air, we observe the evaporation of the former to take place at all temperatures below its boiling point; and though it has been thought that water might be freed from saline matter by distillation, it is found, by experiment, that several salts are carried over along with the vapour of the water, which, in their dry state, would undergo decomposition before they would be induced to assume the elastic form. Hence water, by the common mode of distillation, cannot be rendered pure. From the circumstance, that the air is capable of raising water and other liquids at a low temperature, we are enabled to perform the distillation of such liquids, by making the slightest degree of difference of temperature between the retort and the receiver. Water and alcohol may be obtained perfectly pure, by placing the retort in the temperature of 100°, and the receiver in that of 50° of Farenheit's scale.

The salts most liable to rise with water in distillation are, carbonate ammonia, muriates of lime and magnesia, and nitrate of soda. Indeed, this tendency appears to be directly as the solubility of the salt, or rather as its deliquescent property, which is as its affinity for water.

DISTRESS, in law, is the taking of a personal chattel out of the possession of the wrong doer, into the custody of the person who is injured, to procure a satisfaction for the wrong committed. It is of two kinds; cattle for trespassing and doing damage, or for non-payment of rent or other duties. But the most usual injury, for which a distress may be taken, is that of non-payment of rent.

DISTRIBUTION *of intestate's effects*, after payment of the debts of the deceased, is to be made according to the manner following: one-third shall go to the widow of the intestate, and the residue in equal proportions to his children; or, if dead, to their representatives, that is, their lineal descendants: if there be no children, or legal representatives, then a moiety shall go to the widow, and a moiety to the next kindred in equal degree, or their representatives: if no widow, the whole shall go to the children: if neither widow nor child, the whole shall be distributed amongst the next kindred in equal degree, and their representatives: but no representatives are admitted among collaterals, farther than the children of the intestate's brothers and sisters. The father succeeds to the whole personal effects of his children, if they die intestate and without issue; but if the father be dead, and the mother survive, she shall only come in for a share equally with each of the remaining children.

DITTO, usually written D°. in books of accounts, an Italian word, signifying the aforementioned.

DIVAN, a council chamber, or court of justice, among the eastern nations, perticularly the Turks.

DIVARICATE, a term used in natural history, signifies spreading out widely.

DIVER. See Colymbus.

DIVERGENT *rays*, in optics, are those which, going from a point of the visible object, are dispersed, and continually depart one from another, in proportion as they are removed from the object: in which sense it is opposed to convergent. Concave glasses render the rays divergent, and convex ones convergent. Concave mirrors make the rays converge, and convex ones make them diverge.

DIVERSION, in military affairs, is when an enemy is attacked in one place where they are weak and unprovided, in order to draw off their forces from another place where they have made, or intend to make, an eruption. Thus the Romans had no other way in their power of driving Hannibal out of Italy, but by making a diversion in attacking Carthage.

DIVIDEND. See Arithmetic.

Dividend, in commerce, the proportion of profits which the members of a society, or public company, receive at stated periods, according to the share they possess in the capital or common stock of the concern.

The term is likewise generally applied to the annual interest paid by government on the various public debts, although this is either a terminable or perpetual annuity, and in no respect a division of profits. In this sense, the order by which stockholders receive their interest is called a dividend warrant, and the portions of interest unreceived are denominated unclaimed dividends.

The amount of unclaimed dividends remaining in the hands of the bank of England, previous to the year 1750, seldom exceeded 50,000*l.*; its increase since that period will appear from the following extract from an account laid before the House of Commons.

		l.	*s.*	*d.*
On July 5,	1759 —	102,075	4	11¾
———	1769 —	227,928	6	2¼
———	1779 —	314,885	8	3¼
———	1789 —	547,366	16	6¾

In 1791, an act was passed authorising the bank to advance, out of the unclaimed dividends in their hands, 500,000*l.* for the public service; with a provision, that if the sum in their hands should be reduced under 600,000*l.* the difference should be repaid them. In consequence of the publication of the names of the proprietors of the dividends then unclaimed, a considerable part of them were received, and the sum advanced to government thus became only 376,739*l.* The amount of unclaimed dividends has accumulated considerably, being

On April 1, 1806 .	1,235,265*l.*
— July 1 . . .	1,003,599
— October 1 . .	1,067,778
— January 1, 1807	1,019,336

In consequence of this great increase, the bank, in 1808, advanced the further sum of 500,000*l.* for the public service, on condition that the balance in their hands, on this account, should never be reduced below 100,000*l.*

Dividend, in the university, signifies that part or share, which every one of the fellows equally divide among themselves of their yearly stipend.

DIVINATION, the knowledge of things obscure, or future, which cannot be attained by any natural means.

DIVINE, something relating to God.

DIVING, the art of descending under water to considerable depths, and abiding there a competent time. The uses of diving are considerable, particularly in fishing for pearls, corals, sponges, wrecks of ships, &c. See Pearl, &c.

There have been various engines contrived to render the business of diving safe and easy; the great point is to furnish the diver with fresh air, without which he must either make but a short stay, or perish. Those who dive for sponges in the Mediterranean, carry down sponges dipt in oil in their mouths; but considering the small quantity of air that can be contained in the pores of a sponge, and how much that little will be contracted by the pressure of the incumbent air, such a supply cannot subsist a diver long, since a gallon of air is not fit for respiration above a minute.

Diving *bell.* A diving bell is most conveniently made in form of a truncated cone, the smaller end being closed, and the larger opened. It is to be poised with lead, and so suspended, that the vessel may sink full of air, and with its open base downwards, and as nearly as may be in a situation parallel to the horizon, so as to close with the surface of the water all at once. The diver, sitting under this, sinks down with the included air to the depth desired; and if the cavity of the vessel can contain a tun of water, a single man may remain a full hour without much inconvenience, at five or six fathoms deep; but the lower he goes the included air contracts itself, according to the weight of the water which compresses it, so that at thirty-three feet deep the bell becomes half full of water, the pressure of the incumbent water being then equal to that of the atmosphere: and at all other depths, the space occupied by the compressed air in the upper part of the bell will be to the under part of its capacity filled with water, as thirty-three feet to the surface of the water in the bell below the common surface, and this condensed air being taken in with the breath, soon accommodates itself to the existing circumstances, so as to have no ill effect, provided the bell is admitted to descend slowly; but the greatest inconvenience of this engine is, that the water, entering it, contracts the bulk of air into so small a compass, that it soon heats, and becomes unfit for respiration, so that there is a necessity for its being drawn up to recruit it, besides the uncomfortable situation of the diver, who must be almost covered with water.

To obviate these difficulties of the diving bell, Dr. Halley, to whom we owe the preceding account, contrived a farther apparatus, whereby, not only to recruit the air from time to time, but also to keep the water wholly out of the machine at any depth. This bell was made of wood, containing about sixty cubic feet in its concavity, and was the form of a truncated cone, whose diameter at the top was three feet, and at the bottom five. It was so loaded with lead, that it would go down in a perpendicular direction and no other. In the top was a window to let in light, and likewise a cock to let out the hot air that had been breathed; and below, about a yard under the bell, was a stage suspended by three ropes, each of which was charged with about one hundred weight, to keep it steady. To supply air, the bell had a couple of barrels so cased with lead as to sink when empty, each having a bung hole in its lowest part, to let in the water as the air in them condensed on their descent, and to let it out again when they were drawn up full from below. To a hole in the uppermost part of these was fixed a leathern trunk or hose, long enough to fall below the bung-hole, and kept down by a weight, in such a way that the air in the upper part of the barrels could not escape, unless the lower ends of these hose were first lifted up. These air barrels were made to rise and fall like two buckets in a well; by means of these barrels fresh air was continually supplied from above, and it was done with so much ease, that two men, with less than half their strength, could perform all the labour required. By an additional contrivance it was found practicable for a diver to go out of the engine, to some distance from it, the air being conveyed to him in a continuable stream by small flexible pipes.

A great improvement in the diving bell was made by the late Mr. Spalding, of Edinburgh. This construction seems designed to remedy some inconveniences of Dr. Halley, which are very evident, and of a very dangerous tendency; these are, 1. by Dr. Halley's constructions, the sinking or rising of the bell depends on the people who are at the surface of the water: as the bell when in the water has a very considerable weight, the raising it not only requires a great deal of labour, but there is a possibility of the rope breaking, by which it is raised, and thus every person in the bell would inevitably perish: 2. As there are in many parts of the sea, rocks which lay at a considerable depth, the figure of which cannot possibly be perceived from above, there is danger that some of their ragged prominences may catch hold of one of the edges of the bell in its descent, and thus overset it, before any signal can be given to those above, which would infallibly be attended with the destruction of the people in the bell; and as it must always be unknown before trial what kind of a bottom the sea has in any place, it is plain, that, without some contrivance to obviate this last danger, the descent in Dr. Halley's diving bell is not at all eligible.

How these inconveniences are remedied by Mr. Spalding's new contrivance will be easily understood from the following descriptions: ABCD, fig. 3, represents a section of the bell, which is made of wood, *ee* are iron hooks, by means of which it is suspended by ropes QBF *e* and QAE *e* and QS, as expressed in the figure; *cc* are iron hooks, to which are appended leaden weights, that keep the mouth of the bell always parallel to the surface of the water, whether the machine taken altogether is lighter or heavier than an equal bulk of water. By these weights alone, however, the bell would not sink; another is therefore added, represented at L, and which can be raised or lowered at pleasure, by means of a rope passing over the pulley *a*, and fastened to the sides of the bell M. As the bell descends, this weight, called by Mr. Spalding the balance weight, hangs down a considerable way below the mouth of the bell. In case the edges of the bell is caught by any obstacle, the balance weight is immediately lowered down, so that it may rest upon the bottom; by this means the bell is lightened, so that all danger of oversetting is removed; for, being lighter without the balance weight than an equal bulk of water, it is evident that the bell will rise as far as the length of the rope affixed to the balance weight will allow it. This weight therefore will serve as a kind of anchor, to keep the bell at any particular depth which the divers may think necessary, or by pulling it quite up, the descent may be continued to the very bottom.

By another very ingenious contrivance, Mr. Spalding rendered it possible for the divers to raise the bell, with all the weights appended to it, even to the surface, or to stop at any particular depth, as they think proper; and thus they could still be safe, even though the rope designed for pulling up the bell was broken; for this purpose the bell is divided into two cavities, both of which are made as tight as possible; just above the second bottom, EF, are small slits on the sides of the bell, through which the water entering, as the bell descends, displaces the air originally contained in its cavity, which flies out at the upper orifice of the cock H. When this is done, the divers turn the handle, which stops the cock, so that if any more air was to get into the cavity AEFB, it could no longer be discharged through the orifice H as before. When this cavity is full of water, the bell sinks, but when a considerable quantity of air is admitted, it rises. If therefore the divers have a mind to raise themselves, they turn the small cock by which a communication is made between the upper and under cavities of the bell; the consequence of this is, that a quantity of air immediately enters the upper cavity, forces out a quantity of water contained in it, and thus renders the bell lighter by the whole weight of the water which is displaced thus. If a certain quantity of air is admitted into the upper cavity, the bell will descend very slowly; if a greater quantity, it will neither ascend nor descend, but remain stationary; and if a larger quantity of air be still admitted, it will rise to the top. It is to be observed, however, that the air which is thus let out into the upper cavity must be immediately replaced from the air barrel, and the air is to be let out very slowly, or the bell will rise to the top with so great velocity, that the divers will be in danger of being shaken out of their seats: but by following these directions, every possible accident may be prevented, and people may descend to very great depth without the least apprehension of danger; the bell also becomes so easily manageable in the water, that it may be conducted from one place to another by a small boat with the greatest ease, and with perfect safety to those who are in it.

Instead of wooden seats, used by Dr Halley, Mr. Spalding made use of ropes suspended by hooks *b*, *b*, *b*, and on these ropes the divers may sit without any inconvenience; there are two windows made of thick strong glass for admitting light to the divers; N represents an air cask with its tackle, and C P the flexible pipe through which the air is admitted to the bell; in the ascent and descent of this cask, the pipe is kept down by a small appended weight, as in Dr. Halley's machine; R is a small cock, by which the hot air is discharged as often as it becomes troublesome.

Mr. Spalding is of opinion, that one air barrel, capable of containing thirty gallons, is sufficient for an ordinary machine.

In fig. 1 and 2, are shewn representations of a frame for supporting a diving bell, and transporting it from place to place upon the water. Fig. 1, is a side elevation, and fig. 2, a section of it. The same letters refer to both figures. A B, fig. 2, are sections of two barges, such as are used upon the Thames, at London: D E F, is a frame laying across the barges, and supporting a beam, G, from which hangs a strong block for the rope by which the bell, H, is suspended; the other end of the rope goes round a windlass, *a*, with a ratchet wheel and click, to raise and lower the bell as occasion requires: *b d* are smaller blocks, for the ropes to draw up the air barrels; *e f* are rollers, turned by winches, fixed on the opposite barge to the windlass *a*; the ropes are wound round these rollers in contrary directions, and the winches come close together, so that one man can turn them both at once, and when one rope descends, the other ascends, so as to give a constant supply of air to the divers under the bell, H. When the divers wish to come up, they give a signal to that purpose, and the windlass is turned by men until the bottom of the bell is brought above water; a small boat or raft is rowed under the bell, to take the divers out: the same method is to be used to get them in, and this will be done without wetting them, or any other inconvenience. Several small bells of very different tones should be fixed to the beam G, and strings fastened to them should go into the bell, for the divers to ring as signals to the workmen in the barges above. The barges should be well secured together by cross beams.

Several other machines have been contrived to answer the purposes of the diving-bell; one of which, fig. 4, was invented in 1753, by —— Rowe, Esq. and published in the Universal Magazine.

The engine is a trunk, or hollow vessel, of copper or brass, of sufficient strength to resist the pressures of deep waters, and dimensions to contain the body of a man, supposed to enter therein feet foremost at *t*, bent at the bearing of his knees at *l*, for the more convenient going between rocks and great stones; at *k*, and on the other side, are holes for his arms to pass through, and a glass for his sight at *n*. *h* represents a sleeve made of soft leather, lined with fine cloth, exactly to fit the diver, and fastened to the body of the engine at *k*, where the arms come through; which is likewise defended by a soft quilting, to prevent the arms from being hurt by pressure, and the sleeves from being thrust into the engine; *d d* represents a cover to fit the head of the engine, fastened down with screws, and leather between the borders, so as to prevent leaking in any depth of water; *a b* represents a plate of lead, to be fastened before the engine, in a straight line, passing between the arms, not only as a proper weight to sink the engine, but as a balance thereto; whereby the diver will always be kept in a proper posture for working, and the more so by means of a block, or cradle, supposed to be fastened over the lead, by which means the diver has not only the power of handling what is at the bottom, but may at any time rest his arms from work; *g* is the engine-rope, by which it is let down and hauled up again from the bottom; *z y u* is called the life-line, with a knot at *y*, so as the handle at *z* may always remain at a due distance for the diver to take hold thereof, in order to give any notice to the persons above, as, by agreement, by giving a certain number of pulls, or sudden twitches, which is immediately felt by the person that holds the line. The diver can tarry under water at least half an hour at one time, without the help of pipes, or any other air than what the engine contains. At *i* and *w* are two brass screw caps, or plugs, both which are to be opened as soon as the diver gets from the bottom to the water's surface, in order to give him fresh air by help of a pair of bellows blowing at the latter; at which, when the engine leaks, we likewise pump out the water. In deep water the diver is forced to make use of a saddle on his back, with a ridge touching the upper part of the engine, whereby he can keep his arms at a due distance out of the engine, which otherwise would be thrust in by the column of water pressing thereon equal to the weight thereof.

The subject of submarine navigation was largely and pleasantly descanted upon by Mersennus, in his "Tractatus de Magnetis Proprietatibus," and Bishop Wilkins has given a chapter at some length on the subject, in his "Mathematical Magick," (ed. 1648) where he affirms that Cornelius Dreble has proved, beyond all question, that the contrivance is feasible, by the experiments he made in England. The chapter of Wilkins is entertaining, for a sort of visionary facility with which he removes the difficulties, and enumerates the benefits, of these submarine enterprises. For letting out and taking in such things as the nature of the voyage may require, he recommends bags, or flexible tubes, somewhat resembling the scupper bags of ships. The progressive motion may, he observes, be produced by fins or oars, which will operate with ease when the vessel is truly equipoised; and if swiftness should not be obtained, he supposes the observations and discoveries to be made at the bottom of the sea would abundantly recompence for the defect. The greatest difficulty, in his apprehension, would be, the necessity of renovating the air for respiration and combustion; for remedying which, besides the probability that custom may render men capable of living in air of inferior purity, he has several philosophical views and projects. The conveniences and advantages he enumerates are, 1. Privacy; as a man may thus go to any part of the world invisibly, without being discovered or prevented. 2. Safety from the uncertainty of tides and tempests that vex the surface; from pirates and robbers; and from the ices that so much endanger other voyages towards the poles. 3. It may be of use to undermine and blow up a navy of enemies. 4. Or to relieve a blockaded place. 5. And as the prospect enlarges in the mind of our author, he proceeds to contemplate the unspeakable benefit of submarine discoveries. Experiments on the ascent and descent of submerged bodies; the exploration of the deep caverns and passages, and the waters of the ocean; observations on the nature and kinds of fishes, with allurements, artifices, and treacheries, which may successfully be practised during so familiar a residence in their territories; the food and oil they may afford; the probability of fresh springs for a supply of water at the bottom of the sea; the facility of recovering submarine treasures, whether lost or naturally produced beneath the ocean; and last of all he adds, that

"All kinds of arts and manufactures may be exercised in this vessel. The observations made by it may be both written, and, if need were, printed here likewise. Several colonies may thus inhabit, having their children born and bred up without the knowledge of land, who could not chuse but be amazed with strange conceits upon the discovery of this upper world."

The only modern instance of actual submarine navigation is that of Mr. Bushnel, recorded in the Transactions of the

American Society, vol. iv. The external shape of his vessel bore some resemblance to two upper tortoise shells of equal size, joined together; the place of entrance into the vessel being represented by the opening made by the swell of the shells at the head of the animal. The inside was capable of containing the operator, and air sufficient to support him thirty minutes without receiving fresh air. At the bottom, opposite the entrance, was affixed a quantity of lead for ballast. At one edge, which was directly before the operator, who sat upright, was an oar for rowing forwards and backwards. At the other edge was a rudder for steering. An aperture at the bottom, with its valve, was designed to admit water for the purpose of descending; and two brass forcing-pumps served to eject the water within when necessary for ascending. At the top there was likewise an oar for ascending or descending, or continuing at any particular depth; a water-gauge or barometer determined the depth of descent, a compass directed the course, and a ventilator within supplied the vessel with fresh air when on the surface.

The entrance into the vessel was elliptical, and so small as barely to admit a person. This entrance was surrounded with a broad elliptical iron band, the lower end of which was let into the wood, of which the body of the vessel was made, in such a manner as to give its utmost support to the body of the vessel against the pressure of the water. Above the upper edge of this iron band there was a brass crown or cover, resembling a hat with its crown and brim, which shut water tight upon this iron band. The crown was hung to the iron band with hinges, so as to turn over sideways when open. To make it perfectly secure when shut, it might be screwed down upon the band by the operator, or by a person without.

There were in the brass crown three round doors, one directly in front, and one on each side, large enough to put the hand through: when open they admitted fresh air; their shutters were ground perfectly tight into their places with emery, hung with hinges, and secured in their places when shut; there were likewise several small glass windows in the crown, for looking through and admitting light in the day time, with covers to secure them. There were two air-pipes in the crown. A ventilator within drew fresh air through one of the air-pipes, and discharged it into the lower part of the vessel; the fresh air, introduced by the ventilator, expelled the impure light air through the other air pipe. Both air pipes were so constructed, that they shut themselves whenever the water rose near their tops, so that no water could enter through them, and opened themselves immediately after they rose above the water.

The vessel was chiefly ballasted with lead fixed at the bottom; when this was not sufficient, a quantity was placed within, more or less, according to the weight of the operator; its ballast made it so stiff, that there was no danger of its oversetting. The vessel, with all its appendages, and the operator, was not of sufficient weight to settle it very low in the water. About two hundred pounds of the lead at the bottom for ballast could be let down forty or fifty feet below the vessel; this enabled the operator to rise instantly to the top of the water in case of accident.

When the operator would descend, he places his foot on the top of a brass valve, pressing it, by which he opened a large aperture at the bottom of the vessel; through this the water entered at his pleasure; when he had admitted a sufficient quantity, he descended very gradually; if he admitted too much, he ejected as much as was necessary to obtain an equilibrium by the two brass forcing pumps which were placed at each hand. Whenever the vessel leaked, or he would ascend to the surface, he also made use of these forcing pumps. When the skilful operator had obtained an equilibrium, he could row upward or downward, or continue at any particular depth, with an oar placed near the top of the vessel, formed upon the principle of the screw, the axis of the oar entering the vessel; by turning the oar one way, he raised the vessel; by turning it the other way he depressed it.

A glass tube, eighteen inches long and one inch in diameter, standing upright, its upper end closed, and its lower end, which was open, screwed into a brass pipe, through which the external water had a passage into the glass tube, served as a water-gauge or barometer. There was a piece of cork, with phosphorus on it, put into the water-gauge. When the vessel descended, the water rose in the water-gauge, condensing the air within, and bearing the cork with its phosphorus on its surface. By the light of the phosphorus, the ascent of the water in the guage was rendered visible, and the depth of the vessel under water ascertained by a graduated line.

An oar formed upon the principle of the screw was fixed in the fore part of the vessel; its axis entered the vessel, and being turned one way, rowed the vessel forward, but being turned the other way, rowed it backwards; it was made to be turned with the hand or foot.

A rudder, hung on the hinder part of the vessel, commanded it with the greatest ease. The rudder was made very elastic, and might be used for rowing forward. Its tiller was within the vessel, on the operator's right hand, fixed at a right angle on an iron rod, which passed through the side of the vessel; the rod had a crank on its outside, which commanded the rudder, by means of a rod extending from the end of the crank to a kind of tiller fixed on the left hand of the rudder. Raising or depressing the first mentioned tiller turned the rudder, as the case required.

A compass marked with phosphorus directed the course both above and under the water; and a line and lead sounded the depth when necessary.

The internal shape of the vessel, in every possible section of it, verged towards an ellipsis as near as the design would allow; but every horizontal section of it, although elliptical, was as near to a circle as could be admitted. The body of the vessel was made exceedingly strong; and to strengthen it as much as possible, a firm piece of wood was framed parallel to the conjugate diameter, to prevent the sides from yielding to the great pressure of the incumbent water, in deep immersions. This piece of wood was also a seat for the operator.

Every opening was well secured. The pumps had two sets of valves. The aperture at the bottom for admitting water was covered with a plate perforated full of holes, to receive the water, and prevent any thing from choaking the passage, or stopping the valve from shutting. The brass valve might likewise be forced into its place by a screw, if necessary. The air pipes had a kind of hollow sphere fixed round the top of each, to secure the air-pipe valves from injury: these hollow spheres were perforated full of holes for the passage of the air through the pipes: within the air-pipes were shutters to secure them, should any accident happen to the pipes or the valves on their tops.

Wherever the external apparatus passed through the body of the vessel, the joints were round, and formed by brass pipes, which were driven into the wood of the vessel; the holes through the pipes were very exactly made, and the iron rods that passed through them were turned in a lathe to fit them; the joints were also kept full of oil, to prevent rust and leaking. Particular attention was given, to bring every part necessary for performing the operations, both within and without the vessel, before the operator, and as conveniently as could be devised; so that every thing might be found in the dark, except the water-gauge and the compass, which were visible by the light of the phosphorus, and nothing required the operator to turn to the right hand or to the left, to perform any thing necessary.

The intended object of this vessel was to destroy shipping, by the explosion of a magazine of gunpowder. In the fore part of the brim of the crown of the submarine vessel was a socket, and an iron tube passing through the socket; the tube stood upright, and could slide up and down in the socket six inches; at the top of the tube was a wood screw, fixed by means of a rod, which passed through the tube, and screwed the wood screw fast upon the top of the tube; by pushing the wood screw up against the bottom of a ship, and turning it at the same time, it would enter the planks; driving would also answer the same purpose; when the wood screw was firmly fixed, it could be cast off by unscrewing the rod which fixed it upon the top of the tube.

Behind the submarine vessel was a place above the rudder for carrying a large powder magazine; this was made of two pieces of oak timber, large enough when hollowed out to contain 150 pounds of powder, with the apparatus used in firing it, and was secured in its place by a screw turned by the operator. A strong piece of rope extended from the magazine to the wood screw above mentioned, and was fastened to both. When the wood screw was fixed, and to be cut off from its tube, the magazine was to be cast off likewise by unscrewing it, leaving it hanging to the wood screw; it was lighter than the water, that it might rise up against the object, and apply itself where fastened.

Within the magazine was an apparatus, constructed to run any proposed length of time under twelve hours; when it had run out its time, it unpinioned a strong lock resembling a gun-lock, which gave fire to the powder. This apparatus was so pinioned that it could not possibly move, till by casting off the magazine from the vessel it was set in motion.

The skilful operator could swim so low on the surface of the water, as to approach very near a ship in the night without fear of discovery, and might, if he chose, approach the stem or stern above water with very little danger. He could sink very quickly, keep at any depth he pleased, and row a great distance in any direction he desired, without coming to the surface; and when he rose to the surface, he could soon obtain a fresh supply of air, when, if necessary, he might descend again and pursue his course.

The projector found some time and attention to be requisite for the gradual instruction of this operator, and after various attempts he found one on whom he thought he could depend. He sent this man from New York to a 50 gun ship, lying not far from Governor's Island. He went under the ship, and attempted to fix the wood screw in her bottom, but struck, as he supposed, a bar of iron, which passes from the rudder-hinge, and is spiked under the ship's quarter. Had he removed a few inches, which he might have done without rowing, the projector has no doubt but he might have found wood, where he might have fixed the screw; or, if the ship were sheathed with copper, he might easily have pierced it; but not being well skilled in the management of the vessel, in attempting to row to another place, he lost the ship: after seeking her in vain some time, he rowed to some distance, and rose to the surface of the water, but found day-light had advanced so far that he durst not renew the attempt. He says he could easily have fastened the magazine under the stern of the ship above the water, as he rowed up to the stern, and touched it before he descended. Had he fixed it there, the explosion of 150 pounds of powder (the quantity contained in the magazine) must have been fatal to the ship. In his return from the ship to New York, he passed near Governor's island, and thought he was discovered by the enemy on the island; being in haste to avoid the danger he feared, he cast off the magazine, as he imagined it retarded him in the swell, which was very considerable. After the magazine had been cast off an hour, the time the internal apparatus was set to run, it blew up with great violence.

Mr. Bushnell made some other trials, which may be seen on consulting the original, or Nicholson's Journal, quarto, iv. 229.

DIVINITY, properly signifies the nature, quality, and essence of the true God.

DIVISIBILITY, that property by which the particles of matter in all bodies are capable of a separation, or disunion from each other.

As it is evident that body is extended, so it is no less evident that it is divisible; for since no two particles of matter can exist in the same place, it follows, that they are really distinct from each other, which is all that is meant by being divisible. In this sense the least conceivable particle must still be divisible, since it will consist of parts which will be really distinct. To illustrate this by a familiar instance, let the least imaginable piece of matter be conceived lying on a smooth plain surface, it is evident the surface will not touch it every where: those parts, therefore, which it does not touch, may be supposed separable from the others, and so on, as far as we please; and this is all that is meant, when we say matter is infinitely divisible.

The infinite divisibility of mathematical quantity is demonstrated thus geometrically. Suppose the line A D (Plate Miscel. fig. 7.) perpendicular to B F, and another, as G H, at a small distance from it, also perpendicular to the same line: with the centres C, C, C, &c. describe circles cutting the line G H in the points *e*, *e*, *e*, &c. Now, the greater the radius A C is, the less is the part *e* H. But the radius may be augmented in infinitum; so long, therefore, the part *e* H may be divided into still less portions, consequently it may be divided in infinitum.

All that is supposed in strict geometry (says Mr. Maclaurin) concerning the divisibility of magnitude, amounts to no more, than that a given magnitude may be conceived to be divided into a number of parts, equal to any given or proposed number. It is true, that the number of parts into which a given magnitude may be conceived to be divided is not to be fixed or limited, because no given number is so great but a greater may be conceived and assigned: but there is not, therefore, any necessity of supposing the number of parts actually infinite; and if some have drawn very absurd consequences from such a supposition, yet geometry ought not to be loaded with them.

Thus far we have shown that extension may be divided into an unlimited number of parts; but with respect to the limits of the divisibility of matter itself, we are perfectly in the dark. We can indeed divide certain bodies into surprizing fine and numerous particles, and the works of nature offer many fluids and solids of wonderful tenuity; but both our efforts, and those naturally small objects, advance a very short way towards infinity. Ignorant of the intimate nature of matter, we cannot assert whether it may be capable of infinite division, or whether it ultimately consists of particles of a certain size, and of perfect hardness. We shall now add some instances of the wonderful tenuity of certain bodies, which have been produced either by art, or discovered by means of microscopical observations, amongst the stupendous works of nature.

The spinning of wool, silk, cotton, and such-like substances, affords no bad specimens of this sort; since the thread which has been produced by this means has often been so very fine, as almost to exceed the bounds of credibility, had it not been sufficiently well authenticated. Mr. Boyle mentions that two grains and a half of silk were spun into a thread 300 yards long. A few years ago, a lady of Lincolnshire spun a single pound of woollen yarn into a thread of 168,000 yards long, which is equal to 95 English miles. Also a single pound weight of fine cotton-yarn was lately spun, in the neighbourhood of Manchester, into a thread 134,400 yards long.

The ductility of gold likewise furnishes a striking example of the great tenuity of matter amongst the productions of human ingenuity. A single grain weight of gold has been often extended into a surface equal to 50 square inches. If every square inch of it is divided into square particles of the hundredth part of an inch, which will be plainly visible to the naked eye, the number of those particles in one inch square, will be 10,000; and multiplying this number by the 50 inches, the product is 500,000; that is, the grain of gold may be actually divided into at least half a million of particles, each of which is perfectly apparent to the naked eye. Yet, if those particles are viewed in a good microscope, they will appear like a large surface, the ten-thousandth part of which might by this means be easily discerned. An ingenious artist in London has been able to draw parallel lines upon a glass plate, as also upon silver, so near one another, that 10,000 of them occupy the space of one inch. Those lines can be seen only by the assistance of a very good microscope. Another workman has drawn a silver wire, the diameter of which does not exceed the 750th part of an inch. But those prodigies of human ingenuity will appear extremely gross and rude, if they are compared with the immense subtilty of matter which may every where be observed amongst the works of nature. The animal, the vegetable, and even the mineral kingdom, furnish numerous examples of this sort. What must be the tenuity of the odoriferous parts of musk, when we find that a piece of it will scent a whole room in a short time, and yet it will hardly lose any sensible part of its weight! But supposing it to have lost one-hundredth part of a grain weight, when this small quantity is divided and dispersed through the whole room, it must so expand itself, as not to leave an inch square of space where the sense of smell may not be affected by some of its particles. How small must then be the weight and size of one of those particles! The human eye, unassisted by glasses, can frequently perceive insects so small as to be barely discernible. The least reflection must show, that the limbs, the vessels, and other parts of such animals, must infinitely exceed in fineness every endeavour of human art. But the microscope has discovered wonders that are vastly superior, and such indeed as were utterly unknown to our fore-fathers, before the invention of that noble instrument.

Insects have been discovered so small, as not to exceed the 10,000th part of an inch: so that 1,000,000,000,000 of them might be contained within the space of one cubic inch; yet each animalcule must consist of parts connected with each other; with vessels, with fluids, and with organs necessary for its motions, for its increase, for its propagation, &c. How inconceivably small must those organs be! and yet they are unquestionably composed of other parts still smaller, and still farther removed from the perception of our senses.

DIVISION, in general, is the separating a thing into two or more parts. Although the mechanical division of bodies separates them into smaller parts, it cannot extend to the primary particles of any body, and is, consequently, incapable of breaking what is called the aggregation. Division is also reckoned among the terms in chemistry, but not very properly, as it is merely used preparatory to other operations, particularly solution: for this it is useful, as it increases the quantity of surface, and the points of contact of any body.

DIVISION. See ALGEBRA and ARITHMETIC.

DIVISION, among logicians, is the explication of a complex idea, by enumerating the simple ideas whereof it is composed; in which sense it is nearly allied to definition, only that this last regards names and things, whereas division is employed wholly about ideas.

When the parts of an idea are divided, in order to a clearer explication of the whole, this is called a subdivision: thus, a year is divided into twelve months, a month is subdivided into weeks, weeks into days, days into hours, and so on.

The rules for a good division are these, that the members entirely exhaust the whole; that they be opposite; that subdivisions be not too numerous; that the whole be first divided into its larger parts, and these into the more remote and minute parts.

DIVISION, in natural philosophy, is the taking a thing to pieces, that we may have a more complete conception of the whole: this is frequently necessary in examining very complex things, the several parts of which cannot be surveyed at one view. Thus, to learn the nature of a watch, the workman takes it to pieces, and shews us the spring, wheels, axles, pinions, balances, dial-plate, pointer, case, &c. and after describing the uses and figures of each of them apart, explains how they contribute to form the whole machine.

DIVISION, in music, the dividing the interval of an octave into a number of less intervals. The fourth and fifth divide the octave perfectly, though differently: when the fifth is below, and serves as a bass to the fourth, the division is called harmonical; but when the fourth is below, it is called arithmetical. To run a division, is to play, or sing, after the manner above-mentioned; that is, to divide the intervals of an octave, fifth, fourth, &c. into as many parts, and as agreeably as possible, which depends entirely upon taste and fancy.

DIVISION *of proportion.* If four quantities be proportional $a:b::c:d$; then the assumption of the difference between the antecedent $a-b$, or $b-a$, to either the antecedent a, or consequent b, of the first ratio a to b; and the difference between the antecedents $c-d$ or $d-c$ to either the antecedent b, or consequent d, of the second ratio c to d, is called division of proportion.

DIVISION, in the sea-language, the third part of a fleet of men of war, and sometimes the ninth part: which last happens when the fleet is divided into three squadrons; for then each squadron is distributed into three divisions. See TACTICS NAVAL.

DIVISIONS *of a battalion*, are the several parcels into which a battalion is divided in marching. The lieutenants and ensigns march before the divisions.

DIVORCE, a separation of two *de facto* married together; of which there are two kinds; one *a vinculo matrimonii*, from the very bond of marriage: the other *a mensa et thora*, from bed and board. Causes for separation *a vinculo*, are consanguinity or affinity within the degrees prohibited, also *impuberty* or *frigidity*; where the marriage was merely void *ab initio*, and the sentence of divorce only declaratory of its being so. This divorce enables the parties to marry again: but in the other case, a power for so doing must be obtained by act of parliament. The woman divorced *a vinculo matrimonii* receives all again she brought with her. Divorce *a mensa et thora*, is where the use of matrimony, as the use of cohabitation of the married persons, on their mutual conversation, is prohibited for a time, or without limitation of time. And this is in cases of adultery, cruelty, or the like; in which case, the marriage having been originally good, is not dissolved or affected as to the *vinculum* or bond. The woman under separation by this divorce may sue by her next friend; and she may sue her husband in her own name for alimony. But the children which she hath after the divorce shall be deemed bastards: for a due obedience to the sentence will be intended, unless the contrary be shewn.

DIURETICS. See PHARMACY.

DIURIS, in botany, a genus of the Gynandria Diandria class and order. Nectary dependent; petals nine; the five outer ones very large; of two shapes; columns of the fructification reversed, with a lid at top. One species, D. australasia, described by Dr. Smith in Linnean Transactions.

DIURNAL, in astronomy, something relating to the day, in opposition to nocturnal, which regards the night.

Diurnal *arch*, the arch or number of degrees that the sun, moon, or stars, describe between their rising and setting.

Diurnal *motion of a planet*, is so many degrees and minutes as any planet moves in twenty-four hours. Hence the motion of the earth about its axis is called its diurnal motion.

DOBCHICK, a species of Colymbus.

DOCK, in maritime affairs, is a pit, great pond, or creek, by the side of an harbour, made convenient either for the building or repairing of ships. It is of two sorts: 1. Dry-dock, where the water is kept out by great flood-gates till the ship is built or repaired, when the gates are opened, and the water let in to float and launch her. 2. Wet-dock, a place where the ship may be hauled into out of the tide's way, and so dock herself, or sink herself a place to lie in.

Docks, &c. Liverpool, Hull, and Bristol, but especially the two first of these places, had proved the advantages of wet-docks long before London possessed any such accommodations. The inconveniences arising from the crowded state of the river at all times, but particularly when ships arrived in large fleets, and from the want of sufficient wharf-room for discharging their cargoes, were long felt and complained of by all the principal merchants in London, who were subject to considerable losses from the delays in getting their goods landed, and the opportunities of plunder to which they were exposed. At length, about the year 1793, a plan was circulated for forming capacious wet-docks, with wharfs and warehouses, in a convenient situation adjoining the Thames at Wapping; the project gave rise to much discussion, and to the formation of other plans accommodated to particular interests; but through the indefatigable perseverance of Mr. William Vaughan, assisted by other highly respectable mercantile characters, the original plan was matured, and a bill brought into parliament for carrying it into execution. Contending interests rendered the first application unsuccessful; and a few years after the corporation of London proposed to make a navigable canal or passage across the Isle of Dogs; while another plan was brought forward for making wet docks for West India shipping only; and afterwards one for making docks for East India shipping only; all in the vicinity of each other. These several undertakings, all arising out of the original project of the London docks, have been since carried into execution, to the great convenience of the commerce of the port of London, and the permanent benefit of the subscribers, by whom the large sums necessary for accomplishing them were advanced.

London Dock.

This company was established by an act of 39 and 40 George III. passed the 20th of June, 1800, by which they were empowered to raise a capital stock of 1,200,000*l.*; and, if necessary, to borrow at interest the further sum of 300,000*l.*: but a lager capital being necessary for completing the undertaking, they applied to parliament for leave to augment their capital stock by any further sum not exceeding 500,000*l.*; and have since obtained another act for raising a further sum of 500,000*l.*; so that the total capital stock which the company are authorized to raise, if necessary, is 2,200,000*l.*

The company is under the management of twenty-four directors, who are elected annually. Two general courts of proprietors are held every year, at which all persons are entitled to vote who possess 500*l.* stock or upwards.

The dividends on their stock are restricted to 10 per cent. per annum, and are paid on the first of January, and the first of July. The present dividend is 5½ per cent. and the company pay the property tax thereon. The dividends are paid, and transfers made, on any day except holidays.

The company was required to complete the docks within seven years, and on the 24th of January, 1805, they gave notice, by advertisement, that the basin at Bell-dock, and the dock communicating therewith, and also part of the warehouses, vaults, and quays, were ready for the reception of ships and landing their cargoes, in consequence of which the dock was opened for public use in the following week.

West India Dock.

This company was established by an act of 39 George III. passed the 12th of July 1799, and was impowered to raise a joint stock of 500,000*l.* with liberty to increase the same to 600,000*l.* by consent of the majority of proprietors at a general meeting. This increased capital was, however, found inadequate to complete the undertaking; and in 1802 the company were authorised to add 200,000*l.* to it, making the capital 800,000*l.* which has since been increased to 1,200,000*l.* Of this sum, 1,127,500*l.* has been called for; and a further subscription of 2½ per cent. was added in January, 1808. They were to pay 5 per cent. interest for the money advanced, until the docks were completed, and afterwards to make dividends not exceeding 10 per cent. per annum.

The company is under the management of twenty-one directors, eight of whom must be members of the Corporation of London. They are elected annually, five going out every year for three years, and six the fourth year.

Two general meetings of proprietors are to be held every year, in January and July, at which all persons are entitled to vote who hold 500*l.* stock or upwards.

Votes may be given by power of attorney.

The present dividend is 10 per cent. per annum, and becomes due the 1st of January and the 1st of July. The dividends are payable every day, and the company pay the property tax thereon.

The dock was opened the 27th of August, 1802.

EAST INDIA DOCK.

This company was established by an act of 43 Geo. III. passed the 27th of July, 1803, and was authorised to raise a capital of 200,000*l.* divided into shares of 100*l.* each, with liberty to increase their capital to 300,000*l.* if found necessary. In 1806 they were empowered to add 100,000*l.* to their capital, making with the former sum 400,000*l.* nearly the whole of which has been raised. They were to pay 5 per cent. interest on the money advanced; and after the docks should be completed, to make dividends not exceeding 10 per cent. per annum.

The company is under the management of thirteen directors, who must be holders of at least twenty shares of the company's stock, and four of them must be directors of the East India company. They are elected annually in July, and three go out every year.

Two general meetings are held yearly, in January and July, at which proprietors of five shares and upwards are entitled to vote. They must also be directors of the East India Company, or have been so within two years, or be an agent, husband, consignee, or owner, to the value of 500*l.* or upwards, of East India shipping.

The present dividend is at the rate of 5 per cent. per annum, and is payable at Lady-day and Michaelmas, every day, except Fridays, between the hours of 11 and 2 o'clock.

The dock was opened in August, 1806.

Dock *yards*, in ship building, are magazines of all sorts of naval stores. The principal ones in England are those of Chatham, Portsmouth, Plymouth, Woolwich, Deptford, and Sheerness. In time of peace ships of war are laid up in these docks; those of the first rates mostly at Chatham, where, and at other yards, they receive from time to time such repairs as are necessary. These yards are generally supplied from the northern crowns with hemp, pitch, tar, rosin, &c.; but as for masts, particularly those of the larger size, they are brought from New England.

DOCKET, or Dogget, a brief in writing, on a small piece of paper or parchment, containing the effect of a larger writing, and annexed to other papers for particular purposes. In law, a docket is necessary in all judgments, and no debts will be entitled to a preference, in debts due from a party deceased, as judgment debts, unless such judgments be regularly docketed.

DOCTOR, a person who has passed all the degrees of a faculty, and is empowered to teach or practise the same: thus we say, doctor in divinity, doctor in physic, doctor of laws.

The title of doctor seems to have been created in the XIIth century, instead of master, and established, with the other scholastic degrees of bachelors and licentiates, by Peter Lombard and Gilbert Porreus, then the chief divines of the University of Paris. Gratian did the same thing, at the same time, in the University of Bologna. Though the two names of doctor and master were used a long time together, yet many think that their functions were different, the masters teaching the human sciences, and the doctors those sciences depending on revelation and faith. Spelman takes the title of doctor not to have commenced till after the publication of "Lombard's Sentences," about the year 1140, and affirms that such as explained that work to their scholars were the first that had the appellation of doctors.

To pass doctor in divinity at Oxford, it is necessary the candidate have been four years bachelor of divinity. For doctor of laws, he must have been seven years in the university to commence bachelor of laws, five years after which he may be admitted doctor of laws. Otherwise, in three years after taking the degree of master of arts, he may take the degree of bachelor in laws, and in four years more that of doctor: which same method and time are likewise required to pass the degree of doctor in physic. At Cambridge, to take the degree of doctor in divinity, it is required the candidate have been seven years bachelor of divinity: though in several colleges the bachelor's degree is dispensed with, and they may go out *per saltum*. To commence doctor in laws, the candidate must have been five years bachelor of laws, or seven years master of arts. To pass doctor in physic, he must have been bachelor in physic five years, or seven years master of arts. It is remarkable, that by a statute of 37 Hen. VIII. a doctor of civil law may exercise ecclesiastical jurisdiction, though a layman.

Doctor in music, a musician upon whom some university has conferred the degree of doctor in the faculty of music. By the qualifications formerly required of a candidate, either for a doctor or bachelor's degree in music, it should seem that the science was regarded merely as speculative. The present statutes, however, are formed on a broader principle, and, looking to talent and active science for the necessary qualifications, require of the candidate an exercise in eight vocal parts, with instrumental accompaniments, which he is to submit to the inspection of the musical professor, and to have performed in the music school, or some other public place in the university.

DODARTIA, in botany, so called in honour of M. Dodart, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx five-toothed; corolla lower lip twice as long as the upper; capsule two-celled, globular. There are two species, *viz.* D. orientalis, oriental dodartia, and D. indica, natives of India.

DODECAHEDRON, in geometry, one of the Platonic bodies, or regular solids, contained under twelve equal and regular pentagons. See Body.

DODECANDRIA, the name of the eleventh class in Linnæus's Sexual System; consisting of plants with hermaphrodite flowers, that, according to the title, have twelve stamina or male organs. This class, however, is not limited with respect to the number of stamina. Many genera have sixteen, eighteen, and even nineteen stamina; the essential character seems to be, that, in the class in question, as in Polyandria, the 13th, the stamina are inserted into the receptacle: whereas, in the intermediate class, Icosandria, which is as little determined in point of number as the other two, they are attached to the inside of the calyx. The orders in this class, which are six, are founded upon the number of the styles, or female organs. Asarabacca, mangostan, storax, purple loose-strife, wild Syrian rue, and purslane, have one style; agrimony and heliocarpus have two; burning thorny plant and bastard rocket three; glinus five; illicium eight; and houseleek twelve.

DODECAS, in botany, a genus of the Dodecandria Monogynia class and order. Natural order of Calycanthemæ. Myrti, Jussieu. Essential character: corolla five-petalled: calyx half four-cleft, bearing the corolla, superior; capsule one-celled, connate with the calyx. There is but one species, *viz.* D. surinamensis, a native of Surinam.

DODECATHEON, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Preciæ. Lysimachiæ, Jussieu. Essential character: corolla rotate, reflex; stamina placed on the tube: capsule one celled, oblong. There is only one species, *viz.* D. meadia, Virginian cowslip, or meadia, has a perennial yellow root, from which come out, in the spring, several long smooth leaves, six inches long, and nearly two broad: at first they stand erect, but afterwards they lie on the ground, especially if the plant be much exposed to the sun; from among these leaves arise three or four flower stalks, eight or nine inches high; they are smooth, naked, and terminated by an umbel of flowers, of a peach-coloured blossom; these appear in April or May; the seeds ripen about July, soon after which the leaves decay, and the roots remain inactive till the following spring. It is a native of Virginia, and many parts of North America.

DODO. See Didus.

DODONÆA, in botany, so named in honour of Rembert Dodonæus, a famous botanist of the sixteenth century, a genus of the Octandria Monogynia class and order. Natural order of Dumosæ. Terebintaceæ, Jussieu. Essential character:

calyx four-leaved; corolla none; capsule three-celled, inflated; seeds in couples. There are two species, *viz.* D. viscosa, broad-leaved dodonæa, and D. angustifolia, narrow-leaved dodonæa. The former is a native of the countries between the tropics; the latter is found at the Cape of good Hope.

DOG. See CANIS.

Dog *days*, the same with those called canicular. See CANICULAR *days*.

DOLABRIFORM, in natural history, hatchet shaped.

DOLICHOS, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: two parallel oblong calluses at the base of the standard, compressing the wings underneath. There are thirty-eight species; most of these are annual, and natives either of the East or West Indies. They are chiefly herbaceous, with twining stalks: the flowers are frequently in spikes, and axillary; the legume is often smooth, sometimes villose, or pruniént. Mr. Millar affirms, that he has cultivated more than sixty, besides many varieties.

DOLIOCARPUS, in botany, a genus of the Polyandria Monogynia class and order. Essential character: calyx five-leaved; corolla three-petalled, plaited; stigma sub-bifid; berry globular, crowned with a style, one-celled, two-seeded There are three species.

DOLPHIN. See DELPHINUS.

DOMBEYA, in botany, so called in memory of Jos. Dombey, a genus of the Dioecia Monadelphia class and order. Natural order of Coniferæ. Essential character: male, calyx of the ament; scales terminated by a leaflet; corolla none; anthers ten or twelve, without filaments. Female, calyx ament, with many germs; corolla none; stigma bivalve, unequal; seeds many, in a roundish strobile. There is but one species, *viz.* D. chilensis, a tree very little known, of a resinous nature, in some respects allied to protea; and also to the pines in some particulars of its fructification; the trunk is straight, and of considerable height; the wood is white, solid, and clothed with a kind of double bark. The flowers are male and female, borne on different individuals, and hang in sessile solitary catkins from the top of the branches. A native of Chili.

DOME, in architecture, a spherical roof, or a roof of a spherical form, raised over the middle of a building, as a church, hall, pavilion, vestibule, stair-case, &c. by way of crowning. See ARCHITECTURE.

DOMESDAY, or DOOMS-DAY-BOOK, a very ancient record made in the time of William the Conqueror, which now remains in the Exchequer, and consists of two volumes, a greater and a less; the greater contains a survey of all the lands in most of the counties in England, and the less comprehends some counties that were not then surveyed. The book of domesday was begun by five justices, assigned for that purpose in each county, in the year 1081, and finished in 1086. It was of that authority, that the Conqueror himself submitted, in some cases wherein he was concerned, to be determined by it. Camden calls this book the tax-book of king William; and it was farther called magna rolla. There is likewise a third book of domesday, made by command of the Conqueror; and also a fourth, being an abridgement of the other books.

DOMINICAL *letter*, in chronology, is that letter of the alphabet which points out in the calendar the Sundays throughout the year, thence also called Sunday letter. See CHRONOLOGY.

DONATIA, in botany, a genus of the Triandria Trigynia class and order. Essential character: calyx three-leaved; petals nine, twice as long as the calyx, linear oblong; anthers sub-globular, twin. There is but one species, *viz.* D. fascicularis.

DONAX, in natural history, a genus of Vermes Testacea. Generic character: animal a tethys; shell bivalve, generally with a crenulate margin, the frontal margin very obtuse; hinge with two teeth, and a single marginal one placed a little behind, rarely double, triple, or none. There are nineteen species. D. scortum is a triangular heart-shaped shell, with a flat frontal margin. It inhabits the Indian ocean; cinereous, mixed here and there with violet, within snowy, except near the hinge, which is violet; marginal teeth, double in each valve, with an intermediate cavity. D. scripta inhabits the coast of Malabar, it is elegantly painted with angular reddish, blue, or brown lines; the hinge something resembles that of a Venus.

DOOR, in architecture, an aperture in a wall, to give entrance and exit into and out of a building, or any apartment thereof. See ARCHITECTURE.

DORÆNA, in botany, a genus of the Pentandria Monogynia class and order. Essential character: corolla five-cleft;

stigma emarginate; capsule one-celled. One species; *viz.* D. japonica, a native of Japan.

DORIC *order*, in architecture, the first invented by the Greeks, the second of the five orders, being that between the Tuscan and Ionic. See ARCHITECTURE.

DORIC *dialect*, in grammar, one of the five dialects, or manners of speaking, which were principally in use among the Greeks.

DORIS, in natural history, a genus of the Vermes Mollusca. Generic character: body creeping, oblong and flat beneath; mouth placed below in the fore part; vent behind on the back, and surrounded by a fringe; feelers two to four, seated on the upper part of the body in front, and retractile within their proper receptacles. There are twenty-four species, in two sections: A. tentacula, or feelers, four: B. two tentacula only: D. argo inhabits the European seas, and called sea-lemon. This has an oval body, convex, marked with numerous punctures, is of a lemon-colour, hence its trivial name; the vent is beset with elegant ramifications. D. verrucosa, or warty doris, found in the sea near Aberdeen, Scotland, is of an ovated form, convex, and tuberculated.

DORYCHIUM, in botany, a genus of the Diadelphia Decandria class and order: calyx five-toothed, two-lipped; filaments subulate; stigma capitate; legume turgid, one or two seeded. There are three species, found in France and Spain.

DORMANT, in heraldry, is used for the posture of a lion, or any other beast, lying along in a sleeping attitude, with the head on the fore paws; by which it is distinguished from the couchant, where, though the beast be lying, yet he holds up his head.

DORONICUM, in botany, leopard's bane, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx scales in two rows equal, longer than the disk; seeds of the ray naked, and destitute of down; dow n to those of the disk simple; receptacle naked. There are three species; they grow naturally in Germany, France and Spain.

DORSTENIA, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: receptacle common, one-leaved, fleshy, in which solitary seeds nestle. There are eight species.

DOSSIL, lint made into a cylindric form. See SURGERY.

DOUBLE *letter*, in grammar, a letter which has the force and effect of two. The Greeks have three of these, *viz.* Z, Ξ, Ψ; the Latins have two, X and Z; and most of the modern languages have the same.

DOUGLASSIA, in botany, so named in honour of James Douglas, M. D., a genus of the Polyadelphia Polyandria class and order. Essential character: calyx half six-cleft; corolla none; nectary six; filaments none; germ superior; stigma six-cleft; berry ovate, one-celled; seed one, with a brittle shell. There is but one species, *viz.* D. guianensis, guiana douglassia.

DOVE *tailing*, in carpentry, is the manner of fastening boards together by letting one piece into another, in the form of the tail of a dove. The dove tail is the strongest of the assemblages or jointings, because the tenon, or piece of wood which is put into the other, goes widening to the extreme, so that it cannot be drawn out again, by reason of the extreme or tip being bigger than the hole.

DOWER, the portion which a widow hath of the lands of her husband, after his decease, for the sustenance of herself and the education of her children.

DOWER *by the common law*, is a third part of such lands or tenements whereof the husband was sole seised in fee-simple, or fee-tail, during the marriage, which the wife is to enjoy during her life; for which there lies a writ of dower.

DOWER *by custom*. This kind of dower varies according to the custom and usage of the place, and is to be governed accordingly; and where such custom prevails the wife cannot wave the provision thereby made for her, and claim her thirds at common law, because all customs are equally ancient with the common law itself.

DOWER *ad ostium ecclesiæ*, is where a man of full age, seised of lands in fee, after marriage, endows his wife, at the church door, of a moiety, a third, or other part of his lands, declaring them in certainty; in which case, after her husband's death she may enter into such lands without any other assignment, because the solemn assignment at the church door is equivalent to the assignment *in pais* by metes and bounds; but this assignment cannot be made before marriage, because before she is not entitled to dower.

DOWER *ex assensu patris*, is where the father is seised of lands in fee, and his son and heir apparent, after marriage, endows his wife, by his father's assent, *ad ostium ecclesiæ*, of a certain quantity of them; in which case, after the death of the son, his wife may enter into such parcel without any other assignment, though the father be living; but this assent of the father's must be by deed, because his estate is to be charged *in futuro*, and this may likewise be of more than a third part.

The dowers *ad ostium ecclesiæ*, or *ex assensu patris*, if the wife enter and assent to them, are a good bar of her in common law; but she may, if she will, wave them, and claim her dower at common law, because, being made after marriage, she is not bound by them.

DOWN, the shortest, smoothest, softest, and most delicate feathers of birds, particularly geese, ducks, and swans; growing on their neck and part of the stomach. Down is a commodity of most countries; but that in most repute for fineness, lightness and warmth, comes from Denmark, Sweden, and other northern countries. There is a down called ostrich down, otherwise ostrich's hair, and sometimes wool: it is of two sorts; that called the fine is used by hatters in the manufacture of common hats, while the coarse is used for making lists for white cloth.

DOXOLOGY, an hymn used in praise of the Almighty, distinguished by the title of greater and lesser.

DRABA, in botany, English *whitlow grass*, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosæ, or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle entire, oval oblong; valves flattish parallel to the dissepiment; style none. There are nine species, of which one is D. aizoides, hairy-leaved Alpine whitlow grass. It has a perennial root; the stem is three inches high; petals entire, silicle hairy, rough, ovate, sharp at both ends; ending in a long style. This is a pretty plant, well adapted to rock work, having a sweet smell. It is a native of the mountains of France, Switzerland, Savoy, Austria and Silicia. Draba verna, or D. hispidula of Michaux, is the earliest of the spring flowers in the United States. It flowers from the last of Feburary to the autumn.

DRACHM, a Grecian coin, of the value of seven pence three farthings. This was also the name of a kind of weight, consisting of three scruples, and each scruple of two oboli. As to the proportion that the drachm of the Greeks bore with the ounce of the Romans, Q. Remnius, in his poem of weights and measures, makes the drachm the eighth part of an ounce, not much different from the crown of the Arabians, which weighs something more than the drachm.

Drachm is also a weight used at present by physicians, containing sixty grains, or the eighth part of an ounce.

DRACO, the *dragon*, in natural history, a genus of Amphibia, of the order Reptiles. Generic character: body four-footed, and tailed, and supplied on each side with an expansile membrane, strengthened by radii or bony processes. Of these animals there is only one species, D. volans, or the flying dragon. This is about four inches in length, exclusively of the tail, which is generally six or seven. Its colour is a beautiful pale blue. It abounds in various parts of Africa and Asia, and resembles the genus of lizards (to which it has by some naturalists been attached,) in ranging along the boughs, feeding on the insects, which are, in those situations, amply supplied for its subsistence. It is perfectly gentle and inoffensive. It is distinguished from lizards by being accommodated with large, expansile, cutaneous processes, supported by ribs, which reach to the extremity of this membrane, and by which the animal contracts or extends it. This representation of the flying dragon is totally different from what must be expected by those who are unacquainted with natural history, and whose ideas of the dragon are formed on the monstrous creations of poetry and romance. Though little adapted to excite terror, however, the flying dragon is well calculated to gratify curiosity. See Amphibia, Plate I. fig. 1.

Draco, a constellation of the northern hemisphere. See Astronomy.

DRACOCEPHALUM, in botany, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Scrophulariæ, Jussieu. Essential character: corolla throat inflated, upper lip concave. There are fifteen species. These are mostly herbaceous. The stalks are square, the leaves opposite in pairs. The flowers are either in whorls, forming altogether a spike at the end of the stalk, or axillary on one-flowered or many-flowered peduncles; they are supported by bractes, which are generally broad, and sometimes ciliate.

DRACÆNA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Sarmentaceæ. Asparagi, Jussieu. Essential character: corolla six-parted, erect; filaments somewhat thicker in the middle; berry three-celled, one seeded. There are fourteen species, mostly natives of the East Indies and Cochin China.

DRACONTIUM, in botany, a genus of the Gynandria Polyandria class and order. Natural order of Piperitæ. Aroideæ, Jussieu. Essential character: spathe boat-form; spadix covered; calyx none; petals five; berries many-seeded. There are five species, of which D. polyphillum has a large, knobbed, irregular root, covered with a rugged brown skin. The stalk rises about a foot in height, it is smooth, and of a purple colour, full of sharp protuberances of various shades, shining like the skin of a serpent; it is naked to the top, where it has a tuft of leaves, divided into many parts. The flower-stalk rises immediately from the root, and is seldom more than three inches high, having an oblong swelling hood at top, which opens lengthwise, showing the short, thick pointed style within, upon which the flowers are closely ranged. This plant grows naturally in several islands of America.

DRAGON. See Draco.

Dragon's *blood.* See Pharmacy.

DRAINING. See Agriculture.

DRAMA, a poem, in which the action is represented.

To the Greeks we owe the invention of both forms of dramatic composition, tragedy and comedy. These exhibitions were extremely simple. The action was continued from beginning to end without pauses or intervals; there was no change of scene: and the attention of the spectators was continually occupied either by the actors or the chorus. It was necessary, therefore, in order to give probability to the fiction, that the rule of the three unities should be strictly observed. The poem was confined, and the same action, out of which arose the incidents requisite to support it to its conclusion, and all tending to one great point. No episodes were admissible, but such as were so connected with the main story, as not to be suppressed or transposed without altering or destroying the plot. The unity of place, on a stage which admitted of no change of scene, must, of course, be rigorously attended to, and the fable so constructed as to draw all the characters to the same spot. This, notwithstanding the inconveniences which arose from it, was an indispensable rule, as any violation of it would completely destroy the illusion. The time, strictly speaking, was that of the representation. It might comprehend twenty-four hours, but by no means could it extend beyond that time. The precept of Aristotle even goes to describe the length of the poem; it could not exceed thirteen or fourteen hundred verses.

A drama composed on these principles could afford but little variety of incident and character; it must depend for its success on the poetical talent of its author, and on the interest he could thereby excite in the breasts of his audience for the characters he introduced.

The modern stage gives wider scope to the imagination, and renders the strict observance of the unities less necessary. The introduction of pauses by the division of acts justifies a change of scene, and also allows a longer extension of time, without any violation of probability. Thus, a greater range of subjects for dramatic representation is provided, while at the same time, as the obstructions of art are removed, the mirror, if we may so express it, becomes more true to nature. The poet may so construct his drama, as to lead the imagination of his audience along with him, and thus may pass in review the striking events of history; while, by the aid of scenic illusion, the transition from place to place becomes as consistent with probability as the transition from one period of time to another.

Yet there are, who insist on the application of the Grecian rules to the modern drama. The French, in particular, observe them strictly. Their best pieces are composed on the ancient model; the scene never changes, and the action continues and ends on the same spot where it is supposed to begin. The time, likewise, seldom exceeds that prescribed by the Greek critic, and is often confined to that of the representation. Hence the national taste is so decidedly formed, that the best production of the English school would only afford them matter of ridicule, for its obvious violation of the long established laws of criticism.

The unity of action is certainly essential to that probability which supports the theatrical illusion. Yet even the observance of this rule is not incompatible with variation of scene, and extension of time, though it requires a masterly genius to manage them judiciously. In the works of our immortal Shakspeare we often see this talent exemplified. We be-hold in his Macbeth the transition from the hero to the villain, and view the awful retribution, though long withheld, yet finally overwhelm the guilty. Yet who thinks of objecting to so grand a play, because the scene shifts from Inverness to the English court and back again, or because a period of seventeen years elapses from the murder of Duncan to the death of the usurper.

Hence the rules ought to be subservient to the great end of dramatic representation, the instruction of mankind by impressive and striking lessons, and we may conclude, with our great critic, that "the unities of time and place are not essential to a just drama; and that, though they may sometimes conduce to pleasure, they are always to be sacrificed to the nobler beauties of variety and instruction; that a play written with nice observation of critical rules is to be contemplated as an elaborate curiosity, as the product of superfluous and ostentatious art, by which is shown rather what is possible than what is necessary."

DRAPERY, in sculpture and painting, signifies the representation of the clothing of human figures, and also hangings, tapestry, curtains, and most other things that are not carnations or landscapes. See Painting and Sculpture.

DRASTIC, in physic, an epithet bestowed on such medicines as are of present efficacy, and potent in operation; and is commonly applied to emetics and cathartics.

DRAUGHT, in trade, called also cloff or clough, is a small allowance on weighable goods, made by the king to the importer, or by the seller to the buyer, that the weight may hold out when the goods are weighed again.

The king allows 1*lb.* draught for goods weighing no less than 1*cwt*; 2*lb.* for goods weighing between 1 and 2*cwt.*; 3*lb.* for goods weighing between 2 and 3*cwt.*; 4*lb.* from 3 to 10*cwt.*; 7*lb.* from 10 to 18*cwt.*; 9*lb.* from 18 to 30, or upwards.

DRAWBACK, in commerce, an allowance made to merchants on the re-exportation of certain goods, which in some cases consists of the whole, in others of a part, of the duties which had been paid upon the importation.

Drawbacks were probably originally granted for the encouragement of the carrying trade, which, as the freight of ships is frequently paid by foreigners in money, was supposed to be a more certain source of wealth than other branches of foreign trade. They are granted, not only on foreign commodities which have paid a duty on importation, but also on the exportation of such home manufactures as are subject to excise duties.

Upon the exportation of some articles of foreign produce, of which the quantity imported greatly exceeds what is necessary for the home consumption, the whole of the duties which had been paid on importation are drawn back. Thus, while the American states were under the dominion of Great Britain, they had the monopoly of the tobacco of Maryland and Virginia, of which about 96,000 hogsheads were annually exported, while the home consumption did not exceed 14,000: to facilitate the great exportation which was necesaary in order to get rid of the surplus, the whole duties were drawn back, provided the exportation took place within three years.

Drawbacks are paid by the collector of the customs at the port where the goods are exported, on producing a debenture, authenticated by the proper officers, as the authority or voucher for the payment.

Drawbacks can never, it is probable, be injurious: for they can never turn to any particular employment a greater share of the capital of the country, han would naturally go to that employment. They only prevent the natural tendency of capitals from being deranged by taxation. When the duties paid on the exportation of sugar or tobacco are returned on their exportation, the trade in those articles is only replaced on the situation it would have been in, if the articles had not been taxed.

A still more equitable arrangement than that of drawbacks is, to allow the merchant, who imports any commodity which he may probably wish to export again, to deposit it in the king's warehouses, giving a bond for payment of the duties, should he dispose of it for home consumption. This is called bonding, and is allowed to a considerable extent.

DRAWBRIDGE, a bridge made after the manner of a floor, to draw up or let down, as occasion serves, before the gate of a town or castle. See Bridge.

DRAWING is the art of expressing with accuracy the outline, or true boundary, of objects of every description on any plain superficies. This pleasing method of preserving the forms of persons and places, long after the originals have perished, or entirely changed, has been cultivated from the most remote antiquity, and received many improvements, which were frequently lost and recovered through the temporary patronage and neglect of the rich, under whose auspices only the art of drawing can ever flourish. To form a just conception of the earliest state of drawing, it will be necessary to recur to the distorted forms produced by man in an uncultivated state of nature, in which we may discover genius struggling with ignorance, and always without success; such were the productions of the first population of the world, and such are still the productions of European youth, before the kind hand of experience has pointed out the paths of correctness and taste. The scriptures furnish numerous proofs, that the art of drawing had before their date arrived to considerable perfection, and the remains of Egyptian sculpture, still extant, shew that people to have been tolerable proficients in delineating the outlines of men and animals; but the ancient Greeks appear to have studied nature with infinitely greater success, and we are indebted to them for the best of statues, formed with exquisite skill, from the most noble and graceful models of male and female beauty, which cannot be too frequently examined, and copied, by the student who wishes to excel. The Romans, inspired by emulation, imitated the Greeks, and although they never attained the excellence of their masters, have left multiplied specimens of correct knowledge in the human outline. Long after the fall of their empire, Italy produced a successsion of men, who brought the art of drawing almost to its greatest possible perfection; of those, Michael Angelo and Raphael were particularly celebrated, and though the latter seems to be most admired for his taste and correctness, the former once convinced him he had drawn the figures too small in a painting of Galatea, on the ceiling of a chamber in Il Picciolo Farnese, by sketching a large and admirable head of a Faunus on a wall with charcoal, which was preserved with the utmost care in Keysler's time, who relates the circumstance. Roused by the successful exertions of the Italians, every nation in Europe made their works their study, and many persons at different periods might be mentioned, belonging to each, who have excelled in particular branches of drawing; nor are the modern English at all inferior to their rivals in this essential foundation of all the ramifications of the fine arts, as, without truth in the drawing or formation of the outlines, a statue becomes a disgusting copy of human deformity, and objects delineated in painting or water colours, destitute of this requisite, the representations of creatures of the fancy, unlike those of nature or of art: from these positions it must be obvious, that the student should begin his operations with the greatest caution, acquiring a thorough knowledge of geometry, and the laws of perspective, which will enable him to comprehend the various circular forms adopted by nature, and the peculiar shapes they assume when placed in particular positions.

Drawing may be practised with lead, chalk, crayons, charcoal, water colours, and Indian ink.

To proceed regularly and methodically, the learner must be provided with wove paper, in other words, drawing paper, without wire marks, of different thicknesses and sizes, and middle tint paper, brown or grey, equally calculated to shew the white and black chalks, or coloured, for which it is expressly intended. As paper, when wet, will present an uneven surface, it becomes necessary to stretch it during the operation of colouring by means of drawing-boards, one description of which is merely a strong and true square of deal secured from warping, on which the paper may be fastened by wetting it with a sponge, tracing a border of paste or glue along the edges, and laying it smooth on the board; thus prevented from blistering, the drawing may be cut away from the border of paste when completed; but the most convenient board is composed of a square frame, with a moveable pannel, on which the paper is laid wet, then pressed into the frame, and secured by wedges on the back, when it will dry perfectly even, and become fit for use.

Other instruments required are, compasses for ascertaining distances between lines, forming circles, taking measurements by scale, &c. &c.; a steel pen, for drawing very fine clear lines; a parallel ruler, formed of two pieces of hard black wood fastened together by brass bands, turning on pivots at the extremities so exactly, that, when opened, lines drawn along the outward half must be parallel with the half held firm on the paper; and a T ruler or square so contrived as to supersede the above on the drawing board, by applying the stock or shortest end to the edge of the board, where it is slid backwards or forwards, and the long part used for tracing the line.

DRAWING.

The materials for drawing are, black-lead cut into long pieces, and inclosed in red cedar; the greatest care should be taken in the choice of black-lead pencils, as the inferior are nothing more than fragments of this mineral united by glue, which cannot be brought to a point by a knife, or made to produce a line for a minute together; on the contrary, the genuine black-lead cuts with ease, and yet has so much solidity, that considerable pressure will not break a taper point.

Indian-rubber, which is used for cleansing off erroneous lines made by the black-lead pencil; this singular substance, imported principally from south America in the shape of small bottles, and the East Indies in other forms, is composed of the gum of a tree, which, in hardening, becomes elastic, and possesses a strong adhesive property, extremely useful for removing dirt from drawings and prints.

Indian-ink is another valuable material, brought from China, where the secret of making it still remains; the real imported ink bears certain Chinese characters, breaks smooth and shining, is not gritty, and when used appears of a clear brownish black. The English imitation may be known by the harshness of its compotent parts.

Hair-pencils. The Chinese, who use the Indian-ink for writing, with a brush, make them very excellent for drawing, with white hair drawn through a reed; but those are difficult to procure, and camel's hair inserted in various sized quills are substituted, which are tried by slightly wetting them; if they form a point without separating, they are fit for use.

Chalks. It is common to sketch the outlines of figures with charcoal made from the willow, previous to the use of the chalk, as whatever errors may be committed with this material are easily effaced by the feathers from the wing of a duck or goose.

White chalk, for drawing, is harder than the common chalk, and pipe clay will make a good substitute.

Black chalk, is a hard fossil substance, cut into the shape of slate pencils, and used in steel or brass port-crayons, and with the white is constantly preferred in the model room of the Royal Academy, the professors of which consider it the best material for drawing from plaster figures or the life; red chalk is but little used at present. The French chalk is softer than the Italian.

Stumps made of soft leather, or paper rolled into cylinders, and pointed, are necessary for blending the lights and shades.

Thus prepared, the student must confine himself to the copying of single subjects, and by no means attempt groupes of objects, as the eye, more rapid than thought, will wander over them, and confound his ideas, not yet taught the faculty of discrimination; to attain this faculty, it is absolutely necessary to advance progressively, commencing with the geometrical figures of arches, circles, ovals, cones, cylinders, and squares, which, except the latter, have an evident resemblance to many of the forms of nature, and accurately attain the shading which produces their rotundity, convexity, angles, and most remote parts from the eye. Grapes detached from, or adhering in clusters to, the stalk, and many other fruits with their leaves, furnish excellent hints for the acquiring of graceful turns, and the art of placing justly, strong, direct, and reflected lights. Those require no rules or directions whatever, even in the colouring, as the tints may be composed from the originals. Trees should also be drawn singly, carefully observing the nature of the bark, the characteristics of the trunk, the particular ramifications of the branches, the form of the leaves, and their appearance in the aggregate, so that an observer shall, upon the first inspection of the drawing, pronounce whether it is an oak, an elm, an ash, or a poplar.

Animals may be the next object of the learner's attention, a knowledge of the forms of which will be best obtained by examining the most approved drawings and prints, copying them, and comparing them with living subjects, carefully avoiding in future such errors as may be discovered; he may then proceed to the human figure, commencing his labours with drawing the eye, mouth, nose, feet, hands, &c. separately, till he is perfect, when the whole figure may be attempted. The copying of inanimate substances requires but few directions, as they lay fixed, and may be placed in any position; but it is far otherwise in drawing from animals or man, for which reason an accurate knowledge of the true shape of the bones, the disposition of the muscles, and the exact relative proportions of the different parts of the body, must absolutely be acquired; nor is this all that is necessary; motion continually varying the appearance of the muscles, the student must learn from living subjects every swell or depression in them, which is not the consequence of unnatural distortion: as there are certain limits to their motion, he should be capable of ascertaining those limits correctly from remembrance. It having pleased the divinity to grant the human race the most graceful variety of curved forms throughout the exterior of their frames, and each being subject to sudden and unexpected changes, we may safely assert the artist has a most difficult task in his attempts to delineate them; in order to do so successfully, it would be well for him to imitate the parts already mentioned from good drawings, with black lead, or black chalk, on either of the papers before recommended, endeavouring to give a close resemblance of the outlines with charcoal, and then shading with the greatest care, after the original, in parallel lines of greater or less strength, according with the curve to be expressed, those to be intersected by others forming lozenge intervals; this mechanical part of the art of shading will be better explained by the drawing copied from, than by any directions, and much trouble will be saved by using the middle tint paper; but it should be remembered, that though black chalk can be used upon white paper, black lead must be confined to it. The shadows are sometimes softened off by the stump, yet clear hatched lines in the form above-mentioned have a better effect, not that we would recommend the servile resemblance of an engraving, imitations of this description never failing to injure the freedom of hand, essential in drawing well.

It is necessary that the student should by no means depend upon his own judgment in selecting drawings or prints for copying; those of acknowledged excellence by or after the best masters are to be exclusively preferred, otherwise error would be perpetuated, and the arts would fall into irrecoverable contempt; he will soon see the necessity for this precaution, and learn to look with disgust upon deformity and mediocrity. Supposing the student perfect in his imitations of the different parts of the face, his next step will be to draw the head in every natural position, which forms an introduction to the whole figure, admitting him to have a competent knowledge of the human skeleton and the muscles, as those are the only branches of anatomy useful in drawing; to accomplish this, or confirm his ideas, he should attend lectures on that intricate science, confining his attention solely to the demonstrations and observations applicable to his pursuits, afterwards examining their effects as discoverable in a living subject, and in drawing either from that, or good plaster figures, he should begin with the most prominent muscles, which will facilitate his progress with the less.

The young artist ought, if practicable, to visit the Royal Academy, London, where he will see, at a glance, how the light should be disposed to draw with effect; if that is impossible, he must remember to throw one light downward on the object, whether it proceeds from the day or a candle: and that he cannot too strictly attend to the true proportions of the body and limbs, as nothing is more disgusting than to see a man with a head unnaturally large, an enormous mouth, short legs, or too long arms; to prevent his falling into such errors, let him observe, that in a well-formed person, his arms extended make a distance between the extremities of the middle fingers equal to his length; that the face consists of three exact divisions, from the hair on the forehead to the eyes, from the eyes to the bottom of the nose, and from that to the chin. The whole figure is ten faces in length; from the chin to the collar bone is twice the length of the nose, thence to the lowest part of the breast one face, from that to the navel another, to the groin one, to the upper part of the knee two, the knee is half a face in length, from the lower part of which to the ancle is two faces, and hence to the sole of the foot is one half. Measuring from the extremes of the breast, the breadth will be found to contain two faces, and the bone of the arm from the shoulder to the elbow, the same number; thence, including part of the hand, two faces; and from the shoulder-blade to the hollow between the collar-bones is one face. The thumb is the length of the nose; from the commencement of the hand to the middle of the arm is five lengths of the nose: and from the pectoral muscle to the same place is four. The great toe is of the length of the nose, and the sole of the foot is the sixth part of the length of the figure; the hands are double their breadth in length, and when extended they are exactly the length of the face. The breadth of the limbs vary according to the state of health in the body, and the particular situation of the muscles whenever moved.

The proportions of children are generally thus; three heads in length from the crown of the head to the groin, and thence to the sole of the foot two, one head and a half between the shoulders, one of the body between the hips and armpits; the breadth of the limbs should be ascertained from a healthy child.

It is perhaps impossible to draw a perfectly beautiful figure from any one person: the most skilful statuaries and painters, sensible of this fact, have composed their finest works from different subjects, as it is very common for the possessor of a truly Grecian head to have a deformed trunk, or another to have graceful limbs and the face of a gorgon. To draw a figure correctly, the intended length should be marked, and all the preceding admeasurements strictly adhered to, beginning the sketch on the left hand, with the head, following with the shoulders, the trunk, the leg most in action, then the other, finishing with the arms, and making the outline perfect before any part is finished; as we may imagine a living or plaster model placed before the student, that will serve better for improving him than any written instructions, but he will find the greatest difficulty in correctly copying the eyes, mouth, ears, hands, and feet, and should consequently be particularly careful when employed on those parts to which rules are utterly inapplicable.

To represent the passions well, every possible attention must be paid to their particular influence on the muscular system; certain determinate attitudes follow each sensation of the soul, and it is the muscles which express their energy; in sleeping or quiescent bodies, they are not obtruded on the view; but when their action is excited by some pleasing or horrible cause, they become tense, or relax, and are partially very prominent; the laocoon, and several of the single figures of gladiators, are good studies for the muscles; indeed the modern brethren of the latter, of pugilistic celebrity, might afford many useful hints of manly exertion: it should be recollected, that the most violent emotions of the female sex do not produce the same appearances in their muscles as is observable from similar causes in men, it would therefore be very improper to shew them as prominently; in addition, persons in the lower ranks of life ought to be represented more muscular than the members of the highest orders of the community. (See article Muscles, in ANATOMY).

Drawing of Drapery follows: in this particular, we are in a great measure compelled to have recourse to the ancients, as, however convenient our modern habits may be, they are decidedly ungraceful opposites to the tasteful clothing of antiquity; for this reason every beautiful example from that pure source ought to be studied, carefully distinguishing the light, airy dresses of the heathen deities, and angels of more recent conception, and their almost transparent folds clinging through motion to their forms, from those intended expressly to cover nakedness, and preserve the person from the ill effects of cold air, observing, besides, the particular shapes of garments, characteristic of the Jewish, Grecian, or Roman nations.

Many statuaries have erred in representing their figures as if clothed in wet linen, in order to shew the contour of the limbs to greater perfection; but this absurdity carries its own condemnation with it. It must be obvious to the most superficial observer, that the texture of drapery should be suited to the inner or outward habit, and its richness, or the reverse, to the situation of the party represented: to determine this point with accuracy, it will be proper to read such works as describe the official and other habits of ancient times, and compare their descriptions with antique statues and paintings: the ornaments and insignia of the rich and powerful may be known by the same means.

In drawing of fine linen, the folds should be made delicate, inclined to angles, and numerous, or otherwise, according to the disposition of the habit on the body; where it is confined by a girdle, or broach, they are multiplied, and in lines; but those should neither be parallel nor disposed like rays: the reflected and transparent lights are particularly pleasing in this material, nor are the shades ever deep and harsh. In clothes made of wool, care must be taken to shew it fine on the rich, and coarse on the poor; in either case the folds should be large, and by no means numerous, partly cylindrical in their form, sometimes angular, and at others waved; the lights must not be very strong, but the shades deep, and the reflected lights faint, if the colour of the dye is dark. Silks fall into the least graceful folds of any material used in clothing; it will be best therefore to draw them from reality, endeavouring to catch the most natural, and copying with great attention the brilliant edges which are their characteristics, and the numerous reflections occasioned by the gloss on the inferior projections. Jewels and ornaments of gold, embroidery, &c. will at times be useful, but there are no rules applicable to the drawing of them. In the general disposition of the drapery, the posture of the figure and of the limbs must uniformly be consulted; they must accord, or there can be no other effect than stiffness in the person represented. Drapery gently agitated by the wind, in running or flying figures, has a good effect when it is made to flow in one direction, and not too much extended; the lights require great care, and should be directed on the most rotund parts, and those must not be crossed by dark shade, or the limbs or body so treated will appear broken.

Lest it should be supposed the foregoing rules are rather calculated for a person in some degree acquainted with the art of drawing, than one beginning with the first rudiments, we shall descend to still further minutiæ.

When a picture highly varnished, a drawing in brilliant colours, or glazed print, is to be copied, it should be placed in a reclining position, that the light may not glare on it and confuse the eye; if the painting is large, the distance should be proportionably increased, so as to enable the copyist to see the whole at once. After marking the spaces between the features, and the different parts of the body, the outlines must be faintly sketched; and if the subject contains several figures, it will be proper to find the centre, and mark it, which will give the learner an opportunity of ascertaining the places of the most conspicuous correctly on either side. Having completed the outline, it must be critically examined, and amended where faulty, ere the least attempt be made at finishing. If a print is to be imitated, the lines which compose it are to be followed in every particular with a good pen and Indian ink, as an engraving supersedes all directions.

There are several useful rules to be observed in drawing a truly proportioned head and face: the former contains four equal parts, measuring from the crown to the upper part of the forehead, to the eyebrows, to the lower part of the nose, and to the chin. The first step towards drawing a full face is to form an oval, through which make a perpendicular line, and a second across the centre, then divide the former into four equal parts, the first is to include the hair, the second the forehead, the third the nose, and the last the lips and chin; the transverse line is to be considered five times the length of the eye, one length of which is to be left for the space between the organs of sight; the ears should never be higher than the eye-brows, nor lower than the bottom of the nose; the mouth is the length of the eye, and the middle of it must be on the perpendicular line, and the exterior of the nostrils ought not to extend beyond the inner corner of the eyes. To illustrate the above directions prcatically, they may be followed on an oval of wood made for the purpose, which, when turned sideways, upwards, or downwards, will shew the true lines of the face in those positions. See Plates—Drawing. In drawing the profile, the line of the oval is still to be preserved, but the projections of the nose, &c. must be left to the learner's observations on living figures. It has been observed by an eminent painter, that nothing is more easy than to represent an infant smiling, or under the influence of grief, which is accomplished by raising the corners of the mouth in the first case, and depressing them in the second: in smiling, the eye-brows undergo but little alteration; but in frowning, they are violently contracted, and drawn towards each other. In other parts of the figure, care should be taken to avoid shewing the muscles too strong, even in representing large persons; in youth they are less visible, and in corpulent figures they are almost concealed from view. In the breadth of the limbs it will be found, that the calf of the leg is double the diameter of the ancle, and that the largest part of the thigh is three times the diameter of the smallest.

Drawing of Landscapes. The science of perspective is so absolutely necessary in this branch of the art, that it must be acquired before the student attempts to copy a drawing or print; for although the heights of trees, bushes, hills, &c. &c. vary greatly, yet there is a general and palpable declension in the relative proportions as they retire from the eye; besides, if a building intervenes, the want of truth in this particular becomes instantly obvious.

When the student is master of perspective, he may proceed to copy good drawings, either with black lead pencils or chalk, according to the paper he adopts; but he should prefer those only that give a clear and distinct idea of the outline, as he cannot possibly comprehend the forms of objects which are mixed and lost in others, merely to bring the light into a focus for brilliant effect: it would not be amiss, at the same time, to draw detached objects, till their forms are perfectly and correctly obtained; having accomplished this point, groupes will be more easily understood and copied. Shading with the above materials must be governed by the objects drawn from: in using Indian ink, the student should lay on the colour exceeding faint next the light, and deepen the shade gradually; and we would recommend him to confine himself to it till a good judge of his merit pronounces he may attempt colouring, as he should remember his aim is to become a skilful artist by regular progression, and not a mere gaudy colourist, to entrap vulgar applause. When the student arrives at this most difficult and arduous branch of the art, he cannot too attentively consult the best specimens of colouring within his reach, remarking how the tints of the air in the zenith are generally treated, which is of a purer blue than on the horizon, where the vapours, continually floating near the earth, become more visible, and are tinged with yellow or purple, according to the position of the sun, and their form when condensed and raised in clouds, which partake of the same tints from the same cause, their transparency in some parts, their dazzling light, reflections, and deep shades, in others. He will perceive that the experienced artist, sensible of the existence of moisture in the air between him and the remotest objects, has shewn very distant hills obscured by blue, or faintly purple vapours, which, becoming less dense in nearer objects, are gradually made more perfect, till those in the front of the drawing exhibit a decided boundary, and clearly defined lights and shades. Contrary to Sir Isaac Newton's opinion, that the rays of the sun contained seven primitive colours, more modern philosophers insist there are but three, blue, red, and yellow; those must therefore serve as the grand basis in colouring; but as nature never glares in fierce tints, they should be tempered according to her dictates, and for the causes mentioned above. No one colour should prevail in a good landscape, neither should they be disposed in the prismatic form, but all parts ought to harmonize, and give a pleasing aggregate. The colouring of objects in the fore-ground requires particular attention, as neither a wall, a bank, or a tree, presents one uniform tint; on the contrary, the stones, or bricks, of which the first is composed, always differ from each other in colour; besides, the trickling of dews, the vegetation of different species of moss, the corroding effects of time and the weather, produce characteristic effects extremely picturesque: this is equally observable on wood; and the bark of trees, and banks, present numerous tints in the sand, clay, and stones, of which they are composed, exclusive of the variety of plants scattered on their surface. The walls of castles and of monasteries adorned with beautiful masses of ivy, the north sides of houses in damp situations, and trees, are excellent subjects for contemplation in this particular; indeed, every substance in a state of decay seems to invite representation, by the beautiful properties they assume, which are still further observable as they become useless to the possessor. The peasant's house, in this instance, in complete ruins, with fallen bricks, or broken plastered sides, and almost without thatch, is more inviting to the artist, than all the splendour of Grecian facades and magnificent porticos.

In composing a drawing, the best parts of various views from nature should be selected, always remembering that those parts should never resemble each other, and that none of their lines should be parallel; if nothing more is intended than a good composition, such are to be obtained from reality, by merely correcting little errors committed by nature; for instance, a stream of water may flow in nearly a straight line through a most beautiful district, yet, thus represented, it would have a bad effect in the drawing; equally disagreeable are two or three hills of similar outlines ranged beyond each other: to turn the stream into a more serpentine form, or change the outlines of the hills, will, therefore, be no deviation from propriety: it is far otherwise in making a view of any particular place for topographical purposes; in that case, the object to be attained is not an unexceptionable drawing, but a true representation even of deformity.

The best colours are those sold in boxes, properly mixed with gum, which, rubbed on a tile, and diluted with water in the brush, flow readily, and are very clear: those commonly used will be found properly placed and named in the cases alluded to. Nothing will contribute more towards obtaining correctness in drawing, than a free and unembarrassed conduct of the black-lead pencil and port-crayon, which should not be held too near the points, nor should the rule and compasses be employed, except in making admeasurements and drawings of architecture; when copying from any given subject, it will greatly expedite the progress to imagine the picture or drawing divided into squares, and the paper in an equal number; by this means the true situation of each figure, within these imaginary squares, may be transferred to the same imaginary squares on the paper. A more mechanical method to copy in the same size as the original, or to reduce or enlarge the copy, is, to draw real lines across each, forming an equal number of exact squares, and numbering them throughout so as to correspond: threads stretched across a picture instead of lines must be less injurious to it, and ought to be preferred. The pentagraph is an useful instrument, invented for enlarging or reducing the outlines of pictures, drawings, prints, or plans, or copying them from the original size. In drawing from nature, much circumspection should be used in choosing the spot whence the view is to be seen, as a few feet or yards often make an essential difference in the beauty of the groupes and individual objects; a gentle elevation should be preferred, whence the eye may embrace a large circumference; then fixing upon some certain points, imagine several perpendicular lines, and marking an equal number on the paper, let the horizontal line intersect them; the objects to be represented are thus obtained as in the method of copying by squares. Every peculiarity of the landscape must be caught with avidity, the declination of lines, the apparent lessening of objects, the species of the trees, the tendency of the broken fragments on the edges of clouds, and the movements of the foliage and branches by the wind; the seasons should also be observed, as the lights vary greatly with them, and the colouring essentially. Raging billows, waterfalls, and clouds discharging rain, offer many particulars for minute observation, and the shadows of passing clouds have a beautiful effect, when chasing each other over the sides of mountains, or are spread like a veil over a large tract of country. In making the lights and shades of a landscape, it must never be forgotten, that, whatever place the sun may be in, the light can fall but one way, and that all the difference possible in the shades are their degrees of strength between morning, evening, and noon, and their strength at either extreme of the day, compared with the meridian; as they are very short at that period, and often intermixed with strong reflected light, experienced artists always prefer morning and evening, as productive of those golden and purple tints, which catch upon objects half buried in deep shadow, and give a beautiful effect to the landscape. Claude Lorrain was almost the only painter, who thought himself equal to representing the sun, and the silvery effect of its beams upon water; that he succeeded to admiration must be acknowledged, but it is extremely doubtful whether his pictures will ever be equalled: it is, however, certain, that the attempt has failed in every modern instance. As one step towards imitating the brilliancy of the orb of day, it has been the custom to suppose the sun just beyond the boundary of the picture, by making the sky clear and light on that side, and gradually fading thence through the landscape. As this method is founded upon just principles, the young artist may safely adopt it, though not as an indispensable rule; for the light breaking through clouds, and luminating the centre or front of a view, has an excellent effect, especially if that spot is animated by human figures or cattle. When a building, whether a modern or ancient edifice, is the principal object, the light should be thrown decidedly on it, though that on the sides of clouds next to the sun must be brightest. But as that may be considered too attractive of the attention from the building, the atmosphere ought to be rather dark and tempestuous; because, if there are few clouds, the light distributed on the globules of moisture floating in the air will overpower even the direct rays of the sun on an opaque body. In shading circular bodies, the light side ought not to cut hard upon the next object, but be softened into it in a slight degree; the brightest light succeeds, then the shading gradually deepens about three quarters through, after which the extremity catches a reflected light, and the outline blends with the tint behind it; in the same manner foliage, the edges of hills, &c. should combine with the light or shade behind them. In representing the angles of houses, the strongest shades must be next the light, whence they decline and become lighter: in this case, and in every particular relating to architecture, it will be most proper to draw from the works of the best masters, and finally from reality, as it is almost impossible to describe the consequence of every little light and shade projected from the ornaments. Contrast, when artfully contrived, is the true secret of producing relief; for instance, a plain light surface will not relieve from the paper; but if the same surface has part of its depth shaded, as if placed obliquely, it assumes solidity: thus, if too deeply darkened objects are connected, they will appear on the same line; but if a faint light, derived by reflection from some neighbouring substance, is thrown upon the most distant, it will detach itself, and give an idea of separation from the other: hence it follows, that shade should always be opposed to light throughout a landscape, but in that judicious manner pointed out by nature, whose operations in this case must be closely examined and ascertained, as they are often so faintly and capriciously performed as to elude an eye unaccustomed to accurate observation: let it be remembered, besides, that her contrasts are never violent and glaring, ever declining in force with the distance of the objects; those in the front of a view require the most attention, as, every part being near, they become perfectly distinct, and must be represented with the strongest colours suited to the substance.

There are some other rules proper in drawing; particularly, if a flower is to be copied from nature, it is usual to begin with the centre, proceeding thence with the leaves composing it to the extremities, which method enables the student to lay them one above another, in the correct and beautiful manner they are disposed by the Great Author of all things. In colouring those fascinating objects, infinite skill is required in blending their tints so as to keep each clear and bright. In observing birds, it will be found that the feathers of the head are smallest, whence they proceed to the tail in five ranges. In this instance, and in drawing animals, every precaution cannot be too closely attended to, which will give their true characteristics.

Having completed the necessary instructions for drawing by the improvement of a native genius, or inclination for the study of the fine arts, which is known to be inherent in some, and utterly unknown to the majority of mankind, we shall next notice what may be termed

Mechanical drawing, which is indispensable in many pursuits, and amusing to all, whose time might be less profitably employed. To draw plans, maps, and figures of new inventions well, geometry and perspective must be thoroughly understood, particularly if elevations and sections of buildings are attempted: to proceed regularly, the free use of the black pencil ought to be attained, after which the use of Indian ink with a fine pen should be acquired, with a facility of drawing lines either with or without a ruler, particularly curves beyond the range of a small compass: to those are to be added the doctrines of light, shade, and reflection, and an easy, careless method of shading, which is readily accomplished, if instruments of any kind are to be copied, as they may be placed in the most favourable light at pleasure. Taste is out of the question in this branch of the art, merely suited to the architect, the philosopher or mathematician, and the geographer. Young ladies of fortune, and persons fond of pleasant employment, may derive information from the following modes of proceeding in copying, tracing, &c. &c.

Tracing paper is readily made by taking a sheet of very thin silk, or other paper, and rubbing it over gently with some soft substance, filled with a mixture of equal parts of drying oil and oil of turpentine, which, suspended and dried, will be fit for use in a few days, or it may be had at any of the colour shops. Lay this transparent material on the print or drawing to be transferred, and with a sharp black lead pencil trace the outlines exactly as they appear through the paper. If more permanent or stronger lines are wished, ink mixed with ox-gall will be necessary to make it adhere to the oiled surface.

Tracing against the light: there are two methods; one to lay the print, &c. flat against a pane of glass, with thin paper over it, when the lines appearing through it are to be followed by the lead: the other is more convenient, and consists of a frame inclosing a square of glass, supported by legs, on which the paper is laid as before, and a candle placed behind the glass. A pen and ink may be used in this manner, but they cannot in the former instance.

Another method of using transparent paper. Take a piece of the size required, and rub it equally over on one side with black lead reduced to a powder, till the surface will not readily soil a finger, then lay a piece of white paper, with the blacked paper and leaded side next to it, under the print, and securing them firmly together with pins at the corners, proceed to trace the outlines with a blunt point, and some degree of pressure, which will transfer the lead to the clean paper precisely in the direction the point passed over the print: this may be corrected with the black-lead pencil, and cleansed of any soil by the crumbs of stale bread.

Copying drawings, &c. with fixed materials. Rub a thin piece of paper thoroughly and equally with fresh butter, and after drying it well by a fire, cover it with black-lead, as before-mentioned, or with carmine, lamp-black, or blue-bice, on the side which received the butter. When the operation has so far succeeded, as that the colour will not adhere to any substance passed over it, lay the coloured surface on white paper, the print on it, and trace the subject through with a point, as above.

To transfer any impression with vermilion. Mix the colour with linseed oil in a state sufficiently fluid to flow from the point of a pen, with which let every line of the print be accurately traced; then wet the back of it, and turning the face downwards on clean white dry paper, place other paper on the back, and gently rub or press it, till it may be supposed the red lines are completely transferred to the paper from the print.

Writing, or outlines of prints, may be conveyed exactly by the following method. Mix fine vermilion with water, of the same fluidity as ink, and putting it into a vessel containing cotton, use it with a pen in tracing over the subject, making the lines of the same breadth as the original; then wet white paper with gum-water spread by a sponge, and lay the vermilion tracing on it gently, pressing every part till the process is complete: when the print is withdrawn, the gum will retain the vermilion, and after it is dried they will become inseparable. This mode, except the gum and paper, is used by engravers, who secure the lines by wax on their copperplates.

There are numerous beauties in the skeletons or fibres of leaves: and it is at least a pleasing, if not an useful employment, to collect all, or a part of their varieties, which may be done with decisive accuracy as follows.

To obtain the true shape and fibres of a leaf, rub the back of it gently with any hard substance, so as to bruise the fibres, then apply a small quantity of linseed oil to their edges; after which press the leaf on white paper, and, upon removing it, a perfectly correct representation of every ramification will appear, and the whole may be coloured from the original.

Another way, which may be called printing of a leaf. This is effected by carefully touching the fibres with one of those balls, lightly covered with ink, used by printers, and impressing it on wet paper. This is done to most advantage by a round stick covered with woollen cloth, rolled backwards and forwards over the paper and leaf.

A substitute may be adopted by rubbing and bruising the leaf, oiling it as before, and scattering powdered black lead, charcoal, or the powder of burnt cork, on it, and pressing it on paper. Other colours may be used, prepared with butter or oil, of which blue-bice is the best, as it serves as a ground for colouring the leaf from nature. The back of the leaf must be exclusively preferred, as the fibres project on that side only.

Stenciling is a process well calculated for multiplying of patterns, for working in muslin, &c.; when a print or drawing is to be copied in this way, it must be placed upon a sheet of white paper, and the outline pricked through both with a pin or needle; the pierced sheet may then be laid on a second clean one, and a muslin bag of powdered charcoal shaken or rubbed over it, when, upon removing the former, the latter will be found a pefect copy.

The camera obscura makes the most pleasing representation of nature hitherto discovered, by which the external objects are reflected on any plane within the chamber in the liveliest colours, and every leaf and animal appear in motion; but unfortunately in a reversed position. The constructing of a camera obscura is a very simple operation: close all the windows of an apartment, and leave a single circular aperture, suited for the reception of a convex or plane convex lens in the shutter of that which faces the greatest variety of landscape; then place any smooth white surface before it, at the proper distance, which is to be determined upon the same principle as the movement of the glasses of a telescope, and every portion of the view will be exhibited on it. If the least ray of light makes its way through any other means, the effect will be destroyed; and it will be heightened, if the atmosphere is clear and the sun shines bright.

The portable camera obscura resembles a wooden box or chest, furnished with a circular or angular projection in the middle, opening from it, and to be directed towards the landscape; beyond this aperture, and within the box, is placed a small mirror inclined to an angle of 45 degrees, serving to reflect the exterior rays on a convex lens set in a tube, and the light streaming from this will convey the true forms and colours of the landscape to a paper situated at the proper distance to receive them; this beautiful picture is viewed through an oblong aperture, and may be copied with equal facility and advantage; indeed the most experienced artist may obtain hints from the camera obscura, which might escape his notice in drawing directly from reality. The literally darkened chamber furnishes the means of improvement, though some little contrivance is necessary to use them conveniently, and obviate the unpleasant circumstances attending the drawing the reversed objects; it may, however, be recollected, that any thing drawn in this position will become right on turning the paper; or the person desirous of so doing may place the paper on some low article of furniture, and standing over it, view every part in its proper state; but the portable camera obscura, being expressly intended for making of correct drawings, should be preferred, as it affords a horizontal plane for the hand to rest on conveniently.

Transparencies were not long since extremely fashionable, as blinds for windows, and substitutes for painted glass; indeed authors and artists have been known to venture quarto volumes on the subject. Their effect is certainly pleasing, when the lights are clear and brilliant, and the shades judiciously contrasted with them; but those, like every product of the fine arts under the same circumstances, become contemptible, when incorrectly executed. The choice of the subject is of great importance in each branch of drawing, and none more so than those for transparencies, for which moon-light and fire-light scenes are generally adapted, as both are capable of producing great richness in the tints, and when introduced with ruins are more particularly attractive: for instance, the court of an ancient feudal castle, surrounded by fragments of walls, pierced with windows of magnificent mould, through which the foliage of the ivy hangs in grand festoons, grouping with the aspiring ash, the branches of the latter silvered by moon-light, gleaming between various towers retiring each beyond the other, and waving over the deep shades of the former, at the same time faintly illuminating the gliding figures of midnight plunderers, seen passing through the gateway.

Having excited attention to the nature of the best subjects, it will be necessary to say how they should be treated. Fix the paper intended for this purpose in a straining frame, draw the design, and colour it in the usual manner; then placing it against a window, examine where the shades require strengthening, which will be sometimes necessary on the back of the drawing, and with the opaque substances of ivory or lamp-black, mixed with gum water; having completed it to the due effect, the brightest parts, as the moon or a fire, are to be impregnated with spirits of turpentine on each side of the paper, and the next lights on one side only; those must be covered again with a varnish, composed of two equal portions of spirits of turpentine and Canada balsam, but with great care, lest it spread beyond the desired limits. The moon must not be coloured, but fire and flame will require red lead and gamboge.

There is one other process, which will be entertaining to a studious mind, destitute of any particular partiality for the arts, which is, preparing a sheet of thin white-brown paper, by passing a brush over it filled with oil of turpentine; thus made transparent, it is to be strained upon a frame, and placed against any object that may be preferred; then take a perforated board suited to the eye, and looking through it, draw the outline observable on the transparent paper with a black-lead pencil; the shading of the object may be obtained very correctly by this means, with a little attention; but it should be done rapidly, as the position of the shadows continually vary with the motion of the sun: to facilitate this part of the operation, it would be well to make several degrees of colour, and number them as they appear on the paper, in order to finish the drawing at more leisure.

Drawing *a cast*, among bowlers, is winning the end, without stirring the bow or block.

Drawing, *fine*, among taylors, the art of sowing up button-holes, or any rents in cloth, in so nice a manner, as that they cannot be discovered from the entire part of the cloth.

DREAMS have been described as the imaginations, fancies, or reveries of a sleeping man, and they are said to be deducible to the three following causes: 1. The impressions and ideas lately received, and particularly those of the preceding day. 2. The state of the body, particularly the stomach and brain; and, 3. Association. That dreams are, in part, deducible from the impresssions and ideas of the preceding day, appears from the frequent recurrence of these, especially of the visible ones, in our dreams: in general, ideas that have not affected the mind for some days, recur in dreams only from the second and third causes. That the state of the body affects our dreams, is evident from the dreams of the sick, and of those who labour under indigestions, spasms, and flatulencies; and a little observation will shew that we are carried on from one thing to another in our dreams partly by association. In proof of what we have advanced, we may observe, 1st. That the scenes which present themselves in dreams are taken to be real, and we suppose ourselves present, and actually seeing and hearing what passes, which is occasioned by there being no other reality to oppose to the ideas which offer themselves; whereas, in the common fictions of the fancy, while we are awake, there is always a set of real external objects striking some of our senses, and precluding a like mistake there. Again, the trains of visible ideas, which occur in dreams, are far more vivid than common visible ideas, and may therefore be more easily taken for actual impressions. 2dly. There is a great wildness in our dreams; for the brain, during sleep, is in a state so different from that in which the usual associations were formed, that they can by no means take place during vigilance. The state of the body suggests such ideas, among those that have lately been impressed, as are more suitable to various kinds and degrees of pleasant and painful emotions, excited in the stomach, brain, or other part. Thus a person who has taken opium sees either gay scenes or ghastly ones, according as the opium excites pleasant or painful sensations in the stomach. Hence, it will follow, that ideas will rise successively in dreams, which have no such connection as take place in nature in actual impressions, nor any such as is deducible from association; and yet, if they rise up quickly and vividly, one after another, as subjects, predicates, and other associates use to do, they will be affirmed of each other, and appear to hang together. Thus the same person appears in two places at the same time; two persons, appearing successively in the same place, coalesce into one; a brute is supposed to speak; any idea, qualification, office, &c. coinciding in the instant of time with the idea of one's self, or of another person, adheres immediately, &c. &c. 3dly. We do not take notice of, or are offended at, these inconsistencies, but pass on from one to another. For the associations, which should lead us thus to take notice, and be offended, are, as it were, asleep; the bodily causes also hurrying us on to other and new trains successively. But if the bodily state be such as favours ideas of anxiety and perplexity, then the inconsistency, and apparent impossibility, occurring in dreams, are apt to give great disturbance and uneasiness. It is to be observed, likewise, that we forget the several parts of our dreams very fast in passing from one to another; and that this lessens the apparent inconsistencies, and their influences. 4thly. It is common in dreams for persons to appear to themselves to be transferred from one place to another by a kind of sailing or flying motion. This arises from the change of the apparent magnitude and position of the images excited in the brain, this change being such as a change of distance and position in ourselves would have occasioned. Whatever the reasons be, for which visible images are excited in sleep, like to the objects with which we converse when awake, the same reasons will hold for changes of apparent magnitude and position also; and these changes, in fixed objects, being constantly associated with motions in ourselves when awake, will infer these motions when asleep. But then we cannot have the idea of the *vis inertiæ* of our own bodies answering to the impressions in walking; because the nerves of the muscles either do not admit of such miniature vibrations in sleep, or do not transmit ideas to the mind in consequence thereof; whence we appear to sail, fly, or ride. Yet sometimes a person seems to walk, and even to strike, just as in other cases he seems to feel the impression of a foreign body on his skin. 5thly. Dreams consist chiefly of visible imagery. This agrees remarkably with the perpetual impressions made upon the optic nerves and corresponding parts of the brain during vigilance, and with the distinctness and vividness of the images impressed. 6thly. It may be observed, that many of the things which are presented in dreams appear to be remembered by us, or, at least, as familiar to us; and that this may be solved by the readiness with which they start up, and succeed one another in the fancy. 7thly

Dreams ought to be soon forgotten, as they are in fact; because the state of the brain suffers great changes in passing from sleep to vigilance. The wildness and inconsistency of our dreams render them still more liable to be forgotten. It is said, that a man may remember his dreams best by continuing in the same posture in which he dreamt, which, if true, would be a remarkable confirmation of the doctrine of vibrations; since those which take place in the medullary substance of the brain, would be least disturbed and obliterated by this means. 8thly. The dreams which are presented in the first part of the night are, for the most part, much more confused, irregular, and difficult to be remembered, than those which we dream towards the morning; and these last are often rational to a considerable degree, and regulated according to the usual course of our associations. For the brain begins then to approach to the state of vigilance, or that in which the usual associations were formed and cemented. However, association has some power even in wild and inconsistent dreams.

DREIN, in the military art, a trench made to draw the water out of a moat, which is afterwards filled with hurdles and earth, or with fascines, or bundles of rushes and planks, to facilitate the passage over the mud.

DRESSING *of ores*, the breaking and powdering them in the stamping mill, and afterwards washing them in a wooden trough.

Dressing, in surgery, the treatment of a wound or any disordered part. The apparatus of dressing consists of dossils, tents, plasters, compresses, bandages, bands, ligatures, and strings.

Drift, in naval language, the angle which the line of a ship's motion makes with the nearest meridian, when she drives with her side to the wind and waves, and is not governed by the power of the helm. It also implies the distance which the ship drives on that line. A ship's way is only called drift in a storm, and then when it blows so vehemently as to prevent her from carrying any sail, or at least restrain her to such a portion of sail as may be necessary to keep her sufficiently inclined to one side, that she may not be dismasted by her violent labouring produced by the turbulence of the sea.

DRILL, in mechanics, a small instrument for making such holes as punches will not conveniently serve for. Drills are of various sizes, and are chiefly used by smiths and turners.

Drill, or Drill-box, a name given to an instrument for sowing land in the new method of horse-hoeing husbandry. It plants the corn in rows, makes the channels, sows the seeds in them, and covers them with earth when sown; and all this at the same time, and with great expedition. The principal parts are, the seed-box, the hopper, the plough and its harrow, of all which the seed-box is the chief. It measures, or rather numbers, out the seeds which it receives from the hopper, and is for this purpose as an artificial hand; but it delivers out the seed much more equally than can be done by a natural hand. See Agriculture.

DRINK, a part of our natural food in a liquid form, serving to dilute and moisten the dry meat. See Dietetics.

DRIVING, in the sea-language, is said of a ship when an anchor being let fall will not hold her fast, nor prevent her sailing away with the tide or wind. The best help in this case is to let fall more anchors, or to veer out more cable; for the more cable she has out, the safer she rides. When a ship is a-hull or a-try, they say she drives to leeward.

DRONE, in the history of insects, the male of the common honey bee, larger than the working bees; it is so called from its idleness, as never going abroad to collect either honey or wax. See Apis.

Drone, in music, the largest tube of the bag-pipe; the office of which is to emit one continued deep note, as an accompanying bass to the air or tune played on the smaller pipes.

DROPS, in meteorology, small spherical bodies which the particles of fluids spontaneously form themselves into, when let fall from any height. This spherical figure the Newtonian philosophers demonstrate to be the effect of corpuscular attraction; for, considering that the attractive force of one single particle of a fluid is equally exerted to an equal distance, it must follow that other fluid particles are on every side drawn to it, and will therefore take their places at an equal distance from it, and consequently form a round superficies.

Drops, in medicine, a liquid remedy, the dose of which is estimated by a certain number of drops.

DROPSY, in medicine, an unnatural collection of watery humours in any part of the body. See Medicine.

DROSERA, in botany, a genus of the Pentandria Pentagynia class and order.

Natural order of Gruinales, Capparides, Jussieu. Essential character: calyx five-cleft; petals five; capsule one-celled, five or three valved at the tip; seeds very many. There are nine species. These are herbs of a small size, and singular structure. The leaves in most of the species, near the root, are furnished with glandulous hairs on the upper surface, and fringed round the edge: these hairs have each a small globule of a pellucid liquor like dew, continuing even in the hottest part of the day, and in the fullest exposure to the sun. Hence their English name of sundew. D. acaulis is singular for having a sessile flower in the bosom of the root leaves. These plants have the property of entrapping small insects within their folded leaves. It was discovered by Mr. Whately, a surgeon. On inspecting some of the contracted leaves, he observed a fly in close imprisonment; and on centrically pressing other leaves, yet in their expanded form, with a pin, he observed a sudden elastic spring of them, so as to become inverted upwards, and as it were encircling the pin. The American species are 3. D. rotundifolia, D. Americana, and D. Tenuifolia.

DROWNING, signifies the extinction of life, by a total immersion in water. In some respects there seems to be a great similarity between the death occasioned by immersion in water, and that by strangulation, suffocation by fixed air, apoplexies, epilepsies, sudden fainting, violent shocks of electricity, or even violent falls and bruises. Physicians, however, are not agreed with regard to the nature of the injury done to the animal system in any or all of these accidents. It is, indeed, certain, that in all the cases above mentioned, particularly in drowning, there is very often such a suspension of the vital powers, as to us hath the appearance of a total extinction of them; while yet they may be again set in motion, and the person restored to life, after a much longer submersion than hath been generally thought capable of producing absolute death. It were to be wished, however, that, as it is now universally allowed that drowning is only a suspension of the action of the vital powers, physicians could as unanimously determine the means by which these powers are suspended; because on a knowledge of these means the methods to be used for recovering persons apparently drowned must certainly depend. We shall, in this place, give some directions on the subject, which have been recommended on respectable authority, and have been sanctioned by long experience.

Mr. Hunter observes, that when assistance is soon called after immersion, blowing air into the lungs will, in some cases, effect a recovery; but when any considerable time has been lost, he advises stimulant medicines, such as the vapour of volatile alkali, to be mixed with the air; which may easily be done, by holding spirits of hartshorn in a cup under the receiver of the bellows. And as applications of this kind to the olfactory nerves tend greatly to rouse the living principle, and put the muscles of respiration into action, it may probably, therefore, be most proper to have air impregnated in that manner thrown in by the nose. To prevent the stomach and intestines from being too much distended by the air so injected, the larynx is directed to be gently pressed against the œsophagus and spine. While this business is going on, an assistant should prepare bed-clothes, carefully brought to a proper degree of heat. Heat, our author considers as congenial with the living principle; increasing the necessity of action, it increases action; cold, on the other hand, lessens the necessity, and, of course, the action is diminshed: to a due degree of heat, therefore, the living principle, he thinks, owes its vigour. From experiments, he says, it appears to be a law in animal bodies, that the degree of heat should bear a proportion to the quantity of life; as life is weakened, this proportion requires great accuracy, while greater powers of life allow it greater latitudes. After these and several other observations on the same subject, our author proceeds to more particular directions for the management of drowned people. If bed clothes are put over a person, so as scarce to touch him, steams of volatile alkali, or of warm balsams, may be thrown in, so as to come in contact with many parts of the body. And it might probably be advantageous, Mr. Hunter observes, to have steams of the same kind conveyed into the stomach. This, we are told, may be done by a hollow bougie and a syringe; but the operation should be very speedily performed, as the instrument, by continuing long in the mouth, might produce sickness, which our author says he would always wish to avoid. Some of the warm stimulating substances, such as juice of horse-radish, peppermint water, and spirits of hartshorn, are directed to be thrown into the stomach in a fluid state, as also to be injected by the anus. Motion, possibly, may be of service; it may, at least, be tried; but as it hath less effect than any other of the usually prescribed stimuli, it is directed to be the last part of the process. The same care in the operator, in regulating the proportion of every one of these means, is here directed, as was formerly given for the application of heat. For every one of them, our author observes, may possibly have the same property of destroying entirely the feeble action which they have excited, if administered in too great a quantity: instead, therefore, of increasing and hastening the operations on the first signs of returning life being observed, as is usually done, he desires they may be lessened, and advises their increase to be afterwards proportioned, as nearly as possible, to the quantity of powers as they arise. When the heart begins to move, the application of air to the lungs should be lessened, that when the muscles of respiration begin to act, a good deal may be left for them to do.

Mr. Hunter absolutely forbids blood-letting in all such cases: for as it not only weakens the animal principle, but lessens life itself, it must consequently, he observes, lessen both the powers and dispositions to action. For the same reason he is against introducing any thing into the stomach that might produce sickness or vomiting: and, on the same principle, he says, we should avoid throwing tobacco fumes, or any other such articles, up by the anus, as might tend to an evacuation that way. The following is a description of instruments recommended for such operations by our author. First, a pair of bellows, so contrived with two separate cavities, that, by opening them when applied to the nostrils or mouth of a patient, one cavity will be filled with common air, and the other with air sucked out from the lungs, and by shutting them again, the common air will be thrown into the lungs, and that sucked out of the lungs discharged into the room. The pipe of these should be flexible; in length a foot, or a foot and a half, and at least three eighths of an inch in width. By this the artificial breathing may be continued while the other operations, the application of the stimuli to the stomach excepted, are going on, which could not be conveniently done, if the muzzle of the bellows were introducced into the nose. The end next the nose should be double, and applied to both nostrils. Secondly, A syringe, with a hollow bougie, or flexible catheter, of sufficient length to go into the stomach, and convey any stimulating matter into it, without affecting the lungs. Thirdly, A pair of small bellows, such as are commonly used in throwing fumes of tobacco up by the anus.

Within these few years great numbers of drowned people have been restored to life by a proper use of the remedies we have enumerated, and societies for the recovery of drowned persons have been instituted in different places. The first society of this kind was instituted in Holland, where, from the great abundance of canals and inland seas, the inhabitants are particularly exposed to accidents by water. In a very few years 150 persons were saved from death by this society; and many of these had continued upwards of an hour without any signs of life, after they had been taken out of the water. The society was instituted at Amsterdam in 1767, and, by an advertisement, informed the inhabitants of the United Provinces of the methods proper to be used on such occasions; offering rewards at the same time to those who should, with or without success, use those methods for recovering persons drowned, and seemingly dead. The laudable and humane example of the Dutch was followed, in the year 1768, by the magistrates of health in Milan and Venice; afterwards by the magistrates of Hamburg, in the year 1771: by those of Paris, in the year 1772; and by the magistrates of London in 1774.

The following directions are given for the recovery of drowned persons by the society at London: 1. As soon as the patient is taken out of the water, the wet clothes, if the person is not naked at the time of the accident, should be taken off with all possible expedition on the spot, (unless some convenient house be very near,) and a great coat or two, or some blankets, if convenient, should be wrapped round the body. 2. The patient is to be thus carefully conveyed in the arms of three or four men, or on a bier, to the nearest public or other house, where a good fire, if in the winter season, and a warm bed, can be made ready for its reception. As the body is conveying to this place, a great attention is to be paid to the position of the head; it must be kept supported in a natural and easy posture, not suffered to hang down. 3. In cold or moist weather the patient is to be laid on a mattress or bed before the fire, but not too near, or in a moderately heated room; in warm and sultry weather on a bed only. The body is then to be wrapped as expeditiously as possible with a blanket, and thoroughly dried with warm coarse cloths or flannels. 4. In summer or sultry weather, too much air cannot be admitted. For this reason it will be necessary to set open the windows and doors, as cool refreshing air is of the greatest importance in the process of resuscitation. 5. Not more than six persons are to be present to apply the proper means; a greater number will be useless, and may retard, or totally prevent, the restoration of life, by rendering the air of the apartment unwholesome. It will be necessary, therefore, to request the absence of those who attend merely from motives of curiosity. 6. It will be proper for one of the assistants, with a pair of bellows of the common size, applying the pipe a little way up one nostril, to blow with some force, in order to introduce air into the lungs; at the same time the other nostril and the mouth are to be closed by another assistant, whilst a third person gently presses the chest with his hands, after the lungs are observed to be inflated. By pursuing this process, the noxious and stagnant vapours will be expelled, and natural breathing imitated. If the pipe of the bellows be too large, the air may be blown in at the mouth, the nostrils at the same time being closed, so that it may not escape that way: but the lungs are more easily filled, and natural breathing better imitated, by blowing up the nostril. 7. Let the body be gently rubbed with common salt, or with flannels sprinkled with spirits, as rum or geneva. A warming pan heated (the body being surrounded with flannel) may be lightly moved up and down the back. Fomentations of hot brandy are to be applied to the pit of the stomach, loins, &c., and often renewed. Bottles filled with hot water, heated tiles covered with flannel, or hot bricks, may be efficaciously applied to the soles of the feet, palms of the hands, and other parts of the body. The temples may be rubbed with spirits of hartshorn, and the nostrils now and then tickled with a feather; and snuff, or *eau de luce*, should be occasionally applied. 8. Tobacco fumes should be thrown up the fundament: if a fumigator be not at hand, the common pipe may answer the purpose. The operation should be frequently performed, as it is of importance; for the good effects of this process have been experienced in a variety of instances of suspended animation. But should the application of tobacco smoke in this way be not immediately convenient, or other impediments arise, clysters of this herb, or other acrid infusions with salt, &c. may be thrown up with advantage. 9. When these means have been employed a considerable time without success, and any brewhouse or warm bath can be readily obtained, the body should be carefully conveyed to such a place, and remain in the bath, or surrounded with warm grains, for three or four hours. If a child has been drowned, its body should be wiped perfectly dry, and immediately placed in a bed between two healthy persons. The salutary effects of the natural vital warmth, conveyed in this manner, have been proved in a variety of successful cases. 10. While the various methods of treatment are employed, the body is to be well shaken every ten minutes, in order to render the process of animation more certainly successful; and children, in particular, are to be much agitated, by taking hold of their legs and arms frequently, and for a continuance of time. In various instances, agitation has forwarded the recovery of boys who have been drowned, and continued for a considerable time apparently dead. 11. If there be any signs of returning life, such as sighing, gasping, or convulsive motions, a spoonful of any warm liquid may be administered; and if the act of swallowing is returned, then a cordial in warm brandy or wine may be given in small quantities, and frequently repeated.

DRUG, a general term for goods of the druggist and grocery kinds, especially for those used in medicine and dyeing.

DRUGGET, in commerce, a stuff sometimes all wool, and sometimes half wool half thread, sometimes corded, but usually plain. Those that have the woof of wool, and the warp of thread, are called threaded druggets; and those wrought with the shuttle on a loom of four marches, as the serges of Beauvois, and other like stuffs, corded, are called corded druggets. As to the plain, they are wrought on a loom of two marches, with the shuttle, in the same manner as cloth, camlets, and other like stuffs, not corded.

DRUIDS, the priests or ministers of religion of the ancient Britons and Gauls The druids were chosen out of the best families; and were held, both by the honours of their birth and their office, in the greatest veneration. They are said to have understood astrology, geometry, natural history, politics, and geography: they had the administration of all sacred things, were the interpreters of religion, and the judges of all affairs indifferently.

Whoever refused obedience to them was declared impious and accursed; they held the immortality of the soul, and the metempsychosis; they are divided by some into several classes; they had a chief, or arch-druid, in every nation: he was a sort of high-priest, having an absolute authority over the rest, and was succeeded by the most considerable among his survivors. The youth used to be instructed by them, retiring with them to caves and desolate forests, where they were sometimes kept twenty years. They preserved the memory and actions of great men by their verses; but are said to have sacrificed men to Mercury. Cæsar imagined that the druids came from Britain into Gaul, but several among the modern writers are of a different opinion.

DRUM, is a military musical instrument, in form of a cylinder, hollow within, and covered at the two ends with vellum, which is stretched or slackened at pleasure, by the means of small cords and sliding knots. It is beat upon with sticks. Some drums are made of brass, but they are commonly of wood. There are several beats of the drum, as assembly, chamade, reveillé, retreat, &c.

Drum, *of the ear*. See Anatomy.

Drums, *kettle*, are two sorts of large basins of copper or brass, rounded in the bottom, and covered with vellum or goat-skin, which is kept fast by a circle of iron, and several holes fastened to the body of the drum, and a like number of screws to screw up and down. They are much used among the horse, as also in operas, oratorios, concerts, &c.

DRUMMER, he that beats the drum, of whom each company of foot has one, and sometimes two. Every regiment has a drum major, who has the command over the other drums. They are distinguished from the soldiers by clothes of a different fashion; their post, when a battalion is drawn up, is on the flanks, and on a march it is betwixt the divisions.

DRUNKENNESS, *theory of*. The common and immediate effect of wine is to dispose to joy, *i. e.* to introduce such kinds and degrees of vibrations into the whole nervous system, or into the separate parts thereof, as are attended with a moderate continued pleasure. This it seems to do chiefly by impressing agreeable sensations upon the stomach and bowels, which are thence propagated into the brain, continue there, and also call up the several associated pleasures that have been formed from pleasant impressions made upon the alimentary duct, or even upon any of the external senses. But wine has also probably a considerable effect of the same kind, after it is absorbed by the veins and lacteals, *viz.* by the impressions which it makes on the solids, considered as productions of the nerves, while it circulates with the fluids in an unassimilated state, in the same manner as may be observed of opium; which resembles wine in this respect also, that it produces one species of temporary madness. And we may suppose, that analogous observations hold with regard to all the medicinal and poisonous bodies, which are found to produce considerable disorders in the mind; their greatest and most immediate effect arises from the impressions made on the stomach, and the disorderly vibrations propagated thence into the brain; and yet it seems probable, that such particles as are absorbed produce a similar effect in circulating with the blood.

Wine, after it is absorbed, must rarefy the blood, and consequently distend the veins and sinuses, so as to make them compress the medullary substance, and the nerves themselves, both in their origin and progress; it must, therefore, dispose to some degree of a palsy of the sensations and motions, to which there will be a farther disposition, from the great exhaustion of the nervous capillaments and medullary substance, which a continued state of gaiety and mirth, with the various expressions of it, has occasioned. It is moreover to be noted, that the pleasant vibrations producing this gaiety, by rising higher and higher perpetually, as more wine is taken into the stomach and blood vessels, come at last to border upon, and even to pass into, the disagreeable vibrations belonging to the passions of anger, jealousy, envy, &c. more especially if any of the mental causes of these be presented at the same time.

Now it seems, that, from a comparison of these and such things with each other, the peculiar temporary madness of drunken persons might receive a general explanation. Particularly it seems natural to expect, that they should at first be much disposed to mirth and laughter, with a mixture of small inconsistencies and absurdities; that these last should increase from the vivid trains which force themselves upon the brain, in opposition to the present reality; that they should lose the command and stability of the voluntary motions, from the prevalence of confused vibrations in the brain, so that those appropriated to voluntary motion cannot descend regularly as usual; but that they should stagger and see double; that quarrels and contentions should arise after some time; and all end at last in a temporary apoplexy. And it is very observable, that the free use of fermented liquors disposes to passionateness, to distempers of the head, to melancholy, and to downright madness: all which things have also great connections with each other. The sickness and head-ache which drunkenness occasions the succeeding morning seem to arise, the first from the immediate impressions made on the nerves of the stomach; the second from the peculiar sympathy which the parts of the head, external as well as internal, have with the brain, the part principally affected in drunkenness, by deriving their nerves immediately from it. See HARTLEY on Man.

DRUPA, in botany, a species of seed-vessel, that is succulent, has no valve or external opening like the capsule and pod, and contains within its substance a stone or nut. The cherry, plumb, peach, apricot, and all stone fruit, are of this kind. The stone, or nut, which, in this species of fruit, is surrounded by the soft pulpy flesh, is a kind of woody cup, containing a single kernel or seed. The definition just given will apply to every seed-vessel denominated drupa in the "genera plantarum." The mond is a drupa, so is the seed-vessel of the elm-tree and the genus rumphia; though far from being pulpy or succulent, the first and third are of a substance like leather; the second like parchment. The same may be said of the walnut, pistacia-nut, and some others. Again, the seeds of the elm, flagellaria, and the mango-tree, are not contained in a stone. The seed-vessel of burr-reed is dry, shaped like a top, and contains two angular stones. This species of fruit, or more properly seed-vessel, is commonly roundish, and when seated below the calyx, or receptacle of the flower is furnished, like the apple, at the end opposite to the foot-stalk, with a small umbilicus or cavity, produced by the swelling of the fruit before the falling of the flower-cup.

DRY *rot*, a disease incident to timber used for building, such as flooring boards, joists, wainscotting, &c. Dr. Darwin is of opinion, that the dry rot may be entirely prevented by soaking the timber first in lime water till it has absorbed as much of it as possible, and after it has become dry, immersing it in a weak solution of vitriolic acid in water, which he supposes will not only preserve it from decay for many centuries (if it be kept dry,) but also render it less inflammable; a circumstance that merits considerable attention in constructing houses. In the transactions of the Society for the Encouragement of Arts, we meet with the following account of the cause of the dry rot in timber, and the method of preventing it, communicated by Mr. Batson, of Limehouse. He observes, that the dry rot having taken place in one of his parlours, to such a degree as to require the pulling down part of the wainscot every third year, and perceiving that it arose from a damp, stagnated air, and from the moisture of the earth, he determined, in the month of June, 1783, to build a narrow closet next the wall through which the moisture came to the parlour. This expedient had the desired effect. But, though the rot in the parlour was totally stopped, the evil soon appeared in the closet, where fungi of a yellow colour arose in various parts. In the autumn of the year 1786 the closet was locked up about ten weeks: on opening it, numerous excrescences were observed about the lower part; a white mould was spread by a plant resembling a vine, or sea-weed; and the whole of the inside, china, &c. was covered with a fine powder, of the colour of brick-dust. On cleaning out the closet, it was discovered that the disease had affected the wood so far as to extend through every shelf, and the brackets that supported them. In the beginning of the year 1780, he determined to strip the whole closet of lining and floor, not to leave a particle of the wood behind, and also to dig and take away, about two feet of the earth in depth, and leave the walls to dry, so as to destroy the roots or seeds of the evil. When, by time, the admission of air, and good brushing, it had become properly dry and cleansed, he filled it, of sufficient height for the joists, with anchor-smith's ashes, because no vegetable will grow in them. The joists being sawed off to their proper lengths, and fully prepared, they and their plates were well charred, and laid upon the ashes; particular directions being given, that no scantling or board might be cut or planed in the place, lest any dust or shavings might drop among the ashes. The flooring-boards being very dry, he caused them to be laid close, to prevent the dust getting down, which, perhaps, in the course of time, might bring on vegetation. The framing of the closet was then fixed up, having all the lower pannels let in, to be fastened with buttons only, so that, if any vegetation should arise, the pannels might with ease be taken out and examined. In some situations, it might be expedient and necessary to take out a greater depth of earth; and where ashes can be had from a foundry, they may be substituted for those of anchor smiths; but house ashes are by no means to be depended upon. At the expiration of seven years from the period of making this experiment the wainscot was removed, and the flooring-boards also taken up, when they were found entirely free from any appearance of the rot: two pieces of wood (yellow fir) which had been driven into the wall as plugs, without being previously charred, were alone affected with this disease.

DRYANDRIA, in botany, so named in honour of Jonas Dryander, a Swede, and a most excellent botanist, a genus of the Dioecia Monadelphia class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: calyx two-leaved; corolla five-petalled; or calyx five-leaved, resembling a corolla, surrounded by a two or three leaved calycle; stamina nine: fruit three or four grained. There is but one species, *viz.* D. cordata.

DRYAS, in botany, a genus of the Icosandria Polygynia class and order. Natural order of Senticosæ. Rosaceæ, Jussieu. Essential character: calyx five to ten cleft; petals five to eight; seeds tailed, hairy. There are two species, *viz.* D. anemonoides, and D. octopetala. The latter is a delicate evergreen plant, with snow-white blossoms. The stalks and branches are woody and perennial, lying flat upon the ground, spreading wide about the roots in tufts. It is a native of high mountains in Lapland, Denmark, and Switzerland; also in Scotland and in some parts of Yorkshire. It flowers in June.

DRYPIS, in botany, a genus of the Pentandria Trigynia class and order. Natural order of Caryophillei. Essential character: calyx five-toothed; petals five; capsules clipped round, one seeded. There is only one species, *viz.* D. spinosa, the leaves of which are subulate, somewhat three cornered, mucronate; those at the subdivisions of the stem are lanceolate, with three teeth on each side; peduncles shorter than the flower; calyx erect; corolla crowned, as in Silene, purple or white; petals very narrow, spreading: stamens erect. It is biennial: native of Barbary, Italy, and Istria.

DUCATOON, a silver coin, frequent in several parts of Europe. See COIN.—TABLE.

DUCES *tecum*, in law, a writ that commands a person to appear in the Court of Chancery, and bring with him certain writings, evidences, or other things, which the court is inclined to view.

DUCK. See ANAS.

DUCKING *at the main-yard*, among sea-men, is a way of punishing offenders on board a ship; and is performed by binding the malefactor, by a rope, to the end of the yard, from whence he is violently let down into the sea, once, twice, or three times, according to his offence: and if the offence be very great, he is drawn underneath the keel of the ship, which they call keel-haleing.

DUCT, in general, denotes any tube or canal. See ANATOMY.

DUCTILITY, in physics, a property of certain bodies, whereby they are capable of being expanded, or stretched forth, by means of a hammer, press, &c.

The great ductility of some bodies, especially gold, is very surprising: the gold-beaters and wire-drawers furnish us with abundant proofs of this property; they, every day, reduce gold into lamellæ inconceivably thin, yet without the least aperture, or pore, discoverable, even by the microscope: a single grain of gold may be stretched under the hammer into a leaf that will cover many square inches, and yet the leaf remain so compact as not to transmit the rays of light, nor even admit spirit of wine to transude. Dr. Halley took the following method to compute the ductility of gold: he learned from the wire drawers that an ounce of gold is sufficient to gild, that is, to cover or coat a silver cylinder of forty-eight ounces weight, which cylinder may be drawn out into a wire so very fine, that two yards thereof shall only weigh one grain; and consequently ninety-eight yards of the same wire only forty-nine grains: so that a single grain of gold here gilds ninety-eight yards; and, of course, the ten-thousandth part of a grain is here above one-third of an inch long. And since the third part of an inch is yet capable of being divided into ten lesser parts visible to the naked eye, it it evident that the hundred-thousandth part of a grain of gold may be seen without the assistance of a microscope. Proceeding in his calculus, he found, at length, that a cube of gold whose side is the hundredth part of an inch, contains 2,433,000,000 visible parts; and yet, though the gold wherewith such wire is coated be stretched to such a degree, so intimately does its parts cohere, that there is not any appearance of the colour of the silver underneath.

Mr. Boyle, examining some leaf-gold, found that a grain and a quarter's weight took up an area of fifty square inches; supposing, therefore, the leaf divided by parallel lines one-hundredth of an inch apart, a grain of gold will be divided into five hundred thousand minute squares, all discernible by a good eye: and the same author shews, that an ounce of gold drawn out into wire, would reach 155 miles and a half.

But M. Reaumur has carried the ductility of gold to a still greater length: a gold wire, every body knows, is only a silver one gilt. This cylinder of silver, covered with leaf-gold, they draw through the hole of an iron, and the gilding still keeps pace with the wire, stretch it to what length they can. Now M. Reaumur shews that, in the common way of drawing gold-wire, a cylinder of silver twenty-two inches long and fifteen lines in diameter is stretched to 1,163,520 feet, or is 634,692 lines longer than before, which amounts to about ninety-seven leagues. To wind this thread on silk for use they first flatten it, in doing which it stretches at least one-seventh farther: so that the twenty-two inches are now 111 leagues: but in the flattening, instead of one-seventh, they could stretch it one-fourth, which would bring it to 120 leagues. This appears a prodigious extension, and yet it is nothing to what this gentleman has proved gold to be capable of.

DUCTILITY *of glass*. We all know, that when well penetrated with the heat of the fire the workman can figure and manage glass like soft wax; but what is most remarkable, it may be drawn, or spun out, into threads exceedingly long and fine. Our ordinary spinners do not form their threads of silk, flax, or the like, with half the ease and expedition as the glass-spinners do threads of this brittle matter. We have some of them used in plumes, for children's heads, and divers other works, much finer than any hair, and which bend and wave like hair with every wind. Nothing is more simple and easy than the method of making them. There are two workmen employed; the first holds one end of a piece of glass over the flame of a lamp, and when the heat has softened it, a second operator applies a glass hook to the metal thus in fusion; and withdrawing the hook again, it brings with it a thread of glass, which still adheres to the mass: then, fitting his hook on the circumference of a wheel about two feet and a half in diameter, he turns the wheel as fast as he pleases; which, drawing out the thread, winds it on its run, till, after a certain number of revolutions, it is covered with a skein of glass thread. The mass in fusion over the lamp diminishes insensibly, being wound out like a clue of silk upon the wheel; and the parts, as they recede from the flame, cooling, become more coherent to those next to them, and this by degrees: the parts nearest the fire are always the least coherent, and, of consequence, must give way to the effort the rest make to draw them towards the wheel. The circumference of these threads is usually a flat oval, being three or four times as broad as thick: some of them seem scarcely bigger than the thread of a silk-worm, and are surprisingly flexible. If the two ends of such threads are knotted together, they may be drawn and bent, till the aperture, or space in the middle of the knot, does not exceed one fourth of a line, or one forty-eighth of an inch in diameter. Hence M. Reaumur advances, that the flexibility of glass increases in proportion to the fineness of the threads; and that, probably, had we but the art of drawing threads as fine as a spider's web, we might weave stuffs and cloths of them for wear. Accordingly, he made some experiments this way; and found that he could make threads fine enough, *viz*. as fine, in his judgment, as spider's thread, but he could never make them long enough to do any thing with them.

DUEL, a single combat, at a time and place appointed, in consequence of a challenge. This custom came originally from the northern nations, among whom it was usual to decide all their controversies by arms. Both the accuser and accused gave pledges to the judges on their respective behalf; and the custom prevailed so far amongst the Germans, Danes, and Franks, that none were excused from it but women, sick people, cripples, and such as were under 21 years of age, or above 60. Even ecclesiastics, priests, and monks, were obliged to find championsto fight in their stead. The punishment of the vanquished was, either death by hanging or beheading; or mutilation of members, according to the circumstances of the case. Duels were at first admitted not only on criminal occasions, but on some civil ones, for the maintenance of rights to estates, and the like: in latter times, however, before they were entirely abolished, they were restrained to these four cases: 1. That the crime should be capital. 2 That it should be certain the crime was perpetrated. 3. The accused must, by common fame, be supposed guilty. And, 4. The matter not capable of proof by witnesses. In England, though the trial of duel is disused, the law on which it is founded is still in force. See CHAMPION.

DUEL, at present, is used for a single combat on some private quarrel, and must be premeditated, otherwise it is called a rencounter. If a person be killed in a duel, both the principals and seconds are guilty of murder, whether the seconds engage or not. It is also a very high offence to challenge a person, either by word or letter, or to be the messenger of a challenge.

DUET, in music, a composition expressly written for two voices or instruments, with or without a bass and accompaniments. In good duets the execution is pretty equally distributed between the two parts, and the melodies so connected, intermingled, and dependent on each other, as to lose every effect when separated, but to be perfectly related and concinnous when heard together.

DUKE, is either the title of a sovereign prince, as the Duke of Savoy, Parma, &c. the Grand Duke of Tuscany, Muscovy, &c. or it is the title of honour and nobility next below princes. The commanders of armies in time of war, the governors of provinces, and wardens of marches, in time of peace, were called *duces*, under the latter emperors. The Goths and Vandals divided all Gaul into dutchies and counties, the governors of which they sometimes call *duces*, and sometimes *comites*. In France, under the second race of kings, though they retained the name and form of ducal government, there were scarce any dukes, except those of Burgundy, Aquitain, and France. In England, among the Saxons, the commanders of armies, &c. were called dukes, *duces*, without any addition, till Edward III. made his son, the Black Prince, Duke of Cornwall; after whom there were more made in the same manner, the title descending to their posterity. Duke, then, at present, is a mere title of dignity, without giving any domain, territory, or jurisdiction, over the place from whence the title it taken. A duke is created by patent, cincture of sword, mantle of state, imposition of a cap and coronet of gold on his head, and a verge of gold put into his hand. His title is Grace; and in the style of the heralds, Most high, potent, high-born, and noble prince.

DULCIMER, in music, is a triangular instrument, strung with about fifty wires cast over a bridge at each end, the shortest or most acute of which is about eighteen inches long, and the longest or most grave thirty-six. It is performed upon by striking the wires by little iron rods.

DUMBNESS, the privation of the faculty of speech. The most general, or rather the sole couse of dumbness, is the want of the sense of hearing. The use of language is originally acquired by imitating articulate sounds. From this source of intelligence deaf people are entirely excluded; they cannot acquire articulate sounds by the ear: unless, therefore, articulation be communicated to them by some other medium, these unhappy people must for ever be deprived of the use of language: and as language is the principal source of knowledge, whoever has the misfortune to want the sense of hearing must remain in a state little superior to that of the brute creation. Deafness has in all ages been considered as such a total obstruction to speech or written language, that an attempt to teach the deaf to speak or read has been uniformly regarded as impracticable, till Dr. Wallis, and some others, have of late shown, that although deaf people cannot learn to speak or read by the direction of the ear, there are other sources of imitation by which the same effect may be produced. The organs of hearing and of speech have little or no connection. Persons deprived of the former generally possess the latter in such perfection, that nothing further is necessary, in order to make them articulate, than to teach them how to use these organs. This, indeed, is no easy task; but experience shews that it is practicable. Mr. Thomas Braidwood, late of Edinburgh, was perhaps the first who ever brought this surprising art to any degree of perfection. He began with a single pupil in 1764, and since that period has taught great numbers of people born deaf to speak distinctly, to read, to write, to understand figures, the principles of religion and morality, &c.

But a new and different method, equally laborious and successful, we understand, is practised by the Abbé de l'Epée of Berlin. We are informed that he begins his instructions, not by endeavouring to form the organs of speech to articulate sounds, but by communicating ideas to the mind by means of signs and characters: to effect this, he writes the names of things; and, by a regular system of signs, establishes a connection between these words and the ideas to be excited by them. After he has thus furnished his pupils with ideas and a medium of communication, he teaches them to articulate and pronounce, and renders them not only grammarians, but logicians. In this manner he has enabled one of his pupils to deliver a Latin oration in public, and another to defend a thesis against the objections of one of his fellow pupils in a scholastic disputation; in which the arguments of each were communicated to the other, but whether by signs or in writing is not said.

DUMOSA, (from Dumus, a bush) bushy plants; the name of the forty-third order in Linnæus's Fragments of a Natural Method; consisting of a number of shrubby plants, which are thick set with irregular branches, and bushy.

DUNG, in husbandry, is of several sorts, as that of horses, cows, sheep, hogs, pigeons, geese, hens, &c. See AGRICULTURE.

DUNGEON, in fortification, the highest part of a castle built after the ancient mode; serving as a watch-tower, or place of observation; and also for the retreat of a garrison, in case of necessity, so that they may capitulate with greater advantage.

DUO, in music, a song or composition to be performed in two parts only, one sung, the other played on an instrument, or by two voices.

Duo is also when two voices sing different parts, accompanied with a third, which is a thorough bass. It is seldom that unisons and octaves are used in duos, except at the beginning and end.

DUODENUM, the first of the small guts, so called from its length, which is about twelve fingers breadth. It has its origin at the pylorus, or right orifice of the stomach; from which ascending a little, it afterwards descends again, and towards its end re-ascends, and runs transversely towards the left kidney: at the distance of three or four fingers from the pylorus it receives, at one prominent hiatus or mouth, the choledochic and pancreatic ducts, which discharge their respective liquors into it. See ANATOMY.

DUPLICATE, among lawyers, denotes a copy of any deed, writing, or account. It is also used for the second letters patent, granted by the Lord Chancellor in a case wherein he had before done the same. Also a second letter, written and sent to the same party and purpose as the former, for fear of the first's miscarrying, is called a duplicate.

DUPLICATE *proportion*, or *ratio*, is a ratio compounded of two ratios: thus, the duplicate ratio of *a* to *b*, is the ratio of *a a* to *b b*, or of the square of *a* to the square of *b*. Hence the duplicate ratio ought to be well distinguished from double.

In a series of geometrical proportionals, the first term to the third is said to be in a duplicate ratio of the first to the second: thus in 2, 4, 8, 16, &c. the ratio of 2 to 8 is duplicate of that of 2 to 4, or as the square of 2 to the square of 4. Duplicate ratio is therefore the proportion of squares, as triplicate is of cubes, &c. and the ratio of 2 to 8 is said to be compounded of that of 2 to 4, and of 4 to 8.

DUPLICATION, in general, signifies the doubling of any thing, or multiplying of it by 2: also the folding of any thing back again on itself. See CUBE.

DURA *mater*, one of the membranes which surround the brain. See ANATOMY.

DURANTA, in botany, so called in honour of Castor Durantes, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Vitices, Jussieu. Essential character: calyx five-cleft, superior; berry four-seeded; seeds two-celled. There are three species. These are shrubs with quadrangular branches; the flowers are in loose spikes, either from the axils, or at the ends of the branches. They have generally axillary spines; and they are so much alike in their manner of flowering, as well as in the structure and colour of the flower, that it is doubtful whether they may not be all one species.

DURATION, an idea which we get by attending to the fleeting and perpetually perishing part of succession; the idea of succession being acquired by reflecting on that train of ideas which constantly follow one another in our minds, as long as we are awake. The simple modes of duration are any different lengths of it whereof we have distinct ideas, as hours, days, years, time, eternity, &c. Duration, as marked by certain periods and measures, is what we most properly call time.

Duration *of action*, according to Aristotle, is confined to a natural day in tragedy; but the epopoeia, according to the same critic, has no fixed time.

Duration *of an eclipse*. See Astronomy and Eclipse.

Duration, in botany, the division of vegetables into trees, and perennial and annual herbs, is founded on the different duration of these plants. Trees subsist for several years, both by the root and stem: perennial herbs lose their stems during the winter, and are renewed by the root in the following spring: annuals perform the changes of vegetation but once, and are perpetuated in the seed. Striking as those differences are, Linnæus thinks the duration of plants so fallacious, that he never employs it as a specific difference. The reason he assigns is very pertinent. The duration of plants, he says, is frequently affected by place or climate, and therefore ought not to be regarded as an invariable circumstance proper for discriminating the species. In the warmer climates, which enjoy a perpetual summer, most of the plants are perennial, and of the tree-kind; yet many of them, when removed to our colder European climates, lose their woody texture, and become herbaceous, and frequently annual. Of this the ricinus, or tree palma christi, and marvel of Peru, are familiar instances.

Indian cress, beet, sweet marjoram, and tree-mallow, which, with us, are annual, become, in very warm regions, perennial and shrubby.

DURESSE, in law, is where a person is wrongfully imprisoned, or restrained of his liberty, contrary to law; or is threatened to be killed, wounded, or beaten, till he executes a bond, or other writing. Any bond, deed, or other obligation, obtained by duresse, will be void in law; and in an action brought on the execution of any such deed, the party may plead that it was brought by duresse. A deed must be avoided by special pleading in these cases; for the party cannot plead to it, *non est factum*, because it is his deed.

DURIO, in botany, a genus of the Polyadelphia Polyandria class and order. Natural order of Putamineæ. Capparides, Jussieu. Essential character: calyx five-cleft, pitcher shaped, inferior; corolla five-petalled, small; style one; stamina in five bodies; pome five-celled. There is only one species, *viz*. D. Zibethinus, a lofty tree with flowers below the leaves, which are alternate. The leaves resemble those of the cherry, but not dented at the edges, the flowers are borne in loose heads; they are large, and of a pale yellow white. The fruit is very large, the fleshy part of which is of a creamy substance and delicate taste, but of an unpleasant smell. Native of the East Indies.

DUROIA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Rubiaceæ, Jussieu. Essential character: calyx cylindric, truncate; corolla six-parted; filaments none; pome hispid. There is but one species, *viz*. D. eriopila, a tree, with thick unequal branches, hirsute at the end; leaves terminating, opposite, approximating; petioles very short; flowers at the ends of the branches, sessile, many, several of them abortive; corollas white, fruit larger than a turkey's egg, spherical, covered very thick with erect brown hairs; umbilicate, with the hollow calyx; it is well flavoured, and much esteemed at Surinam, where it is a native.

DUTCHY *court*, a court of the dutch chamber of Lancaster, held at Westminster, before the chancellor of the same, for matters concerning the lands and franchises of that dutchy. The proceedings in this court are by English bill, as in chancery. Gwyn says that this court grew out of the grant of king Edw. III. who gave the dutchy to John of Gaunt, and endowed it with royal rights and privileges; several others of our ancient kings likewise separated this dutchy from the crown, and settled it in the natural persons of themselves and their heirs; though, in succeeding times, it was united to the crown again.

DUTY, in general, denotes any thing that one is obliged to perform.

Duty, in polity and commerce, signifies the impost laid on merchandizes, at importation or exportation, commonly called the duties of customs; also the taxes of excise, stamp duties, &c. See Customs, Excise, &c.

DWARF, in general, an appellation given to things greatly inferior in size to that which is usual in their several kinds; thus there are dwarfs of the human species, dwarf-dogs, dwarf-trees, &c.

Dwarf *fruit-trees* are propagated by grafting them on a quince-stock, about six inches above the ground; and when the bud is shot so far as to have four eyes, it must be stopped, to give rise for lateral branches, for which purpose the uppermost eye should always be left outwards.

Apple, pear, plum, and cherry-trees are thus formed into dwarfs, but the summer and autumn pears are found to succeed best. As to the planting of dwarf-trees, they should be set at twenty-five feet square distance, and the ground between sown or planted for kitchen use while the trees are young, only keeping at some distance from their roots; stakes also should be fixed all around them, to which the branches may be nailed with list, and thereby trimmed in an horizontal direction, and prevented from crossing one another.

DYE, any square body, as the trunk, or notched part of a pedestal; or it is the middle of the pedestal, or that part included between the base and the corniche, so called, because it is often made in the form of a cube or dye. See Architecture.

DYEING, as the word is commonly used, is the art of communicating colour of some considerable degree of permanence to articles used in clothing; the processess for colouring other substances will be found under the articles of staining wood, bone, leather, and marble.

This art is probably of great antiquity, as we find accounts of coloured garments in the earliest records of history. The ancient Egyptians must have carried it to great perfection, as the method of producing very brilliant colours of extreme durability was well known to them, numerous specimens of such colours on various substances being still found on the walls of their early built temples, on the sides of their catacombs, and on the coverings of their mummies; and it may be fairly inferred, from their producing such fine colours on these substances, that they must have known how to do so on other substances, and in other manners; besides which, Pliny expressly mentions, (Hist. Nat. Lib. 35. chap. 2.) that the Egyptians had a mode of dyeing, which from his description was very like that which we use for colouring printed linens, as the stuffs were immersed in vats, where they received various colours, probably after having been impregnated with different mordants.

Among the Greeks, dyeing was but little practised; but the Tyrians, who may be called their neighbours, were, at a very early period, acquainted with the method of producing the beautiful tint of purple, for which they were so long famous; from the Tyrians the art proceeded to the Greeks, and from them to the Romans.

The ancients also obtained from the coccus, now known by the name of kermes, a colour, which was almost as highly esteemed as the purple, and which was sometimes mixed with it. See Coccus.

There is reason to think it was not till the time of Alexander, that the Greeks attempted materially to improve the black, blue, yellow, and green dyes; which it is probable they learned the means of effecting from the natives of Asia, with which the conquest of Alexander rendered them familiar, and among some of whom, particularly the Indians, the art of dying fine colours was known from the earliest antiquity. But as the art of dyeing has not proceeded to us directly from the Indians, it is sufficient to note this circumstance, in tracing its progress in countries more adjacent to our own.

The qualities of the colours used by the ancients may be judged of by the substances employed in making them; of which M. Biscoff, who has minutely examined the subject, enumerates the following ingredients, in addition to the coccus and purple shell fish:

1. Alum; but this it is probable the ancients were unacquainted with in its present state of purity.

2. Alkanet, which Suidas says was used by women as a paint.

3. The blood of birds, which was used among the Jews.

4. The fucus; that of Crete was preferred, and was generally employed as a ground for valuable colours.

5. Broom.

6. The violet; from which the Gauls prepared a colour that resembled one kind of purple.

7. Lotos medicago arborea, snail trefoil; the bark was used in dyeing skins, and the root in dyeing wool.

8. The bark of the walnut tree, and the peel of the shell.

9. Madder; there is no certainty whether the ancients used the same species with us, or another root of the same tribe.

10. Woad; but we do not know that the ancients used the same preparation of it which we do.

Our acquisitions of dyeing materials, especially since the discovery of America, give us such a decided superiority over the ancients in this respect, that we probably have no cause to regret the loss of their methods, even in the instance of their celebrated purple, which it may be questioned if we do not equal in beauty with a purple prepared from other much cheaper materials.

The kermes affords a colour which was almost as highly esteemed by the ancients as the purple, and we probably know how to employ the kermes to greater advantage than they did, as we possess alum in a state of purity, which they knew not how to obtain, with which the stuff is prepared to receive a more durable and beautiful colour; yet our dyers have almost entirely discontinued the use of it, because they can obtain from cochineal a colour beyond all comparison more beautiful.

The ancients were also unacqnainted with that useful substance, soap, which gives us a superiority in scouring, and some parts of the art of dyeing; instead of it they used two species of plants, one called radicula by Pliny, and struthian by the Greeks, which some think to be our saponaria, soap-wort; and the other being a species of poppy, according to Pliny: some of the bolar earths were likewise employed for the same purpose.

From America we have acquired several substances, which have been found useful in dyeing; namely, cochineal, brasil-wood, and anotta. But above all, we are indebted for the superiority of our colours to our preparations of alum, and the solution of tin, which give so much brilliancy to many of our dyes.

The Venetians, who derived much of their power from furnishing shipping for the crusades, acquired the arts of dyeing used in the east at the same time: from thence they spread over the rest of Italy: in the year 1338, Florence contained two hundred thousand manufacturers, who are said to have made from seventy to eighty thousand pieces of cloth.

About the year 1300, archil is said to have been discovered accidentally by a Florentine merchant. Having observed that urine gave a very fine colour to a certain species of moss, he made experiments, and learned to prepare archil. He kept this discovery long secret, and his posterity, (a branch of which still subsists, according to Dominique Manni,) have retained the name *Ruccellai*, from oreiglia, the Spanish term for that species of moss.

The first collection of the processes employed in dyeing appeared in Venice, in the year 1429, under the title of "Mariegola de l'Arte de i Tentori:" a second edition of it much improved came out in 1510; and a certain person called Ventura Rosetti, having formed the design of rendering this description more useful and extensive, travelled through the different parts of Italy, and the neighbouring countries, to make himself acquainted with the various processes employed, which he published, under the title "Plictho," and which, according to M. Bischoff, ought to be considered as forming the leading step toward the perfection which the art of dyeing has since attained. It is remarkable, that in "Plictho," not a word is said either of cochineal or of indigo, which makes it probable that these two dyes were not employed in Italy.

Pliny speaks of a substance called indicum, but only as being used in painting. It is probable, however, that the Indians employed it in dyeing. The first of it used in Europe appears to have been brought by the Dutch from the East Indies. The cultivation of it in America was first established in Mexico, and afterwards in other parts, where it acquired a superior quality to that which is procured from India. The use of indigo was not at first easily established; it was strictly prohibited in England in the reign of Elizabeth, as was also logwood, and the the prohibitionwas not taken off till the reign of Charles II. Its use was also proscribed in Saxony, and in the edicts against it, it is spoken of as a corrosive colour, and called food for the devil, *fressende teufels*.

The prohibitions against indigo were caused by the representations of those who prepared woad, that its use would destroy the sale of this article, which was the produce of the country. The prejudice against indigo was likewise communicated to France, and Colbert's instruction forbade the use of more than a certain quantity in the pastel vats.

Cochineal was introduced into Europe

shortly after the conquest of Mexico. The Spaniards having observed that the Mexicans employed cochineal in painting their houses, and in dyeing their cotton, gave their government an account of it, and in the year 1523, Cortes was ordered to promote the increase of the valuable insect from which it is obtained.

The natural colour obtained from cochineal is only a dull crimson; but soon after it was known in Europe, an eminent chemist, of the name of Kepler, found out the present process for dyeing scarlet with it, by means of a solution of tin, and carried the secret to London, in the year 1543: this process was first used at Bow, and hence the scarlet produced by it was called the Bow dye.

A Flemish painter, called Gluck, got possession of the secret, and communicated it to Giles Gobelin, who established a manufactory of it in the place in France which still bears his name. This undertaking was deemed so rash, that it was termed Gobelin's folly: but his astonishing success at length induced people to suppose that he had made a compact with the devil, from which the application of the term goblins to evil spirits is probably derived. The knowledge of this process afterwards spread throughout all Europe.

The discovery of this mode of dyeing scarlet may be considered as the most remarkable æra in the art of dyeing. The ancients applied the name scarlet to a colour obtained from kermes, which was much inferior in beauty, to the colour procured from cochineal.

Dufay, Hellot, Macquer, and Berthollet, were susessively charged by the French government with the care of improving the art of dyeing. Dufay was the first who entertained just, though imperfect ideas of the nature of colouring substances, and the power by which they adhere; he examined certain processes with great sagacity, and established the surest methods that could at that time be employed, for determining the goodness of a colour. Hellot published a methodical description of the processes used in dyeing wool, which even now is the best treatise we have on the subject. Macquer has given an exact description of the processes employed in dyeing silk; he has made us acquainted with the combinations of the colouring principle of Prussian blue; he has endeavoured to make an application of it to the art of dyeing, and has given us a process for communicating the most brilliant colours to silk by means of cochineal. He intended to publish a general treatise on the art of dyeing, of which he gave the prospectus in 1782; but his death, which took place in 1784, prevented the execution of any part of the work.

Berthollet succeeded Macquer; his treatise on dyeing is one of the best epitomes on the subject; and chemistry and the arts of dyeing, and of bleaching, have been much indebted to his labours.

In his theory of dyeing, he refers all the combinations produced in the formation of colours to the laws of chemical attraction: and all the changes, which the colouring particles undergo, to the conjunction of the elements of the new combination. The first effect of the attraction he considers as analogous to the formation of neutral salts; the second to combustion, putrefaction, and many other operations of nature.

Besides the authors mentioned, Chaptal, D'Apligny, D'Ambourney, and Hauffman, in France, have published treatises on the art of dyeing, which have much contributed to its improvement. In Sweden, Scheffer alone has written on the subject; his work is accompanied with notes by the celebrated Bergman. In Germany, experiments in different processes of dyeing have been published by Beckmann, Poerner, Vogler, and Francheville. In England, two very valuable essays on dyeing, by Delaval and by Henry, have appeared; to which may be added the excellent treatise on the philosophy of permanent colours, by Dr. Bancroft.

Of the Attractions of Colouring Substances.

A variety of theories have been produced by ingenious men, to account for the effects of dyeing. Bergman seems to be the first who referred them entirely to chemical principles; and this opinion is so consonant to reason, that it is now universally adopted.

Dyeing, then, is to be considered merely as a chemical process; but in order that it may succeed, it is necessary that the colouring matters should be dissolved in some fluid, (for in their solid state no attraction takes place between them and the stuff,) and that their attraction to the fluid should be less than that to the stuff. Besides, the colouring matters being brought within the proper distance for attraction by this means, they are also caused to apply themselves more equally, as every part of the stuff has thus an opportunity of attracting to itself the proper quantity of colouring matter.

The stuff receives the dye better, in proportion to the degree of affinity which the colouring matter has to it and to the solvent relatively, for if its attraction to the stuff is much more than to the solvent, the stuff receives the dye too rapidly, and it will be scarcely possible to prevent its being unequal: but if, on the other hand, its attraction to the solvent is too great, the stuff will either not take the dye at all, or it will take it very slowly and faintly. Wool has a stronger attraction for colouring matters than silk, silk than cotton, and this latter a stronger than linen. Hence it is necessary to use solvents for the dyes of the stuffs last mentioned, which have a weaker affinity for them than for those used in dyeing wool.

The essential circumstances in dyeing are, to ascertain the affinities of the colouring substance; first, to the solvents; secondly, to those substances which modify its colour, increase its brilliancy, and strengthen its union with the stuff; thirdly, to the different agents, which may change the colour, and principally to air and light.

The colouring matters possess chemical properties, that distinguish them from all others: they have attractions peculiar to themselves, by means of which they unite with acids, alkalies, metallic oxides, and some earths, particularly alumen. They frequently precipitate oxides and alumine from the acids which held them in solution; at other times they unite with salts, and form supra-compounds, which combine with the wool, silk, cotton, or linen: and with these their union is rendered much more close by means of alumine, or a metallic oxide, than it would be without their intervention.

The qualities of the uncombined colouring particles are modified when they unite with any substance; and if this compound unites with a stuff, it undergoes new modifications. Thus the properties of the colouring particles of cochineal are modified by being combined with the oxide of tin; and those of the substance thence resulting are again modified by their union with the wool or silk: and all these modifications are analogous to what is observed in other chemical combinations.

Of Mordants.

The title of mordant is applied to those substances which serve as intermedes between the colouring particles and the stuff to be dyed, either for the purpose of facilitating, or of modifying their combination; and by their means, colours are varied, brightened, made to strike, and rendered more durable.

Was it possible to procure a sufficient number of colouring matters, having a strong affinity to cloth, to answer all the purposes of dyeing, that art would be exceedingly simple and easy. But, except indigo, there is scarcely a dye-stuff which yields of itself a good colour, sufficiently permanent to deserve the name of a dye. This difficulty is obviated by employing an intermediate substance, which has a strong affinity both for the stuff and the colouring matter, and this is the principal purpose for which the mordant is used.

A mordant is not always a simple agent; new combinations are sometimes formed by the ingredients which compose it: so that the compounds resulting from the mixture, and not the simple substances that compose it, are the immediate agents which produce the effect.

Sometimes the mordant is mixed with the colouring particles, sometimes the stuff is impregnated with it, and on other occasions both those modes are united; and, finally, stuffs are dyed successively with liquors containing different substances, the last of which only can act on that with which the stuff is impregnated.

The principal substances employed as mordants are, aluminous salts, lime, metallic oxides, some astringent substances, and animal matters.

Formerly sulphate of alumen was the only species used as a mordant in dyeing; but of late years acetite of alumen has been introduced with excellent effect, particularly for cottons or linens, whose attraction to the alumen being weak, they require it to be applied, combined with a substance to which it has not so strong an union as it has to sulphuric acid; and its attraction to acetous acid is found to be sufficiently inferior to that for the cotton or linen, that it readily quits the acetous acid to combine with them.

Acetite of alumen is prepared by pouring acetite of lead into a solution of alum, in the proportion of one part of the acetite of lead to three of the alum in weight, a sixteenth of potash, and as much of powdered chalk, are also added. In this mixture, the sulphuric acid combines with the lead, and is precipitated; and the alumen, or base of the alum, combines with the acetous acid, as it parts from the lead, and forms acetite of alumen; the chalk and potash serve to saturate the excess of acid.

The final effect of alumining, in whatever way performed, and whatever chemical changes may have taken place in it, consists in the combination of alumen with the stuff; this union is probably imperfect, and the acids but partially separated at first, but becomes complete when the stuff is afterwards impregnated with the colouring substance.

The attraction of alumen for animal substances may be shewn by direct experiment; for if a solution of alum is mixed with a solution of glue, on adding an alkali, the glue is precipitated in combination with the alumen.

The attraction of alumen for most colouring substances may also be proved by experiment. If a solution of a colouring substance be mixed with a solution of alum, and an alkali be added, which decomposes the alum, the colouring matter will be precipitated combined with the alum, and the liquor will remain clear. The matter precipitated is called a lake. In this experiment too much alkali must not be added, because alkalies are capable of dissolving most lakes.

No direct experiment has yet shewn that alumen attracts any vegetable substances, except colouring matters: its attraction to them seems much weaker than that which it has for animal substances; hence the acetite of alumen is a better mordant than alum for linen and cotton, as has been observed; and upon this depend the different means employed to increase the fixidity of the colouring particles in dyeing these substances.

Lime is the only earth, besides alum, which is employed in dyeing: the affinity of lime for cloth is sufficiently strong; it is, however, found to answer the purpose of a mordant less perfectly than alumen, on account of the colour, which is not so good. It is employed either in the state of lime-water, or of that of sulphate of lime dissolved in water.

Metallic oxides have so great an attraction for many colouring substances, that they quit the acids in which they were dissolved, and are precipitated in combination with them: they have also the property of uniting with animal substances; it is therefore natural, that they should serve as a bond of union between the colouring particles and animal substances; but, besides the attraction of the oxides for colouring substances, and for animal matter, their solutions in acids possess qualities which render them more or less fit to act as mordants: thus, those oxides which easily part with their acids, such as that of tin, are capable of combining with animal substances, without the aid of colouring particles: it is sufficient to impregnate wool or silk with a solution of tin, although they be afterwards carefully washed, which is not the case with other metallic solutions.

Some metallic substances afford in combination only a white and colourless basis; and some, by the admixture of their own colour, modify that which is proper to the colouring particles; but in many metallic oxides, the colour varies according to the proportion of the oxygen they contain, and the quantity of this is easily liable to change. Upon these circumstances their properties in dyeing principally depend.

The attraction of metallic oxides for substances of vegetable origin is much weaker than for animal substances, and we are even ignorant whether they are capable of contracting a real union with them or not: metallic solutions are therefore ill-fitted to serve as mordants for colours in linen or cotton, except iron, the oxide of which unites firmly with vegetable substances, as is shewn by iron moulds, which are owing to a real combination of this oxide. When the colouring particles have precipitated a metallic oxide from its menstruum, the supernatent liquor contains the disengaged acid, which is commonly capable of dissolving a portion of the compound of colouring substance and oxide, so that the liquor remains coloured: but sometimes the whole of the colouring matter is precipitated, when the proportions have been accurately adjusted: this precipitation is facilitated, and rendered more complete, by the presence of the stuff, which assists, by the tendency it has to unite with the compound of oxide and colouring matter.

Uncombined metallic oxides have also a very evident action on many colouring substances when boiled with them, and modify their colour; the oxide of tin, in particular, increases the brightness and fixidity of several.

The compounds of oxides and colouring substances may be compared to many other chemical compounds which are insoluble, when the principles of which they are formed are properly proportioned, but which are capable of being super-saturated by an excess of one of the principles, and thence of becoming soluble. Thus, a metallic oxide, united with a colouring substance in excess, will produce a liquor, the colour of which will be modified by the oxide; whereas, when the colouring matter is not in excess, the compound will be insoluble, or nearly so: these effects are very evident in the combination of iron with the astringent principle.

Some other saline substances, as well as the metallic salts, are also employed as mordants. The neutral salts, sal ammoniac, nitre, and particularly sea salt, act as mordants, and modify colours, but it is difficult to ascertain the manner in which they act: salts with calcareous bases also modify colours; but as these modifications are nearly similar to those which would be produced by the addition of a small quantity of lime, it is probable they are decomposed, and that a little of the lime enters into combination with the colouring particles and the stuff.

Astringent substances are often employed as mordants. Tan, or the astringent principle, having a strong affinity for cloth, and for colouring substances, is found very useful for this purpose. It is commonly prepared by infusing nut-galls in water; the cloth is immersed in this solution, and allowed to remain till it is sufficiently impregnated with the tan. Sumach, which consists of the shoots of the rhus coriaria (a shrub that grows in the southern parts of Europe,) is often used and prepared in the same way as nut-galls.

Animal substances are sometimes used as mordants; in the process for dyeing the Turkey red, the cotton stuff is impregnated with animal oil; and it is probable linen and cotton would take other colours better, after some similar preparation.

Exsiccation favours the union of the substances which have an attraction for the stuff, and the decompositions which may result from that union; but the exsiccation should be slow, that the substances may not be separated before their mutual attractions have produced their effect.

To judge of the most advantageous manner of employing mordants, we must first pay attention to the combinations which may be produced, either by the action of the substances which compose them, or by that of the colouring matter and the stuff: secondly, to the circumstances which may concur in bringing about these combinations more or less quickly, or in rendering them more or less complete; thirdly, to the action that the liquor in which the stuff is immersed may have, either on its colour or texture; and in order to foresee what that may be, it is necessary to know the proportions of the principles which enter into the composition of the mordant, and what will be left in an uncombined state in the liquor.

Of the action of air and light on colours.

The action of atmospheric air on colours is chiefly owing to the oxygen it contains; this Berthollet has shewn in some cases to have similar effects to a slight combustion; as when the air renders a substance yellow, fawn-coloured, or brown, which he supposes it does by the oxygen combining with the hydrogen of the stuff, and leaving the charcoal predominant, which then communicates its own colour to it. The action of the air in bleaching he supposes to be caused by the combination of its oxygen with the colouring matter of the stuff, which renders it soluble in alkaline lixivia; which for this reason should always be used alternately with exposure to the air.

The changes which occur in the colours produced by the union of colouring matter with metallic oxides are effects compounded of the change that takes place in the colouring matter, and of that which the metallic oxide undergoes.

The light of the sun considerably accelerates the alteration of colours; this, according to Berthollet, it effects, by favouring the combination of oxygen, and by the combustion thereby produced. Mr. Sennebier (who has published many interesting observations on the effect o light on colours,) on the contrary, attributes these effects to a direct combination of light with the substances; but Berthollet established his opinion by a number of accurate experiments, which give it a decided superiority.

Colouring substances resist the action of the air more or less, according as they are more or less disposed to unite with oxygen, and thereby to suffer more or less quickly a smaller or greater degree of combustion: light favours this effect; but the colouring matter, in its separate state, is much more prone to this combustion that when united to a substance, such as alumen, which may either defend it by its own power of resisting combustion, or, by attracting it strongly, weaken its action on other substances, which is the chief effect of mordants; and this compound acquires greater durability, when it is capable of combining intimately with the stuff. Thus the colouring matter of cochineal dissolves easily in water, and its colour is quickley changed by the air; but when united to the oxide of tin, it becomes much brighter, and almost insoluble in water, though it is still easily affected by the air, and by oxygenated marine acid: it resists the action of these better, however, when it has formed a triple compound with a woollen stuff.

Oxygen may unite in a small proportion with some colouring substances, without weakening their colour, or changing it to another: thus indigo, which becomes green by uniting with an alkali, with lime, or a metallic oxide, resumes its colour, and quits those substances, when it recovers a small portion of the oxygen which it had lost. The liquor of the whelk, employed to dye purple, is naturally yellowish; but when exposed to the air, and more especially in the sunshine, it quickly passes through various shades, and at length assumes that colour so precious in the eyes of the ancients.

It may be considered as a general fact, that colours become brighter by their union with a small portion of oxygen; for this reason it is found necessary to air stuffs, when they come out of the bath, and sometimes even to take them out of it from time to time, expressly for this purpose; but in some cases the quantity of oxygen, which, thus becoming fixed, contributes to the brightness of the colour, is very inconsiderable, and its deterioration soon commences.

The action of the air affects not only the colouring matter and the stuffs, but also metallic oxide, when they are employed as intermedes, because the oxides are deprived at first by the colouring matter of part of their oxygen, and absorb it afterwards from the air. Those oxides, then, whose colour varies in proportion to their quantity of oxygen, cause changes of colour in the stuff in this manner.

Thus the blue given to wool, by sulphate of copper and logwood, soon changes into a green by the action of the air; because the copper, which is blue, when combined with a small portion of oxygen, becomes green, by its union with a larger quantity.

Colouring matter, in a state of combination with most substances, is less liable to be changed by the air than when uncombined; but there are some exceptions; for alkalies produce a contrary effect: they darken the colours to which they are added, and are found by experiment to promote the absorption of air, and in proportion as this takes place, the colours in general become more and more brown. This is consonant to the effect they produce on other substances, such as sulphur, for they favour the absorption of air, because they have a strong attraction for the substance which is the result of that absorption.

Of the differences between Wool, Silk, Cotton, and Linen, and the operations by which they are prepared for dyeing.

Wool and silk are animal substances, cotton and linen are vegetable productions. Animal substances have a greater disposition to combine with other substances than those of vegetable origin; hence they are more liable to be destroyed by different agents, and are more disposed to combine with colouring particles. Berthollet accounts for these properties by their principles being more disposed to assume a gaseous form, and having less cohesive force among themselves. Thus the pure or caustic alkalies destroy animal substances, because they combine with them, and thereby lose their causticity. For this cause animal substances cannot bear leys, and alkalies should be used with great caution in the processes for dyeing them; whereas no danger is to be apprehended from the use of alkalies with vegetable substances. Nitric and sulphuric acids have also considerable action on animal substances.

Silk appears to bear some resemblance to vegetable substances, by being less disposed to combine with colouring particles, and by resisting the action of alkalies and acids more powerfully; but though the action of these substances on silk is weaker than upon wool, they should still be employed with great caution, because the brightness of colour in silk appears to depend upon the smoothness of its surface, which should therefore be preserved unimpaired.

Cotton withstands the action of acids better than flax or hemp, and is difficultly destroyed even by the nitric acid.

Of Wool.

Wool is naturally covered with a kind of grease called suint, which preserves it from moths, so that it is not scoured until it is about to be dyed or spun. In order to scour wool, it is put for about a quarter of an hour into a kettle containing a sufficient quantity of water, mixed with a fourth part of putrid urine, heated to such a degree as the hand can just bear, and it is stirred from time to time with sticks; it is then taken out and put to drain. It is next carried in a large basket to a stream of running water, where it is moved about until the grease is entirely separated, and no longer renders the water turbid; it is then taken out, and again left to drain. It sometimes loses in this operation more than a fifth of its weight.

The scouring should be carefully performed, bacause the wool is thereby better fitted to receive the dye. In this process the volatile alkali of the urine unites with the grease, and forms a kind of soap, soluble in water.

When wool is dyed in the fleece, its filaments, being separate, absorb a larger quantity of the colouring matter; for the same reason woollen yarn takes up more than cloth; but cloths themselves vary considerably in this respect, according to their degree of fineness, or the closeness of their texture. The wool dyed in the fleece is chiefly intended to form cloths of mixed colours.

For most colours wool requires to be prepared by being boiled with saline substances, principally with alum and tartar. For some dyes wool does not require this preparation, and then it must be well washed in warm water, and wrung out, or left to drain.

The asperity of the surface of the filaments of wool, and their disposition to acquire a progressive motion towards their roots, form an obstacle to the spinning of wool, which is removed by impregnating it with oil. This oil must be discharged previous to the stuff, formed of the wool, being dyed. For this purpose it is carried to the fulling mill, where it is beaten with large beetles in a trough of water, in which a particular kind of clay has been diffused; that, uniting with the oil, renders it soluble in the water.

Of Silk.

Silk is naturally coated with a substance, which has been considered as a gum, to which it owes its stiffness and elasticity; that which is most commonly met with contains, besides, a yellow colouring matter. Most of the purposes for which silk is employed require that both these substances should be removed, which is effected by scouring it with soap.

The scouring ought not to be so complete for silks which are to be dyed, as for those which are intended to remain white, and a difference ought to be made according to the colour the silk should leave.

This difference consists in the quantity of soap employed; for common colours, the silk is boiled for three or four hours in a solution of twenty pounds of soap for every hundred of silk, taking care to fill up the kettle from time to time, that there may be always a sufficient proportion of fluid. The quantity of soap is increased for those silks which are to be dyed blue, and more especially for those which are to be scarlet, cherry colour, &c. because for these colours the ground must be whiter than for such as are less delicate.

When silk is intended to be employed white, it undergoes three operations: First, the hanks of silk are kept in a solution of thirty pounds of soap to the hundred weight of silk, which ought to be very hot, but not boiling. When the immersed part of the hanks is freed from the gum, they are turned upon the skein sticks, that the parts not before immersed may undergo the same operation; they are then taken out of the kettle, and wrung out according as the operation is completed.

In the second operation, the silk is put into bags of coarse cloth, five and twenty or thirty pounds in each bag, which is called a boiling bag. In these bags it is boiled for an hour and a half in a bath of soap, prepared like the former, but with less soap, taking care to keep the bags constantly stirred, that those which touch the bottom of the kettle may not receive too much heat.

The third operation is intended principally to give the silk a slight cast, to make the white more pleasing; from which it derives different names, such as

China white, silver white, azure white, or thread white. For this purpose a solution of soap is prepared, the proper strength of which is determined by its mode of frothing when agitated; for the China white, which should have a slight tinge of red, a small quantity of anotta is added, and the silk is shaken over in it till it has acquired the desired shade. To the other whites more or less of a blue tinge is given, by adding a little blue to the solution of soap.

The preparation of silk with alum is necessary in all cases, for without it the greatest part of the colours applied would possess neither beauty nor durability. For this operation forty or fifty pounds of Roman alum, previously dissolved in warm water, is mixed with about forty or fifty pails of water.

After having washed and beetled the silk, and wrung it out with the jack and pin, in order to separate any soap it may have retained, it is immersed in the alum liquor for eight or nine hours, after which it is wrung out by hand over the vat, and washed in a stream of water.

The above quantity of liquor will be sufficient for one hundred and fifty pounds of silk; but when it grows weak, which is known by the taste, twenty or twenty-five pounds of alum, dissolved as before, must be added, and this addition must be repeated, till the liquor acquires a disagreeable smell, and then it may be employed for stuffs intended for browns, marones, and other dark colours, till it has lost all its strength. The preparation of silk with alum is always made in the cold, because if the liquor should be employed hot, the lustre of the silk is liable to be impaired.

Of Cotton.

The several species of cotton differ principally in the length of their filaments, their fineness, their strength and colour. They are of different shades, from a deep yellow to a white. The darkest cotton comes from Siam and Bengal, and is often made into stuffs in its natural colour. The most beautiful is not always the whitest: it is necessary to bleach it. Processes similar to those employed for linen may be employed; but those in which oxygenated muriatic acid has been used are more expeditious, produce a more beautiful white, and prepare the cotton better (according to M. Decroisille) for the reception of a fine colour in dyeing.

In order to dispose cotton to receive the dye, it must be first scoured; some boil it in sour water, but more frequently alkaline ley is used; the cotton must be boiled in it for two hours, and then wrung out; afterwards be rinsed in a stream of water, till the water comes off clear, and then be dried. The cotton stuffs, which are to be prepared, must be soaked for some time in water, mixed with at most one fiftieth of sulphuric acid, after which they must be carefully washed in a stream of water and dried. The acid employed in this operation has been observed to take up a quantity of calcareous earth and iron, which would have injured the colours.

Aluming and galling are generally necessary in dyeing cotton and linen.

In the preparation with alum, about four ounces of it are required to each pound of the stuff. It must be employed with the precautions mentioned in the last article; some add a solution of soda, in the proportion of one-sixteenth of the alum, others a small quantity of tartar and arsenic. The thread is well impregnated by working it pound by pound in this solution. It is then put altogether into a vessel, and what remains of the liquor is poured upon it. It is left there for twenty-four hours, and then removed to a stream of water, where it is suffered to remain for an hour and a half, or two hours, in order to extract a part of the alum, and then it is washed. In this operation the cotton gains about one-fortieth of its weight.

In the operation of galling, different quantities of galls, or other astringents, are used, according to the quality of the astringents, or the effect desired. The galls, powdered, are boiled for about two hours in a quantity of water proportioned to that of the thread to be galled; the liquor is then suffered to cool to a temperature which the hand can just support, after which it is divided into a number of equal parts, that the thread may be wrought pound by pound, and what remains is poured upon the whole together, as described in the process of aluming. It is then left for twenty-four hours especially when intended for maddering for black, but for other colours twelve or fifteen are sufficient. After this it is to be wrung out and dried. When stuffs are to be galled, which have already received a colour, the operation must be performed in the cold, that the colour may not be injured. Cotton which has been alumed, acquires more weight in the galling than that which has not undergone that process. Although alum adheres but in small quantities to cotton, it gives it a greater power of combining both with the astringent principle, and the colouring matter.

Of Flax.

As flax and hemp possess the same properties, as far as relates to dyeing, the directions for one will succeed equally well for the other.

Flax must undergo several preparations before it is fit to receive the dye; the first is the watering, by which the fibrous parts of the plant become disposed to separate, so as to be rendered fit for spinning.

In watering, a glutinous juice, which holds the green colouring part of the plant in solution, and which is the medium of union between its cortical and ligneous parts, undergoes a greater or less degree of putrefaction, according to the mode of conducting the operation. This process is performed to the greatest advantage in pits situated on the banks of rivers, where the water may be changed often enough to prevent a degree of putrefaction that would injure the flax, and be prejudicial to the workmen, yet not so often as to hinder the degree of putrefaction necessary for rendering the glutinous substance soluble in water. After watering, the flax is dried, and the ligneous parts separated by a mechanical operation.

Some have proposed the mixing a small quantity of caustic alkali with the water, to increase its solvent power, but it appears from Dr. Home's experiments, that the alkali retards the operation, and renders the flax liable to break. But after the watering and drying, alkaline substances dissolve the greatest part of the colouring matter, on account of the change it has undergone from the exposure to air and light, and the consequent absorption of oxygen.

The processes published by the prince of S. Sever, for obtaining fine dressed hemp, depend on the solution of the colouring matter by alkali. He directs that dressed hemp be lixiviated in a solution of two parts soda and one of lime, then impregnated with soap, and kept in digestion; and afterwards well washed and hackled; but in this process only that portion of the colouring matter is dissolved, which would have been carried off by the first leys used in the beginning of the bleaching of the cloth. The great fineness given to it probably cannot be produced, but at the expense of the length and firmness of the filaments.

A clergyman of the department of Somme, in France, employs a process not liable to the inconveniences caused by leying the dressed hemp. He waters the hemp as soon as it is pulled, and separates the cortical part by a peculiar operation immediately after the watering, and having soaked it in a weak solution of black soap, he washes it with great care; previous to the drying, the colouring matter, (which would afterwards have been soluble only in alkali) may be dissolved and extracted by water, with the addition of a small quantity of soap; the hemp becomes much whiter, and divides better and more minutely, without, however, having been injured; and the leys preparatory to the bleaching become unnecessary. Thread and linen contain then a colouring substance, most of which may be extracted by simple leys, but there is a part of it, which is really combined with the vegetable fibres, and which can only be taken away by the destruction of its nature, effected by the combustion it undergoes during its combination with oxygen. Thread loses, by the operations employed in bleaching, from one-fourth to one-third of its weight.

Flax, or linen, intended to be dyed, must be subjected to the same operations of scouring, aluming, and galling, which cotton undergoes.

The well known greater difficulty with which linen, cotton, and silk, take dyes than wool, have been accounted for by supposing the pores of their fibres to be smaller; this, however, appears not to be true, from the greater quantity of colouring matter which they absorb. Unbleached cotton is always preferred for dyeing Turkey red, because in this state its colour is more permanent. The same thing is observed of raw or unscoured silk, which is found to combine more easily with the colouring matter, and to receive a more permanent colour in this state, than after it has been scoured and whitened. This has been accounted for also on mechanical principles, but it more probably is owing to the difference of the affinity, which exists between the colouring matter and the substance separated from the silk or cotton in bleaching or scouring. This substance acts probably the part of a mordant, and having a stronger affinity for the stuff and the colouring matter, than the stuff has for the latter, the colour communicated is more durable, when the silk or cotton is dyed in the unbleached or unscoured state.

Of the Processes for dyeing black.

According to the method described by Hellot, woollen cloth to be dyed black ought to have received the deepest blue tint, to have been washed in the river as soon as taken out of the vat, and to have afterwards been cleaned at the fulling-mill.

For an hundred pounds of the stuff, ten pounds of logwood, and ten pounds of Aleppo galls powdered, are put into a bag, and boiled for twelve hours in a middle sized copper, with a sufficient quantity of water. One-third of this bath is put into another copper, with two pounds of verdigrise, and into this the stuff is immersed, stirring it continually for two hours, and observing to keep the bath very hot, without letting it boil. The stuff is then taken out, and a portion of the bath equal to the former is put into the copper, with eight pounds of vitriol, or sulphate of iron. The fire is now to be diminished, and the bath suffered to cool for half an hour, whilst the vitriol dissolves; the stuff is then put in again, moved about well for an hour, and afterwards taken out to air. Lastly, the remainder of the bath is added, taking care that the bag be well pressed out. Fifteen or twenty pounds of sumach are now put in, and the bath is made to boil once, and then immediately stopped with a little cold water; two pounds more of the sulphate of iron are added, and the stuff is kept another hour. The stuff is now washed, aired, and again put into the copper, constantly stirring it for an hour: it is then carried to the river, well washed, and then fulled When the water comes off clear, another bath is prepared with weld, which is made to boil for a moment, and after being cooled, the stuff is passed through it, to soften it, and render the black more firm. In this manner a very beautiful black is obtained, without making the stuff too harsh.

In general, more simple processes are employed. Cloth previously dyed blue is merely boiled in a bath of galls for two hours; it is then kept two hours in the bath of logwood and sulphate of iron, without boiling, and afterwards washed and fulled. M. Hellot has also found the following method to succeed. For fifteen ells of deep blue cloth, a bath is to be made with a pound and a half of yellow wood, five pounds of logwood, and ten pounds of sumach. After having boiled the cloth in this bath for three hours, it is taken out, ten pounds of sulphate of iron are put into the copper, and the cloth is then put into it for two hours more. It is then aired, put into the bath again for another hour, and afterwards washed and fulled. This black is less velvety than that of the process first described.

Black may be dyed without a blue ground, and this is usually done for stuffs of low price. In this method the stuff is dyed of a brown, or root colour, with green walnut peels, or the root of the walnut tree: they are then blackened as above directed.

The proportions used by the English dyers are, for every hundred pounds of woollen cloth, dyed first of a deep blue, about five pounds of sulphate of iron, five pounds of galls, and thirty of logwood. They begin with galling the cloth, and then pass it through the decoction of logwood, to which the sulphate of iron has been added.

Some recommend fine cloths to be fulled with soap suds; but this operation requires an experienced workman, to cleanse the cloth perfectly of the soap. Many advise to give the cloth a dip in a bath of weld when it comes from the fulling mill, which they say softens it, and fixes the black. Lewis says, the weld bath is totally useless when the cloth has been treated with soap-suds, though in other cases it may be of advantage. He ascribes its effects entirely to the alkali with which the dyers commonly prepare its decoction.

The leaves of the uva ursi may be employed instead of galls. They must be carefully dried in autumn, so that they may remain green. When they are to be used, 100 pounds of wool are boiled for two hours with sixteen pounds of sulphate of iron and eight of tartar: the day following the cloth is to be rinsed as after aluming: 150 pounds of uva ursi are then to be boiled in water for two hours, and after their being taken out, a little madder is to be added to the liquor, at the same time putting in the cloth, which is to remain there an hour and a half, or an hour and three quarters, after which it is to be rinsed in water. This process gives a pretty good black to blue cloth, but only a deep brown to white: the madder and tartar are supposed by Lewis to be useless.

Of dyeing Silk black.

It is necessary to cleanse silk that is to be dyed from the substance which adheres to it, called its gum; for though raw silk takes the dye with more facility, the colour is much less intense, and less durable, than when the silk is scoured; which is done by boiling it four or five hours with a fifth of its weight of white soap, after which it is beetled and carefully washed.

After being cleansed, the silk must be galled; for which nearly three-fourths of its weight of galls are boiled for three or four hours, but their quantity must depend on the kind used; after boiling, the liquor is left at rest for two hours, that the galls may subside; the silk is then put into the bath, and left in it from twelve to thirty-six hours; it is then taken out, and washed in the river. Silk is capable of combining with much of the astringent matter of the galls, which attracts the colouring matter in proportion; therefore, when what is called a heavy black is required, it is allowed to remain longer in the gall liquor, the galling is repeated, and it is dipped in the dye a greater number of times, and left in it also for a considerable time. This method neither improves the dye nor the silk; but is merely used to give profit to the vender where silk is sold by weight.

Silk-dyers preserve the black bath for silk for several years; when its effect becomes weak, it is renewed by adding more of its ingredients, and when the grounds accumulate too much, they are taken out.

While the silk is preparing for dyeing the bath is heated, taking care to stir it occasionally, that the grounds, which fall to the bottom, may not acquire too much heat; it should never be heated so as to boil. Gum and solution of iron are added, in proportions depending on the different processes used: and when the gum is dissolved, and the bath near boiling, it is left to settle for about an hour. The silk is then dipped into it, being in general at first divided into three parts, each of which is put in successively. Each part is afterwards wrung gently three times, and hung up in the air after each wringing. The action of the air deepens the shade, and the wringing out the liquor prepares the silk to imbibe a fresh quantity.

After this the bath is again heated, and as much gum and sulphate of iron is put in as at first. The operation is repeated twice for light blacks; but for the heavy blacks three times; and after the last the silk is left in the bath for twelve hours. Sixty pounds of silk are commonly dyed at one operation.

After the dyeing is finished, the silk is rinced, by turning and shaking it in a vessel of cold water.

Silk when dyed is extremely harsh; to soften it, a solution of four or five pounds of soap to every hundred pounds of silk is poured through a cloth into a large vessel of water; being well mixed, the silk is put in, and left about a quarter of an hour, after which it is wrung out and dried.

When raw silk is dyed, the galling is performed with cold liquor, to preserve its natural gum, and the elasticity which it causes. If the gall liquor is weak, the silk is left in it for several days; liquor that has been employed for other silk is generally used, and silk which has naturally a yellow hue is preferred. The raw silk thus prepared is dyed in the cold bath; it takes the dye readily, and the water in which other silk has been rinced suffices to communicate it, if sulphate of iron be added. It requires more or less time to lie in the rincings, according to their strength: sometimes three or four days are necessary, after which it is washed, and beetled once or twice; but not wrung, that its elasticity may not be injured. It may be dyed more speedily by shaking it over in the cold bath after galling, and then airing it, and repeating these operations a few times; after which it is to be washed and dried as above.

Macquer describes a more simple process, with which they dye velvet black at Genoa; it is as follows.

For an hundred pounds of silk, twenty pounds of Aleppo galls, in powder, are to be boiled an hour in a sufficient quantity of water. The bath is then left to settle till the galls have fallen to the bottom, when they are taken out, and two pounds and a half of English vitriol of iron, twelve pounds of iron filings, and twenty pounds of gum, are put into a copper cullender with two handles, and immersed in the bath; the cullender is supported by sticks, that it may not touch the bottom, and an hour is allowed for dissolving the gum, which is occasionally stirred. If all the gum be dissolved in that time, three or four pounds more may be added. The cullender is only removed during the dyeing, and is put in again after it: the copper is kept hot the whole time, but not suffered to boil: the silk is galled with one-third of Aleppo galls, and left in the liquor six hours the first time, and twelve the second. The rest of the process is conducted in the common method. The gum is useful to keep the dye suspended in the liquor; but it is probable a smaller quantity might answer

As galls are expensive, the following method has been used to lessen their consumption. The silk, after being boiled and washed in the river, is prepared by immersing it in a strong decoction of walnut peels till the colour is exhausted: it is then wrung, dried, and again washed in the river; after which it is left in a solution of two ounces of verdigrise for every pound of silk, in cold water, for two hours, and then dipped in a strong decoction of logwood, which gives it a blue ground; it is then wrung out, dried, and washed in the river. The black bath for it is prepared by macerating two pounds of galls and three of sumach in twenty-five gallons of water, over a slow fire, for twelve hours; after straining, three pounds of sulphate of iron and as much gum arabic are dissolved in it. In this solution the silk is dipped at two different times, left two hours in the bath each time, and aired and dried after each dipping; it is then beetled twice at the river, dipped again, and left in the bath four or five hours; drained, dried, and again beetled twice, as before. The heat of the bath must not exceed 122 Fahrenheit. Before each of the last dippings, half a pound of sulphate of iron, and as much gum arabic, should be added. Some think that the galls are only added to increase the weight, and that the sumach is sufficient for the dye.

Of dyeing Cotton and Linen black.

Cotton and linen do not take a black that will resist soap. The weakness of their affinity for iron renders a solution of it necessary in dyeing them in some acid, to which it has less attraction than to the sulphuric. This solution is prepared with iron and vinegar, or alegar from small beer or fermented worts, according as the country where the process it carried on affords them cheapest. (Pyrolignous acid, or the acid liquor procured in distilling spirits of turpentine, has also been used for the same purpose with success.) Pieces of old iron are thrown into the acid liquor, and they are allowed to remain in it six weeks or two months before it is used, that it may be fully saturated with the iron. This solution is called iron liquor in this country.

The process for dyeing linen and cotton thread black at Rouen is the following. It is first dyed sky blue; then wrung out and dried, (a deep blue is thought to be better;) it is next galled, using four ounces of galls to every pound of thread, and leaving them twenty-four hours in the gall liquor: after which they are wrung out and dried again. About five quarts of the iron liquor are then poured into a tub, in which the thread is worked by hand, pound by pound, for a quarter of an hour, and then wrung out and aired. This operation is repeated twice, adding each time a fresh quantity of the iron liquor, which should be carefully scummed; after this the thread is again aired, wrung out, washed at the river, and dried.

The thread receives the colour by immersion in the following bath. A pound of alder bark for every pound of thread is boiled an hour, in a sufficient quantity of water; about half the bath that served for the galling, and half as much sumach as alder bark, are then added, and the whole boiled together for two hours, and strained through a sieve. When the liquor is cold, the thread is put into it on sticks, and worked pound by pound, airing it from time to time; it is then let down into the bath again, left in it twenty-four hours, wrung out, and dried. To soften this thread, it is usual to soak and work it in the remains of a weld bath, that has been used for other colours, adding to it a little logwood.

At Manchester, the method used is, to first gall the stuff with galls or sumach, then to dye it in the iron liquor, and afterwards to dip it in a decoction of logwood and a little verdigrise. This process is repeated till a deep black is obtained. It is necessary to wash and dry after each operation. The iron liquor for this process is frequently composed of infusion of alder-bark and iron.

M. Guhliche recommends highly the following solution of iron for dyeing linen and cotton. A pound of rice is to be boiled in twelve or fifteen quarts of water till wholly dissolved; the vessel that contains this liquor is to be half filled with old iron made red hot, and the whole to be exposed to the air and light for a week; an equal quantity of red-hot iron is to be thrown into as many quarts of vinegar, which is also to be exposed to the air and light: after some days, the two solutions are to be mixed together, and exposed to the air and light for another week. The liquor is then to be decanted, and kept in a close vessel for use.

The linen or cotton left in this liquor for twenty-four hours acquires a good black. If the liquor does not contain iron enough, a fresh portion should be used, which will produce a permanent black. This liquor may be advantageously substituted for sulphate of iron in dyeing wool or silk, which only require to be dipped in a decoction of logwood, after being taken out of the bath, to give them a beautiful black.

Berthollet mentions, that iron ought to be more oxygenated to unite with cotton or linen, than with wool or silk; and that therefore the longer the iron liquor is exposed to the air the better. The place of galls, which bear an high price, is frequently supplied by oak bark, oak sawdust, sumach, the cups and husks of acorns, and other astringents.

Of dyeing Wool blue.

Blue may be dyed by woad alone, which would give a permanent but not a deep blue; but if indigo be mixed with it, a very rich colour will be obtained.

The following is the method of preparing a blue vat, recommended by M. Quatremere. Into a vat about seven and a half feet deep, and five and a half broad, are thrown two balls of woad, weighing together, about four hundred pounds, first breaking them; thirty pounds of weld are boiled in a copper for three hours, in a sufficient quantity of water to fill the vat; when this decoction is made, twenty pounds of madder, and a basket full of bran, are added, and it is boiled half an hour longer. This bath is cooled with twenty buckets of water; and after it is settled the weld is taken out, and it is poured into the vat; all the time it is running in, and for a quarter of an hour after, it is to be stirred with the rake. The vat is then covered up very hot, and left to stand for six hours, when it is raked again for half an hour, and this operation is repeated every three hours.

When blue veins appear on the surface of the vat, eight or nine pounds of quick lime are thrown in. Immediately after the lime, or, along with it, the indigo is put into the vat, being first ground fine in a mill with the least possible quantity of water. When it is diluted to the consistence of a thick pap, it is drawn off at the lower part of the mill, and thrown thus into the vat. The quantity of indigo depends on the shade of colour required. From ten to thirty pounds may be put to the vat now described.

If on striking the vat with the rake a fine blue scum arises, it is fit for use, after being stirred twice with the rake in six hours, to mix the ingredients. Great care should be taken not to expose the vat to the air, except when stirring it. As soon as that operation is over, the vat is covered with a wooden lid, on which are spread thick cloths, to retain the heat as much as possible. Notwithstanding this care, the heat is so much diminished at the end of eight or ten days, that the liquor must be re-heated, by pouring the greater part of it into a copper over a large fire: when it is hot enough, it is returned into the vat, and covered as before.

This vat is liable to two inconveniences; first, it runs sometimes into the putrefactive fermentation, which is known by the fetid odour it exhales, and by the reddish colour it assumes. This accident is remedied by adding more lime. The vat is then raked, after two hours lime is put in, the raking performed again, and these operations are repeated till the vat is recovered; secondly, if too much lime is added, the necessary fermentation is retarded; this is remedied by putting in more bran or madder, or a basket or two of fresh woad.

When cloth is to be dyed, the vat is raked two hours before the operation, and to prevent it from coming in contact with the sediment, which would cause inequalities in the colour, a kind of lattice of large cords, called a cross, is introduced; when wool is to be dyed, a net with small meshes is placed over this. The wool or cloth being thoroughly wetted with clear water, a little warm, is pressed out, and dipped into the vat, where it is moved about a longer or a shorter time, according as the colour is intended to be more or less deep, taking it out occasionally to expose it to the air; the action of which is necessary to change the green colour, given the stuff by the bath, to a blue. Wool and cloth dyed in this manner, ought to be carefully washed, to carry off the loose colouring matter; and those which are of a deep blue ought to be even fulled with soap, which cleanses them effectually, without injuring the colour.

A vat which contains no woad is called an indigo vat; the vessel used for this preparation is of copper, into which is poured, according to its capacity, water; in forty pails of which, six pounds of potash, twelve ounces of madder, and six pounds of bran, have been boiled; six pounds of indigo, ground in water, are then put in, and after raking it carefully, the vat is covered; a slow fire is to be kept up round it. Twelve hours after it is filled, it is to be raked a second time, which is to be repeated at similar intervals of time, till it comes to a blue, which will generally happen in forty-eight hours. If the bath be well managed it will be of a fine green, covered with coppery scales and a fine blue scum. In this vat the indigo is rendered soluble in the water by the alkali instead of lime; the operation of dyeing with it is the same as the preceding.

Hellot describes two vats, in which the indigo is dissolved by means of urine. Madder is added to them, and in the one vinegar is put, in the other alum and tartar, of each an equal weight to the indigo. The quantity of urine ought to be very considerable. It is probable the indigo is dissolved in them by the ammonia formed in the urine. These vats are not so good as those before described; less work can be performed with them, so that they are adapted only to small dye-houses.

The colour dyed by a solution of indigo in sulphuric acid is called Saxon blue, from having been discovered at Grossenhayn, in Saxony, by Counsellor Barth. M. Poerner, who has paid great attention to this preparation, directs four parts of sulphuric acid to be poured on one of indigo, in fine powder: the mixture is to be stirred for some time. After having stood twenty-four hours, one part of good dry potash in fine powder is added; the whole is to be again well stirred, and having stood twenty-four hours longer, more or less water is added gradually.

To dye Saxon blue, the cloth is prepared with alum and tartar; a greater or less proportion of indigo is put into the bath, according as the shade required is, deep or light; for deep shades the stuff must be passed several times through the bath; light shades may be dyed after the deep ones, but they have more lustre when dyed in a fresh bath.

Of dyeing Silk blue.

Silk is dyed blue by the indigo vat before described. In general, a larger proportion of indigo is put in than is there directed, but nearly the same quantities of bran and madder. Macquer says, that half a pound of madder for every pound of potash makes the vat greener, and the colour more fixed. When the vat is come to about two pounds of potash, three or four ounces of madder should be added; it should then be raked, and in four hours it will be fit for dyeing. Its heat should be just what the hand can bear without pain. The silk is prepared for this bath by being boiled with thirty pounds of soap for every hundred pounds of silk, and being afterwards well cleansed from it by two or more beetlings in a stream of water. As the silk is very liable to take the colour unevenly, it is necessary to dye it in small portions; the workman dips each hank separately, and when he has turned it once or twice in the bath, he wrings it strongly over it, and airs it, to turn the green colour to a blue; when the green is thoroughly changed, he throws it into some clear water, after which he wrings it several times with the pin. Care must be taken that the silk dyed blue dry speedily. In the winter, and in damp weather, it should be dried in a chamber heated by a stove, where it should be hung on a frame kept in constant motion. When the bath grows weak, a pound of potash, an ounce of madder, and an handful of bran well washed, are added. Indigo is also put in when it appears to be wanted. Some dyers use vats grown weak to dye light shades, but fresh vats give a more beautiful and permanent colour.

As indigo alone cannot give a deep blue, the silk must be prepared by receiving a ground, or other colour, previous to dyeing. For the Turkey blue, a very strong archil bath is first given; and for the French royal blue, a weaker one of the same kind. Cochineal is used also for the ground of another fine deep blue, which is more permanent. Verdigrise and logwood are also used for a preparatory colour, but produce a blue that is not permanent. It might be rendered more lasting, by making the shade lighter than that intended in this bath, afterwards dipping it in the archil bath, and lastly in the blue vat.

When raw silk is to be dyed blue, that which is of a white colour should be chosen. It should be thoroughly soaked in water, and afterwards put into the vat in separate hanks, in the same manner as the scoured silk. In general, raw silk takes the dye more readily; wherefore, when it can be done, the scoured silk is put into the bath before it. If raw silk requires archil, or the other grounds mentioned, it should be treated as directed for silk in general.

The solution of indigo in sulphuric acid is also used for silk; the colour called English blue is produced by it. To give silk this colour, it is first dyed a light blue, and then dipped in hot water, washed in a stream, and afterwards left in a bath made with the sulphate of indigo, to which a little tin has been added, till the proper shade is obtained, or the bath exhausted.

The silk, before it is put into this bath, may be dipped in a solution of alum, in which it should remain only a very short time. Silk, dyed in this manner, is free from the reddish shade given by the blue vat, and from the greenish cast of common Saxon blue.

Of dyeing Cotton and Linen blue.

The vat for dyeing cotton and linen blue should contain, according to M. Pileur d'Apligny, about 120 gallons. The quantity of indigo used is generally from six to eight pounds. This indigo, after being pounded, is boiled in a ley drawn off clear from a quantity of lime equal to the indigo, and double its weight of potash. The boiling is continued till the indigo is thoroughly penetrated with ley, which should be carefully stirred all the while.

During the boiling of the indigo, an equal weight to it of quicklime is to be slacked; about twenty quarts of warm water are added, and in this is dissolved sulphate of iron, twice the weight of the lime. When the solution is completed, the liquor is poured into the vat previously half filled with water. To this the solution of indigo is added, and the rest of the ley not used in boiling it. After this the vat must be filled up to within two or three inches of the brim, and be raked two or three times a day, till it is fit for dyeing; which generally happens in 48 hours, or sooner, according to the temperature of the air. Some add to this vat a little bran, madder, and woad.

In the process used at Rouen, which is simpler, 20 pounds of indigo, macerated for a week in caustic ley, which will float an egg, are ground in a mill; three hogsheads and an half of water are then put into the vat, and afterwards twenty pounds of lime. When the lime is thoroughly slacked, the vat is raked, and thirty-six pounds of copperas are put in. When the solution of this is complete, the ground indigo is put in through a sieve. On the same day it is raked seven or eight times: and after having stood 36 hours it is fit for dyeing.

Bergman recommends a still simpler bath, composed in the proportions of three drachms of powdered indigo, three drachms of copperas, and three drachms of lime, to two pints of water. This being well raked will, in the course of a few hours, be fit for use.

The solution of indigo in sulphuric acid has been hitherto only used for dyeing wool and silk. The affinity of vegetable substances for indigo is not sufficiently strong to separate it from the sulphuric acid. It cannot therefore be employed to advantage in dyeing cotton or linen.

Attempts have been made to dye cloth with Prussian blue, but no method has yet been found to make this colour apply itself evenly, sufficiently certain and perfect for general use. This process deserves farther experiments, as the colour produced by it was very beautiful, and not liable to change, though exposed to all the vicissitudes of the air. But dust and rubbing injure it; and any touch of an alkaline liquor destroys it altogether. The process in which stuffs, previously impregnated with alum and copperas, are submitted to a solution of Prussian alkali, seems that most likely to succeed in diffusing the dye equally, if improved by farther trials. Perhaps also a solution of caustic alkali might form a sufficient solvent for the Prussian blue, if ground with it, to admit of its being used in somewhat the same way as indigo.

Of dyeing Wool red.

Red colours are of various shades, according to the nature of the colouring matters used. They all require mordants to render them permanent. The principal shades of red are, scarlet, crimson, and madder red.

Madder red is only employed for dyeing coarse woollen stuffs. To produce this red, the stuffs are first boiled for two or three hours with alum and tartar; they are then left to drain, slightly wrung out, and then put into a linen bag, and carried to a cool place, where they are to remain a few days. Some recommend five ounces of alum and one of tartar to each pound of wool; by increasing the proportion of tartar, a deep and permanent cinnamon colour is produced instead of red; others advise to use only a seventh part of tartar. The madder bath should not exceed the temperature which the hand can bear; if let to boil, the colour will be different from that required. When the water is at this heat, Hellot recommends half a pound of grape madder to be put into it for every pound of wool to be dyed. It is to be well stirred before the wool is introduced, which should remain in it for an hour without boiling, except for a few minutes towards the end of this period, to make the combination of the colouring matter with the stuff more certain.

Madder reds are sometimes rosed, as it is called, with archil and brazil wood. In this way they become more beautiful and velvety, but the brightness thus given is not permanent.

When sulphate of copper is employed as a mordant, the madder dye yields a clear brown, somewhat inclined to a yellow; when solution of tin is used, the tint, according to Berthollet, is somewhat brighter than that obtained by the common method, but is always more inclined to yellow or fawn colour.

The red procured from kermes is finer than that from madder. The kermes is an insect found on a small species of live oak, in Languedoc, Spain, Portugal, and other places; the females alone are used, they are of the shape and size of a pea, and of a reddish brown colour.

To dye woollen yarn with kermes, it is first boiled half an hour in water with bran; then two hours in a fresh bath, of one fifth of Roman alum, and one tenth of tartar dissolved in sour water; after this, it is left in a linen bag for some days in a cool place. To obtain a full colour, as much kermes as equals three fourths, or even the whole of the weight of the yarn, is put into a warm bath, and the wool is put in at the first boiling. As cloth is less dense than wool, either spun or in the fleece, it requires one fourth less of the salts in boiling, and of the kermes in the bath.

The scarlet made by kermes was called scarlet in grain, from the insect resembling a grain; it has much less bloom than that procured from cochineal; but is more permanent, and spots of grease may be discharged from it without injury. Since the art of heightening the colour of cochineal by solution of tin has been discovered, kermes has not been much used.

The scarlet produced by the preparation of cochineal just mentioned is esteemed the finest and most splendid of any. Cloth to be dyed with it is first submitted to the following bath: six pounds of tartar are infused in the water made warm, for every hundred pounds of the cloth; the bath is then stirred briskly, and when the heat has increased a little more, half a pound of powdered cochineal is to be added, and the whole is then to be well mixed; immediately afterwards, five pounds of a very clear solution of tin are to be poured in, and carefully mixed. When the bath begins to boil, the cloth is introduced, and briskly moved for two or three turns, after which it is moved more slowly. The boiling having continued for two hours, the cloth is taken out, exposed to the air, and carried to the river to be well washed.

The cloth is afterwards passed through a second bath for the reddening; to prepare which, the boiler is to be first emptied, and again filled with water; and when this has just reached the boiling point, five pounds and three quarters of cochineal, powdered and sifted, are to be added. These are to be well mixed; and some time afterwards, when a crust that forms on the surface opens of itself in several places, 13 or 14 pounds of solution of tin are poured in. Should the bath after that rise above the edge of the boiler, it may be cooled with a little water. The bath being well mixed, the cloth is put in, and turned quickly two or three times. It is then boiled in the bath for an hour, taking care to keep it under the surface. It is afterwards taken out, exposed to the air, and, when cool, washed in the river, and dried.

Some dyers do not remove the cloth out of the first bath; but merely refresh it, and perform the operation of reddening in the same bath. In this method, the infusion of cochineal, made in a separate vessel, and mixed with a proper proportion of tin, is added. By conducting the process in this way, the scarlet is supposed to be equally fine, and there is a considerable saving of time and fuel.

To give scarlet the bright lively red, called fire colour, a yellow tinge is communicated to the cloth by boiling fustic in the first bath, or by adding a little turmeric to the cochineal. A larger proportion of the solution of tin also produces this yellow shade, but it renders the cloth harsh, and limits the action of the colouring matter.

Dr Bancroft recommends a method of dyeing scarlet, in which a much smaller portion of cochineal produces an equal effect. He conceived scarlet, from his experiments, to be a compound colour, caused by about three-fourths of crimson or rose colour, and one-fourth of pure bright yellow. He therefore supposed, that, when the natural crimson of the cochineal is made scarlet, by the usual process, a fourth of the colouring matter of the cochineal must be changed from its natural crimson to a yellow colour by the action of the solution of tin. For this reason he introduced a bright yellow dye into the bath with the cochineal, and reduced the quantity of this more expensive ingredient. He also found that a mixture of two pounds of sulphuric acid with about three pounds of muriatic acid, poured on fourteen ounces of granulated tin, with exposure to heat, produced a solution of tin, that had twice the effect of the common nitro-muriatic solution, at less than a third of the expense, and which raised the colours more, without producing a yellow shade. For the yellow dye, Dr. Bancroft used quercitron bark. His process for dyeing scarlet, by the use of this substance, and the above preparation of tin, is as follows:

An hundred pounds of cloth are to be put into a tin vessel, nearly filled with water, in which about eight pounds of the murio-sulphuric solution of tin have been previously mixed. The liquor is made to boil, and the cloth is turned through it by the winch for a quarter of an hour in the usual manner. The cloth is then taken out, and four pounds of cochineal, with two pounds and a half of quercitron bark in powder, put into the bath and well mixed. The cloth is then returned into the liquor, which is then made to boil, and the operation is continued, as usual, till the colour be duly raised, and the dyeing liquor exhausted, which will usually happen in about fifteen or twenty minutes; after which the cloth may be taken out, and rinsed as usual. In this method, the labour and fuel necessary for the second bath are saved; the operation is finished in much less time; all the tartar will be saved, as well as two-thirds of the expense of the solvent for the tin, and at least one-fourth of the cochineal usually employed; and the colour produced will not be inferior, in any respect, to that dyed with so much more expense and trouble in the ordinary way; and, moreover, looks much better than it by candle light.

A rose colour may be readily and cheaply dyed by the above process, by only omitting the quercitron bark.

Crimson is produced either by dyeing the wool this colour at once, or by first dyeing it scarlet, and then changing the shade to that required. To dye crimson by a single process, a solution of two ounces and a half of alum, and an ounce and a half of tartar, are employed in the boiling for every pound of the stuff, for each of which also an ounce of cochineal is to be afterwards used in dyeing it. It is customary to employ solution of tin, but in smaller proportion than for dyeing scarlet. To render the crimson deeper, and give it more bloom, archil and potash are frequently used, but this bloom is extremely fugacious.

To produce a crimson from a scarlet, the alkalies, alum, and earthy salts are used, all of which have this effect. Crimson is the natural colour of the cochineal, and to produce it from a stuff dyed scarlet, the stuff is boiled for an hour in a solution of alum, the strength of which is to be regulated by the depth of shade required.

Of dyeing Silk red.

The red colour obtained from madder does not possess sufficient brightness for silk; one of the best processes for its use is the following of M. Guhliche; for every pound of silk, four ounces of alum and one of solution of tin are to be mixed with water; when the liquor has become clear it is decanted, and the silk is soaked in it for twelve hours, after which it is immersed in a bath of half a pound of madder to each pound of silk, softened by boiling with an infusion of galls in white wine. The bath is to be kept moderately hot for an hour, and then made to boil for two minutes. The silk is then to be taken out, washed in a stream of water, and dried in the sun. The colour thus obtained is very permanent. By leaving out the galls it is clearer.

Crimson produced on silk by cochineal is called grain crimson, to distinguish it from a colour called false crimson, dyed with Brazil wood. For the grain crimson, the silk, being well cleansed from soap at the river, is to be immersed for a night in alum liquor of the full strength; it is then to be washed, and twice beetled at the river. The bath is prepared by filling a long boiler two-thirds with water, to which are added, when it boils, from half an ounce to two ounces of powdered white galls for every pound of silk. When it has boiled for a few moments, from two to three ounces of cochineal, powdered and sifted, are put in for every pound of silk, and afterwards one ounce of tartar for every pound of cochineal. When the tartar is dissolved, one ounce of solution of tin is added for every ounce of tartar. Macquer recommends this solution of tin to be made by dissolving six ounces of fine grain tin, with two ounces of sal ammoniac, in a pound of nitric acid, diluted with twelve ounces of water. When these ingredients are mixed together, the boiler is to be filled with cold water, the proportion of which, for every pound of silk, is about eight or ten quarts. In this bath the silk is to be immediately immersed, and turned on the winch till it appears of an uniform colour; the fire is then increased, and the bath is kept boiling for two hours, taking care to turn the silk occasionally; the fire is afterwards put out, and the silk immersed in the bath, where it is suffered to remain a few hours longer; it is then taken out, washed at the river, twice beetled, and dried.

To obtain other shades of red, the above processes must be varied. If, after the silk has been wrung out of the solution of tin, it is steeped for a night in a cold solution of alum, in the proportion of one ounce to a quart of water, wrung, dried, then washed, and boiled with cochineal, it will appear of a pale poppy colour. But a fine poppy-red may be procured by steeping it twelve hours in the solution of tin, diluted with eight parts of water, then leaving it all night in the solution of alum, after which it is to be washed, dried, and passed through two baths of cochineal, taking care to add to the second bath a small quantity of sulphuric acid.

The colour that comes nearest to scarlet has been produced, on silk, by first dyeing it crimson and then dyeing it with carthamus, and afterwards submitting it to a yellow bath without heat. The colour thus given is very fine, but the dye of carthamus is not permanent. In Dr. Bancroft's process, the silk is soaked for two hours in a solution of tin, in the murio-sulphuric acid, after which it is wrung out and dried partially. It is then to be dyed in a bath, prepared with four parts of cochineal and three of quercitron bark. In this way a colour approaching to scarlet is obtained. To give the colour more body, the immersion may be repeated in the solution of tin, and in the dyeing bath; the brightness of the scarlet is increased by the addition of carthamus. A lively rose colour is produced by omitting the quercitron bark, and dyeing with the cochineal alone.

Of dyeing Cotton and Linen red.

To dye cotton and linen red, madder is used; which cotton attracts more strongly than linen. The madder-red of cotton is distinguished into two kinds, the one is called simple madder-red; the other, which is much brighter, is called Turkey, or Adrianople red.

The process used at Rouen for the simple madder-red is as follows. The cotton must be scoured, galled with one part of galls to four of cotton, and then alumed with four ounces of Roman alum to one pound of cotton, and an equal weight of water: to the solution of alum one twentieth part of a solution of soda, consisting of half a pound of soda to a quart of water, must be added. When the cotton is taken out of this mordant, it is slightly wrung with the pin and dried; the colour is more beautiful as the drying is slow; twenty pounds of cotton are usually dyed at once, but ten would be better, because when many hanks are dyed at a time it is difficult to make the colour equal. To prepare the bath for ten pounds of cotton, about two hundred and twenty quarts of water should be heated in a copper, and when almost too hot for the hand, six pounds of good Dutch grape madder are to be carefully dispersed through it. When it is well mixed, the cotton is to be immersed, hank by hank, on sticks. When all the cotton is in, it is to be well worked, and the hanks turned on the sticks for three quarters of an hour, the bath being kept constantly at the same degree of heat, without boiling; at the end of this time the cotton is to be taken out and left on the edges of the copper, a pint of the above ley of soda is to be added to the bath, and the cotton to be put into it again, and boiled from ten to fifteen minutes: lastly, it is to be taken out, left to drain, wrung, washed in a stream of water, and wrung on the pin a second time.

Two days afterwards the cotton receives a second maddering, in the proportion of eight ounces of madder to the pound of cotton, and is worked as in the first maddering, except that no ley is added, and that well water is used for the bath: after this the cotton is left to cool, washed, wrung, and dried. M. d'Apligny recommends, instead of receiving two madder baths, that the cotton be alumed twice, and then dyed in a single bath only. This red is made more lively by soaking the cotton, pound by pound, in a bath of warm water, into which about a pint of the ley is poured; it is then wrung and dried; then washed in a stream of water, and spread on the grass, where the red brightens more than by any other operation.

The Turkey red possesses a degree of brightness much superior to the common madder red, and more powerfully resists the action of alkalies, alum, soap, and acids. The processes used in Turkey for this red are very complicated and tedious, some taking a month to perfect; the best of them are detailed in Berthollet's treatise on the "Elements of Dyeing." Their efficacy depends chiefly on the impregnation of the cotton with animal matter, which is mostly done by fish-oil and sheeps' dung.

One of the best processes for the Adrianople red, practised in our part of the world, is that at Glasgow, introduced by M. Papillon, at the expense and at the instance of the commissioners for manufactures in Scotland, and which is as follows: A ley is prepared for 100*lb.* of cotton, from 100*lb.* of Alicant barilla, 20*lb.* of pearl-ashes, and 100*lb.* of quicklime, strong enough to bear an egg. A weaker sort is also prepared, of the strength marked by two degrees of the French hydrometer, the first kind being of six degrees. (A saturated solution of common salt marks 60°, and soft water 0°, on this instrument.) The pearl-ashes are dissolved in ten pails of soft-water, of four gallons each, and the lime in fourteen pails; the liquors are let to stand till quite clear, and then ten pails of each are mixed together. In this the cotton is boiled five hours, washed in running-water, and dried; it is then submitted to what is called the grey bath.

For the grey bath, in twenty pails of the strong ley are mixed two pails of sheep's dung, two quarts of oil of vitriol, and one pound of gum arabic and one pound of sal ammoniac, previously dissolved in a proper quantity of the weak ley; and, lastly, twenty-five pounds of olive oil well mixed with two pails of the weak ley. The whole being well mixed, the cotton is trodden down in it till it is well soaked, left thus for twenty-four hours, and then wrung hard and dried. This operation is repeated a second and a third time, after which the cotton is well washed and dried.

The white bath, in which the cotton is next placed, is managed in every particular as the preceding, except that the sheeps' dung is omitted in it.

The gall bath, in which it is then put, is prepared by boiling twenty-five pounds of bruised galls in ten pails of river-water until four or five are boiled away; the liquor is strained into a tub, and cold water is poured on the galls in the strainer. In this liquor, made milk warm, the cotton is to be dipped, hank by hank, and left to steep in it twenty-four hours. It is then wrung carefully and equally, and dried well without washing.

For the first alum bath, twenty-five pounds of Roman alum are dissolved in fourteen pails of warm water, without making it boil: the liquor is well skimmed, two pails of the strong ley are added, and the whole is let to cool till it is luke-warm. In this bath the cotton is dipped, handled hank by hank, left to steep twenty-four hours, then wrung equally, and dried well without washing.

The second alum bath, to which it is next submitted, is managed exactly like the above: but after the cotton is dry, it is steeped six hours in the river, and then washed and dried.

Into the dyeing bath it is next put, by ten pounds at a time; which is prepared by mixing two and a half gallons of ox blood with twenty-eight pails of milk-warm water, adding twenty-five pounds of madder, and stirring all well together.

The ten pounds of cotton, previously put on sticks, is dipped into this liquor, and turned constantly for one hour, during which the heat is gradually increased, till the liquor begins to boil at the end of the hour. The cotton is then sunk in it, boiled gently one hour longer, and then washed and dried.

For the next ten pounds of cotton, so much of the boiling liquor is taken out, that what remains may produce a lukewarm heat with the fresh water with which the copper is again filled up, and then the dyeing liquor is made up as above.

For the fixing bath, five or six pails of the grey bath liquor, and as much of the white bath liquor, are mixed together; in this the cotton is trodden down, left to steep six hours, and then wrung moderately and equally, and dried without washing.

The brightening bath is prepared by dissolving carefully and completely ten pounds of white soap, in sixteen or eighteen pails of warm water: if any little bits of the soap remain undissolved, they will make spots in the cotton; four pails of the strong ley are added, and well stirred in. In this liquor the cotton is sunk, kept down with cross sticks, covered up, and boiled gently two hours; it is then washed and dried, which completes the process.

For the common madder red, Mr. Wilson advises acetite of alumen to be used as the mordant, instead of alum. The cotton in his process is galled, dried, then impregnated with the acetite of alumen diluted with hot water; dried a second time, maddered, washed, and dried again.

The scarlet colour communicated to cotton by cochineal is far from being permanent; but if it is desired, Dr. Bancroft recommends the cotton to be first steeped for half an hour in a diluted solution of murio-sulphate of tin, to wring it, and then plunge it into water, in which as much potash has been dissolved as will neutralize the acid adhering to the cotton, so that the oxide of tin may be more copiously fixed on its fibres; the stuff rinsed in water is then to be dyed with cochineal and quercitron bark, in the proportion of four pounds of the former to two of the latter. A full bright colour is thus given, that will resist soap and the air.

With acetite of alumen, used as a mordant, cotton dyed with cochineal receives a beautiful crimson; it will bear washing and the weather for some time; but is not permanent. Dr. Bancroft thinks that a small portion of cochineal added, in dyeing madder reds on the finer cottons, would be highly advantageous.

Of dyeing Wool yellow.

Weld is most commonly used in dyeing yellow. For the preparatory bath for dyeing wool this colour, Hellot directs four ounces of alum, and only one of tartar, to be used for every pound of wool.

For the dyeing bath, the weld is boiled inclosed in a thin linen bag, in the proportion of from three to to six pounds for every pound of cloth; it is kept from rising by a wooden cross: some dyers add a little quicklime and ashes, which heighten the colour, but render it less capable of resisting acids. Lighter shades of colour may be obtained by dyeing after deeper ones, adding water after each dipping, and keeping the bath at a boiling heat. These are not so lively as when fresh baths are used with a suitable proportion of weld. Alum renders the shade psler and more lively, tartar still paler, but sulphate of iron causes it to incline to brown.

Poerner recommends a similar preparation for this dye to that for scarlet, by which the colour will be brighter, more permanent, and lighter.

Dr. Bancroft states quercitron bark to be the cheapest and best substance for dyeing wool yellow. For its use the following process is directed. The bark, with an equal weight, or one-third more, of alum, is to be boiled for about ten minutes, in a suitable proportion of water; the stuff previously scoured is then immersed in the bath. The higher colours are dyed first, and afterwards the pale straw colours. The colour may be considerably heightened, by passing the unrinsed stuff a few times through hot water, to which one pound and a half of clean powdered chalk has been added for every hundred pounds of stuff.

The bark in boiling should be tied up in a thin linen bag, and suspended in the liquor, after having been first reduced to powder. This is the cheapest and quickest process; but the colour will be fuller and more permanent, if the stuff is first boiled for an hour and a quarter in a bath of a sixth or an eighth of its weight of alum, dissolved in a proper quantity of water, and be then, without being rinsed, immersed in the dyeing bath, formed by a weight of powdered quercitron bark equal to that of the alum, tied up in a linen bag, in clean hot water: it is to be turned through the boiling liquor in the usual manner, till its colour appears sufficient. One pound of clean powdered chalk, for every hundred pounds of stuff, is then to be mixed with the dyeing bath, and the operation is to be continued for eight or ten minutes longer. The addition of the chalk heightens and brightens the colour.

To give a beautiful orange-yellow to woollen stuffs, ten pounds of quercitron bark tied up in a bag, for every hundred pounds of stuff, are to be put into the bath with hot water. At the end of six or eight minutes, an equal weight of murio-sulphate of tin is to be added, and the mixture to be well stirred for two or three minutes. The cloth, first scoured, and completely wetted, is then immersed in the dyeing liquor, and briskly turned for a few minutes; by this process the highest yellow may be produced in less than fifteen minutes.

High shades of yellow are given by young fustic and nitro-muriate of tin, but they are less permanent, less beautiful, and more costly than those obtained from the above bark.

Of dyeing Silk yellow.

To dye silk a plain yellow, in general, weld alone is used. The silk is first scoured with soap, in the proportion of twenty pounds of soap to the hundred of silk, then alumed, and washed.

The dyeing bath is prepared with two pounds of weld to every pound of silk, which, having boiled for fifteen minutes, is to be passed into the vat through a sieve or cloth. When the temperature is as high as the hand can bear, the silk is introduced, and turned, until it acquires an uniform colour; during this time the weld is to be boiled a second time in fresh water; one half of the first bath is then taken out, and its place supplied with a fresh decoction. The temperature of the fresh bath may be a little higher than that of the former, but should not be too great, lest the colour already fixed be dissolved. The stuff is to be turned as before, and then taken out of the bath. Soda is to be dissolved in a part of the second decoction, and a larger or smaller quantity of the solution is to be added to the bath, according to the intensity of the shade wanted. The colour is examined by taking out a skein and wringing it.

To produce shades having more of a gold colour, anotta is added in proportion to the depth of the colour required.

Lighter shades, such as pale lemon colour, are obtained by previously whitening the silk, and regulating the proportion of the ingredients of the bath by the shade required. To give a yellow, with a green tinge, a little indigo is added to the bath, if the silk has not been previously azured; to prevent the greenish shade being too deep, the silk should be more slightly alumed than usual.

Dr. Bancroft asserts that all the shades of yellow can be given at a cheaper rate by quercitron bark than by weld. To dye with this bark, a quantity of it powdered, and inclosed in a bag, in proportion to the shade wanted, from one to two pounds for every pound of silk, is put into the vat while the water is cold. Heat is applied, and when the bath is rather more than blood warm, or of the temperature 100°, the silk, after being first alumed, is immersed and dyed in the usual way. A deeper shade may be given by adding a small quantity of chalk or pearl-ashes towards the end of the operation. To produce a more lively yellow, a small portion of murio-sulphate of tin may be employed, but it should be used cautiously, as it is apt to diminish the lustre of the silk.

To dye silk of an aurora or orange colour, after having been properly scoured, it may be immersed in an alkaline solution of anotta, the strength of which is to be regulated by the shade required. The temperature of the bath should be between that of tepid and boiling water. When the desired shade is obtained, the silk is to be twice washed and beetled, to free it from the superfluous colouring matter, which would injure the beauty of the colour. When raw silk is to be dyed, that which is naturally white should be selected, and the bath should be nearly cold; for otherwise the alkali, by dissolving the gum of the silk, destroys its elasticity. Silk is died of an orange colour by anotta, but if a redder shade be wanted, it is procured by alum, vinegar, or lemon juice. These colours are beautiful, but do not possess permanency.

Of dyeing Cotton and Linen yellow.

In dyeing cotton or linen yellow, the first operation is to scour the stuff with a ley prepared from the ashes of green wood; it is then washed, dried, and alumed with one fourth of its weight of alum; after twenty-four hours, it is taken out of the alum liquor, and dried without being washed. A weld bath is then prepared, by an infusion of a pound and a quarter of weld for every pound of the stuff, and in this it is dyed, by being turned and wrought till it has acquired the proper shade. It is then taken out of the bath, and soaked, for an hour and a half, in a solution of a quantity of sulphate of copper equal to one fourth of the weight of the stuff; it is then thrown, without being washed, into a solution of soap, in the same proportions: after being well stirred, it is boiled in it, for nearly an hour, and then well washed and dried.

If a deeper colour is wanted, the stuff is not alumed, but two pounds and a half of weld are used for every pound of the stuff, for each of which a drachm of verdigrise mixed with a part of the bath is added; in this bath it is dipped and worked, till it has acquired an uniform colour; it is then taken out of the bath, and a little ley of soda poured in; after this it is again returned into the bath, kept there a quarter of an hour, and then taken out, wrung, and dried. Other shades of yellow may be obtained, by varying the proportion of the ingredients; a lemon colour may be procured, by using only one pound of weld for every pound of cotton, and by diminishing tbe proportion of verdigris, or using alum as a substitute.

Dr. Bancroft directs a method for dyeing cotton yellow, which he asserts to be much cheaper, and which appears better in several respects, particularly as to the mordant. It is as follows:

'The mordant to be used is the acetite of alumen, formed by dissolving one pound of sugar of lead, and three pounds of alum, in a sufficient quantity of warm water. In this liquor, heated to 100°, the cotton is to be steeped two hours, after being first properly rinsed. It is then taken out and moderately pressed over a vessel, to prevent waste of the liquor. It is then dried in a stove heat, and after being again soaked in the aluminous solution, is wrung out a second time and dried: it is then barely wetted with lime-water, and afterwards dried; and if a full and bright colour is wanted, it may be necessary to soak the stuff again in the diluted aluminous mordant, and, after drying, to wet it a second time with lime-water: after it has been soaked for the last time it should be well rinced in clean water, to separate the uncombined portion of the mordart, which might injure the application of the colouring matter. By the use of the lime-water, a greater proportion of alumen combines with the stuff, as well as a certain portion of lime.

In the preparation of the dyeing bath from twelve to eighteen pounds of quercitron bark are inclosed in a bag, for every hundred pounds of the stuff, varying the proportion according to the shade required. The bark is put into the water while cold, and immediately after the stuff is immersed, and agitated or turned in it for an hour or an hour and a half, during which the water should be gradually heated, and the temperature raised to 120°. At the end of this time the heat is increased, and the dyeing liquor brought to a boiling temperature; but at this temperature the stuff must only remain in it for a few minutes, because otherwise the yellow assumes a brownish hue. The stuff, having thus acquired a sufficient colour, is taken out, rinsed, and dried.

Many attempts have been made to imitate the shade of yellow which nankeens possess; but none have hitherto succeeded, so as to produce a colour whose difference from the real nankeen could not be in general distinguished at first sight; or in the very few instances where this was at all doubtful, a little wear soon betrayed this deception. Chaptal has recommended a colour procured from salt of iron for this purpose; and in the processes of others, iron in general has been the colouring substance used; but a colour from iron has the evident defect of getting black stains from the least touch of any astringent liquor, to which it is perpetually liable wherever tea is used. It is therefore useless to insert receipts for a colour which never yet came sufficiently near what it was intended, to produce the least competition in the market with the real article.

Nankeen is made of cotton, whose colour is naturally such as we see it; some of the best grows in Bhaugalpore in the East Indies; it would be an object well worth the attention of the cotton planters in the West India Isands, to get over plants or seeds of this species of cotton, to raise it for the English market. Perhaps the Bhaugalpore cotton might be imported from the East cheap enough for the use of our manufacturers, which would save the nation much of the large sums that go out of it annually for the purchase of nankeens.

Of dyeing Wool green.

Having given an account of the most approved processes for dyeing the four simple colours, black, red, blue and yellow, we now proceed to the compound colours; which are so called, because in general they are produced in dyeing by mixtures of the simple colours, though in a few instances substances are found which produce some of the compound colours without addition.

To dye woollen green, either a blue or a yellow dye may be first given to it; but the first is generally done, because the yellow dye of the stuff would injure the blue bath. The intensity of the blue must be proportioned to the shade of green required. When the blue dye is given, the yellow is communicated by some of the processes described. The cloth, having first got the proper ground, is washed at the fulling mill, and boiled as for the common process of welding; but when the shade is to be light, the proportion of salts should be less. In this case the quantity of weld used should also be less, but for all other shades it should be greater than for dyeing simple yellow.

Sulphate of indigo is employed for the greens called Saxon greens. Dr. Bancroft directs for this dye, that from six to eight pounds of quercitron bark, enclosed in a bag, should be put into the bath for every hundred pounds of cloth, with only a small proportion of water just as it begins to grow warm. When the water boils, six pounds of muriosulphate of tin should be put in, and a few minutes after, about four pounds of alum; these having boiled five or six minutes, cold water should be added, and the fire be diminished, so as to bring down the heat of the liquor nearly to what the hand is just able to bear; immediately after this as much sulphate of indigo is to be added, as will suffice to produce the shade of green required, taking care to mix it thoroughly with the bath. The cloth, previously scoured and moistened, should then be expeditiously put into the liquor, and turned very briskly through it for a quarter of an hour, that the colour may apply itself evenly in every part. By these means very full, even, and beautiful greens may be dyed in half an hour; but during this space it is best to keep the liquor a little below the boiling heat.

Of dyeing of Silk green.

The silk is first scoured, as for other colours; and for light shades the scouring must be as complete as for blue. It is then first dyed yellow in small parcels, (after being well alumed, and slightly washed at the river) by carefully turning it in the weld bath. When it has acquired the proper shade of yellow for the green required, which is known by trying a pattern in the blue vat, it is taken out, washed, and then immersed in the blue vat. A deeper colour is given, and the shade varied, by adding a decoction of logwood, fustic, or anotta, to the yellow bath, after the weld has been taken out. For light shades a lighter ground is given.

For Saxon green from sulphate of indigo, the silk is prepared by boiling as for welding, and afterwards washed. Then fustic in chips, enclosed in a bag, is put into the same bath, boiled for an hour and a half, and then taken out, and the bath let to cool till the hand can bear its heat. A pound and a quarter of indigo is added for every eighteen yards of stuff; the stuff should be first turned quickly, and afterwards more slowly, and it should be taken out before the bath boils.

In Dr. Bancroft's process for the Saxon green, four pounds of quercitron bark, three pounds of alum, and two pounds of murio-sulphate of tin, are infused in a proper quantity of water: the bath is boiled ten or fifteen minutes, and when cooled till the hand can bear it, is fit for use: by adding different proportions of sulphate of indigo, various beautiful shades of green may be obtained. Care must be taken to keep the bath constantly stirred, to prevent the colouring matter from subsiding. Those shades which are intended to incline to yellow should be dyed first; and by adding sulphate of indigo, the green having a shade of blue may be obtained.

Of dyeing Cotton and Linen green.

Cotton and linen are scoured in the usual way, and then first dyed blue; after being cleaned, they are dipped in the weld bath, to produce a green colour. The strength of the blue and yellow is proportioned to the shade of green wanted. But as it is difficult to give cotton velvet an uniform colour in the blue vat, it is first dyed yellow with turmeric, and the process completed by giving it a green by sulphate of indigo.

The different shades of olive, and drakes-neck green, are given to cotton thread, after is has received a blue ground, by galling it, dipping it in a weaker or stronger bath of iron liquor, then in the weld bath, and afterwards in the bath with sulphate of copper; the colour is lastly brightened with soap.

Yellow colours are rendered more intense by means of alkalies, sulphate of lime, and ammoniacal salts, but become fainter by means of acids, solutions of tin, and alum.

Of dyeing Wool purple, violet, and lilac.

Violet, purple, lilac, dove colour, and a great variety of other shades, are produced by the mixture of red and blue, according to the proportions of the substances employed. For violets, a deep blue ground is given, and for purples a lighter blue; in lilacs, and similar colours, both the red and blue are light.

For violets and purples, the stuff should first be dyed a light blue, not deeper than sky blue; it is then boiled with alum and two-fifths of tartar, and is afterwards dipped in a bath composed of nearly two-thirds the quantity of cochineal required for scarlet, with the addition of tartar. The same process is followed as for dyeing scarlet. It is common to dye these colours after the reddening for scarlet, making such additions of cochineal and tartar as the intensity of the shade may require.

For lilacs, dove colours, and other lighter shades, the stuff may be dipped in the bath which has served for violet and purple, and is somewhat exhausted, taking care to add a proper quantity of alum and tartar. For reddish shades, such as peach-blossom, a small proportion of solution of tin is added. It may be observed, in general, that though the proportion of cochineal is less in lighter shades, the quantity of tartar must not be diminished.

A less expensive process is recommended by M. Poerner for these colours: he prepares the stuff by boiling it an hour and a half, with three ounces of alum for every pound of it, and leaving it a night in the liquor after it is cold: he makes the bath with an ounce and a half of cochineal, and two ounces of tartar, for every pound of stuff, boiling it three-quarters of an hour, and then adding two ounces and a half of sulphate of indigo in the above proportion to the stuff, he stirs the bath, and makes it boil gently for a quarter of an hour, and thus obtains a very beautiful violet; he increases and diminishes the indigo in all proportions, from five drams to five ounces to each pound of stuff, according to the shade wanted; he also reduces the quantity of cochineal, but never below an ounce to the pound, because the colour would then be too dull: he varies the proportion of tartar, and prepares the stuff with different quantities of solution of tin.

A purple colour, as well as some other shades, may be given to wool by logwood, with the addition of galls, but the colours thus obtained are not permanent. M. Decroizille discovered a process, by which a durable dye may be procured from logwood, of which the following is an account. The mordant used was a solution of tin in a mixture of sulphuric acid, common salt, and water; to which were added red acidulous tartrite of potash, and sulphate of copper.

If the wool is to be dyed in the fleece, it will require a third of its weight of this mordant, but for cloth a fifth will be sufficient. A bath is to be prepared as hot as the hand can bear, with which the mordant is to be well mixed, and the stuff is to be dipped in it and stirred; the same temperature is to be kept up for two hours, and increased a little towards the end; after which the stuff is to be taken out, aired, and well washed. A fresh bath of pure water is prepared at the same temperature, to which a sufficient quantity of the decoction of logwood is added: in this the stuff is immersed and stirred; the heat is then increased to the boiling temperature, and continued so for fifteen minutes, after which the stuff is taken out, aired, and carefully rinsed. If the decoction of one pound of logwood has been used for every three pounds of wool, and a proportionate quantity for stuffs that require less, a fine violet colour is produced; to which a sufficient quantity of Brazil wood imparts the shade known in France by the name of *prune de Monsieur*.

The colours produced by logwood, Brazil, fustic, and yellow wood, may be fixed on wool to advantage by the last mentioned mordant. The alkali of the soap used in fulling is apt to change the colour given by the two first of these substances, but this is remedied by a slightly acid bath a little hot, called the brightening bath, for which sulphuric acid is the best; the colour after this is as deep, and frequently much brighter, than before the change. Wool dyed by means of this mordant is said to admit of being spun into a finer and more beautiful thread than that prepared by alum. If the sulphate of copper is omitted, more beautiful colours are produced by fustic and yellow wood, as well as by weld. An orange red is given by madder with it, but not so deep as with a similar quantity of alum. When sulphate of copper is omitted, the wool is said to be much harsher, and the mordant prepared without it yields but indifferent colours with logwood, and in particular with Brazil wood.

Of dyeing Silk violet or purple.

Silk may be dyed violet in two different modes; the colour produced by the one is called the fine colour, and that by the other the false, the latter of which is dyed by means of archil or Brazil wood. When the fine colour is required, the silk must first be passed through a cochineal bath, and afterwards be dipped in the blue vat. The preparation and dyeing of silk with the cochineal are the same as for crimson, with the omission of tartar and solution of tin, by which the colour is heightened. The quantity of cochineal made use of, is always proportioned to the required shade, whether it be more or less intense; but the usual proportion for a fine violet colour, is two ounces of cochineal for each pound of silk. When the silk is dyed, it is washed at the river, twice beetled, dipped in a blue vat, more or less strong in proportion to the depth of the shade of violet wanted, and then washed and dried, with the precautions which all colours require that are dyed in this vat. If the violet is to have greater strength and beauty, it is usual to pass it through the archil bath; without this, light shades would be too dull.

When silk has been dyed with cochineal as above directed, only a very light shade is requisite for purple; the shades which are deepest are dipped in a weak blue vat, but those which are to be lighter, it is sufficient to dip in water incorporated with a small quantity of the liquor of the vat, because in the vat itself they would acquire too deep a tinge of blue, however weak it might be. The light shades of this colour, as gilly flower, peach-blossom, &c. are produced in this manner, by diminishing the quantity of cochineal.

The false violet colour of the greatest beauty is given to silk by archil, in the various ways used for producing it; the bath of which is to have its strength proportioned to the colour required. The silk having been beetled at the river, after scouring, is turned in the archil bath on the skein sticks; and when the colour is deemed sufficiently deep, a pattern is tried in the blue vat, to ascertain whether it takes the violet colour intended to be produced. If the shade is of the proper depth, the silk is beetled at the river, and dipped in the vat in the same way as for the fine violet colours; and less either of the blue or of the archil colour is given, according as the violet is intended to have the blue or red shade predominant.

A violet colour may be imparted to silks by immersing them in water impregnated with verdigris as a substitute for aluming, and next giving them a bath of logwood, in which they assume a blue colour; which is converted into a violet, either by dipping them in a weaker or stronger solution of alum, or by adding it to the bath; the alum imparts a red shade to the colouring matter of the logwood. This violet possesses but little beauty or durability; but if the alumed silk be immersed in a bath of Brazil wood, and next in a bath of archil, after washing it at the river, a colour is obtained, possessing a much higher degree of beauty and intensity. M. Decroizilles' process, above related, for dyeing wool, succeeds equally well, according to his account, in communicating a violet colour to silk.

Of dyeing Cotton and Linen violet.

To communicate a violet colour to cotton and linen, they commonly receive first a blue ground in the vat, proportioned to the shade required, and are then dried. They are afterwards galled with the proportion of three ounces of galls to every pound of stuff, and being left in this bath for 12 or 13 hours, are wrung out and dried again. They are next passed through a decoction of logwood, and when thoroughly soaked and taken out, the bath receives an addition of two drams of alum, and one of dissolved verdigrise, for every pound of the yarn. The skeins are then dipped again on the skein sticks, and turned for about 15 minutes, when they are taken out and aired; they are next immersed in the bath for 15 minutes, taken out and wrung. To complete the process, the vat employed is emptied; half of the decoction of logwood not before used is now poured in, with the addition of two drams of alum, and the yarn is again dipped in it till it has acquired the shade proposed, which must always regulate the strength or weakness of the decoction of logwood. This colour bears the air tolerably well, but is much inferior in permanency to that which is obtained by the use of madder.

Of dyeing Wool orange.

Orange, being a mixture of yellow and red, may be communicated by the processes for dyeing scarlet in which yellow is used, by diminishing the proportion of red, and increasing that of yellow. Wool dyed red by madder, and afterwards yellow by weld, acquires a cinnamon colour, for which the most proper mordant is a mixture of alum and tartar. The shades may be varied at pleasure, by substituting other yellow dye stuffs for weld, and by altering the proportions as circumstances may require. Wool receives a reddish yellow, by being passed through the madder bath after having been dyed yellow. Brazil wood is sometimes employed with yellow substances singly, or mixed with cochineal and madder, to produce this colour. When, instead of weld, or other yellow dyes, walnut-tree root, walnut-peels, or sumach, are used, snuff, chesnut, musk, and other shades, are obtained.

Of dyeing Silk orange shades.

Marones, cinnamons, and all the intermediate shades, are given to silk, by logwood, Brazil, and fustic; a bath is prepared by mixing decoctions of these three woods made separately; the proportion of each is varied according to the shade required, but that of fustic ought to prevail; the bath should be of a moderate temperature; and the silk, after being scoured and alumed in the usual manner, is immersed in it. The silk is turned on the skein sticks in the bath, and when taken out, if the colour be uniform, it is wrung, and dipped in a second bath of the three ingredients, the proportions of which are regulated according to the effect of the first bath, in order to obtain the shade required.

For some colours blue is united to red and yellow; it is thus olives are produced; a blue ground is first given, then the yellow dye, and lastly a slight maddering. Olive may be dyed without using the blue vat, by dipping the silk in a very strong weld bath, after being first alumed; to this a decoction of logwood is afterwards added, and when the silk is dipped, a little solution of alkali is put in, which turns it green, and gives the silk the olive colour. The silk is repeatedly dipped in this bath until it has acquired the proper shade.

A kind of reddish olive is produced by a bath of fustic, to which more or less copperas and logwood have been added. Russet-olive is dyed, by adding fustic and logwood to the bath after welding. The addition of logwood alone gives a redder colour, if such is required.

Of dyeing Cotton and Linen orange shades.

By beginning with weld and verdigris, cinnamon colour is given to thread and cotton, which are then dipped in a solution of copperas, wrung, and dried. When dry, they are galled with three ounces of galls to the pound dyed; they are then dried again, alumed as for red, and maddered. After being then washed, they are put into very warm soap-suds, and turned till they are sufficiently brightened; a decoction of fustic is sometimes added in the aluming.

M. d'Apligny states, that a fine olive may be imparted to cotton and thread from four parts of weld and one of potash, boiled in a sufficient quantity of water, and Brazil wood, which has been steeped one night, boiled separately with a little verdigris, by mixing the two decoctions in the proportions the shade requires, and immersing therein the thread or cotton.

Of dyeing Cloth brown or grey.

To impart a brown shade, the stuff as soon as dyed is dipped in a solution of copperas, to which an astringent has been added; which is better than mixing copperas with the bath, as some do.

Coffee, damascene, and other shades, are produced, by giving the cloth first a colour more or less deep, according to the shade wanted, and then dipping it in a bath of galls, sumach, alder-bark, and copperas, according to the effect desired.

Blue-greys are given by solution of indigo in sulphuric acid, combined with a mixture of decoction of galls and copperas. Other shades are obtained by a bath of cochineal, fustic, and galls, to which copperas is added.

For marone, and similar colours, saunders and galls are employed; and sometimes a browning with the addition of logwood. These colours may be made to incline to crimson or purple, by adding a small quantity of cochineal or madder. A little tartar gives brightness to the colour. With a mixture of galls, fustic, and logwood, some madder, and a little alum, hazel colours are produced.

Of dyeing Silk dark mixed colours.

Silk may be dyed a violet purple, without a blue ground, by preparing it with a mordant of two ounces of alum, one ounce of solution of tin, and half an ounce of muriatic acid, to each pound; steeping it twelve hours in a mixture of one part of galls dissolved in white wine, with three parts of water; and then, after wringing, dyeing it in a bath composed with two ounces of cochineal and a small quantity of iron liquor, till the intended shade is given. Madder may be used in the same way.

Colours resembling that of bricks may be produced, by immersing silk in an annotta bath, after preparing it with a mixture of solution of galls and iron liquor.

By the combination of brazil, logwood, archil, and galls, and by browning with copperas, a nnmber of different shades are dyed: but though their brightness is pleasing, they are not permanent.

Of dyeing Cotton and Linen dark mixed colours.

Thread and cotton may be dyed a permanent violet, by submitting them, after being scoured in the common mode, to a mordant prepared by boiling two quarts of iron liquor with four quarts of water, for every pound, carefully removing all the scum, and adding to this liquor poured into a vat, while warm, four ounces of sulphate of copper, and one ounce of nitre, to the quantity stated. In this thc skeins are steeped ten or twelve hours, wrung out, and dried, and then dyed in a madder bath, if suitable to the shade wanted. If a deep violet is required, two ounces of verdigris must be added to the bath; and the colour becomes still deeper, by galling the yarn more or less before it is steeped in the mordant, if the nitre be omitted. If the proportion of nitre is increased, and the sulphate of copper diminished, the violet inclines more to lilac. By modifying the mordant in different ways, a number of different shades may be produced.

To dye cotton different shades of marone colour, it is galled, dipped, and worked in the usual way in a bath, to which more or less iron liquor has been added. It is then washed in a bath mixed with verdigris, welded, and dyed in a bath of fustic, to which a solution of alum and soda are sometimes added: it is then completely washed, after that well maddered, then dipped in a weak solution of sulphate of copper, and lastly in soap-suds.

For some hazels and snuff colours, a browning is sometimes given by soot, after the welding, and a madder bath, to which galls and fustic have been added; the soot is sometimes mixed with the bath: a browning is likewise given by solution of copperas. Walnut peels are also used for the same purpose: the colour they impart is rather dull, but it is not liable to be changed by the air into a yellower shade, as is the case in the brownings imparted by means of iron. The goodness of this dye, and its cheapness, are sufficient to recommend its use for grave colours, which are sometimes fashionable.

For calico printing, see CALICO *Printing*.

DYNAMICS. This branch of mechanics relates to the action of forces that give motion to solid bodies; which forces are calculated, both by their active powers, and by the proportion of time in which those powers become efficient. Our readers cannot fail to perceive, that the complete analysis of all appertaining to this subject would occupy many formidable volumes; while the generality of those who have absolute occasion to acquire a complete knowledge of dynamics, would be led to consult the various elaborate publications that have been published, for the edification of such as possess that disposition. We must, necessarily, study simplicity, so far as our subject may admit, and endeavour to bring the most prominent matters into a moderate compass.

Each body is considered as a mass of atoms divisible *ad infinitum;* the bulk or substance of a mass we consider as having density, which relates directly to the quantity of the matter, and inversely refers to the magnitude. We are also compelled to consider, that, as the generality of bodies are more or less porous, their quantity of matter is not in every instance found to correspond with the bulk they exhibit. Thus we find that a pound of gold and a pound of lead, though apparently solid, give very different weights within the same bulk. The former is said to be more dense, while the latter is said to be more rare; density and rarity being opposite qualities. Therefore, if we could always ascertain the number of atoms, or of minute parts, contained in a mass, we should be able to appreciate the density; because, under the certainty that, in proportion as more or less atoms are comprised within a given space, so must the mass be more or less dense; *i. e.* heavier or lighter.

In computing density we therefore take the rectangle of the mass, and, ascertaining the dimensions, discover by its weight how many atoms, or particles, it contains. Hence is derived our table of specific gravities, or the comparative weights of various bodies of unequal densities. (See HYDROSTATICS.) From this it will be seen that bodies of similar substance and form, but differing in bulk, are to each other in proportion to the magnitude of their respective masses; while, on the other hand, bodies of similar form, and equal in bulk, are, to each other, in proportion to their respective densities.

Forces are considered according to the quantities of motion they are capable of producing; but, as we cannot measure those forces, we are under the necessity of ascertaining the power by means of the effect. Thus we can correctly ascertain the force of gunpowder by the effect produced by the shot; or we can fully explain the force with which the spring of a watch acts, by finding what resistance it is capable of overcoming; or we may compute the strength of a horse, by witnessing the weight he can draw. But it must be obvious we could not discover, *per se*, either the strength of the gunpowder, the elastic powers of the spring, or the muscular vigour of the animal.

Force and velocity are, in fact, synonymous terms; for the impetus given to the shot fired from a cannon, estimated by the bulk of the shot, and the distance to which it may be projected, or the impression it may make on an opposing object, completely supply the result of our research; remarking, that, this being a diminishing force, its action will be strongest at the moment of expulsion, and gradually less as it recedes from the origin of motion, until it finally acquires a state of rest. The spring in a measure partakes of the same diminishing tendency; but as it may be held in equilibrio at any period of its exertion, it cannot be classed with the former, though, rigidly speaking, it is assuredly a diminishing force; for, as we see in clocks and watches, springs will in due time arrive at a state of rest, or inaction. The animal power is subject to so many anomalies, that it is next to impossible to treat of it with any strict adherence to calculation; because, in so doing, we are compelled to banish what we know to be the effects of labour, and to consider the power as always equal, and always maintaining the same physical ability. Here, indeed, we find theorists generally proceeding upon a wrong basis; and, of course, rarely correct in their conclusions. We find them estimating the powers of horses, &c. as though their limbs had no flexibility, their muscles no relaxation, and as if their shoulders were insensible to pressure; in fact, they generally consider the animal as a fulcrum of wood, iron, &c. The absurdity of such a calculation must be obvious.

But to proceed. We consider force to be either equal (or permanent), accelerating (or gaining in power), or diminishing (or losing in power). Thus, the motion of a well-regulated clock may be considered as an equal force; because, in equal periods, it proceeds over equal spaces. A weight falling from a height is an accelerating force; because it gradually accumulates velocity in proportion to the space through which it falls: and a shot fired from a cannon is a diminishing force; because it constantly and gradually loses velocity, until, at length, it ceases to move. Dissimilar bodies will move through the same space in exact ratio with their own squares, and their relative impulses; but if two bodies, of equal bulk and density, be set in motion oppositely, by the same momentum, or power, they will hold each other in equilibrio: and if two such bodies so acted upon should meet, they will mutually obstruct each other's progress. Of this we may frequently see instances in the game of billiards. But if two bodies of different density be acted upon by forces that correspond with their masses respectively, the greater will overcome the lesser: as will also a body impelled by a greater force than one of equal density, to which it may come in opposition. Thus, a pistol shot meeting a fives' ball will cause it to deviate from its course, or to recede.

Uniform, or perfectly equal, motion does not exist naturally. It is, perhaps, not to be found any where; though our mechanical arts have furnished us with various instances of great approximation thereto, for a time only. Yet all motions, generally speaking, would be uniform, were it not that obstacles perpetually present themselves to retard their velocity, either perceptibly or imperceptibly. We are, however, compelled to consider uniform motion to exist; else we could form no just comparison on many occasions; and, as some standard is needful, we estimate the velocity of bodies by seconds of time; taking a second as a unit. The following will be sufficient to give full insight into this part of our subject.

When bodies have different uniform motions, the spaces described are proportional to the times and velocities, jointly. Hence the velocity is as the space divided by the time. For the velocities of two bodies, moving uniformly, are directly as the spaces, and inversely as the time; for, in equal times, the velocities are proportional to the spaces run over; and if the velocities are equal, the spaces passed over are proportional to the times; again, if the spaces passed over are equal, the velocities are reciprocally as the times.

We have an easy mode of exhibiting the comparative velocities of bodies: let the velocities be described by base lines, and let the altitudes express the time; the area of each figure thus found will display the space over which the body, of which it is respectively the representative, has passed. This shows their progress, whatever may be their direction; but where they follow the same, or a parallel course, though their velocities should be different, their several situations are easily ascertainable. In such case we may consider them as moving in concentric orbits, and, after ascertaining their several velocities, remove them, according thereto, at suitable distances from the centre, when all would be found to persorm their revolutions within the same period; their velocities being equal to the rectangle contained under the diameters of the orbits in which they severally move. Or, we may consider them all as moving in the same orbit, as the hour, minute, and second hands of a watch, all shew their progress upon the same index, or dial plate.

But we sometimes find two forces acting upon the same body; if they be simultaneous (or equal) the movement of the body being equally acted upon by either, it will assume a medium course, and divide the angle at which the two forces stand apart. Thus, in fig. 1. Plate Dynamics, if a body O be equally impelled by two forces, the one in the direction of S T, the other of N R, it will traverse the diagonal line, O X, and arrive at the opposite corner of the square; and that too in the same time, say one second, as it would have required, if acted upon by only one of the forces, to have passed from O either to T or to R.

If the forces are unequal, the body will be impelled in the same manner towards the opposite point of a parallelogram, and will thus gain more towards the course of the stronger power, than in the direction of the weaker; between which it will exhibit a true proportion. Say that A B, fig. 2. be the direction of a force three times as powerful as the force A C. The body will move along the diagonal A D, in the same time that it would have been urged by the greater power from A to B; or by the lesser power from A to C. Perhaps no more obvious proof of this could be deduced, than the course of a ship, when laying, what is technically called, "near the wind." The real track of the ship is always seen by her wake, or a peculiar mark left in the water; though the ship's head may lay quite in another direction. Therefore, it is customary to ascertain the angle made between the wake and the ship's apparent course, by means of a compass, and to set off that angle under the head of lee-way; the wake always appearing rather towards the weather (or wind-side) quarter of the vessel. Thus, although it should seem the vessel were proceeding in the direct line E F, fig. 3, yet on account of the wind acting as two different powers, that is, partly causing her to proceed in the direction of her keel, and partly in a line with her beam, or diameter, she would arrive at the opposite point G; supposing her progress forward to be twice the amount of her lee-way, or lateral tendency, as above stated, the wake would describe her true course, while her apparent course would always appear to be parallel with the line E F.

Let us suppose that H and I, fig. 4. two equal weights, were to be raised by means of a chord from each meeting in K: the line of force which should raise them with equal velocity would be along the diagonal K L. If the weights were unequal, the line would not be the diagonal of an equilateral quadrangle, as in the preceding case, but along the parallel Q V of the diagonal formed by a proportionate parallelogram, fig. 5. The angle being more acute with the line of the greater weight B, and more obtuse with that of the lesser weight C, the parallelogram would be formed of sides corresponding with the proportions of the two weights; which are in this instance considered at 4 to 1.

When various bodies, moving in the same course, are acted upon equally by a second power, not in a line with that of the primary momentum, they will each preserve their relative situations in regard to each other. We have a familiar proof of this in the descent of rain, &c. which will be found to preserve a parallel course among the drops respectively, though they may each be driven from the line of gravity, and be impelled into an oblique direction, by the force of wind. The case is similar among the vessels of a fleet, supposing all to sail alike, when they get into a current; they will preserve their relative situations, and perform all their evolutions, precisely as though they were in stagnant water.

Uniformly varied motion relates to bodies, which, at regular periods, or at regular distances, receive new impulses, either in the same direction, or in opposition thereto; in the first case, the new momentum is to be added to the former velocity: in the latter case, it is to be deducted from it. In variable motions we compute the velocity, according either to a medium taken at the average of the accession of forces, or we consider the velocity at the instant chosen for calculation to be equal to an unit; *i. e.* a second of time; we may thus calculate each unit separately. A force causing a body to move quicker is termed an accelerating force; though the term is also applied to forces which cause the motion to vary: when it occasions a regular increase of velocity, by an equable addition of impulse, it is termed an uniformly accelerating force; but if it occasions a body to move regularly slower, as an additional weight in mechanics, or a lengthened pendulum in clock-work, it is called an uniformly retarding force.

A single body would, by a constant force, give four objects of consideration, *viz.* the space, the time, the velocity, and the force: any three of these being given, the fourth may be found. For the velocities generated in equal bodies, by the action of constant forces, are in the compound ratio of the forces, and the times of acting. The momenta generated in unequal bodies are also conjointly as the forces, and their times of action; and the momenta lost or destroyed in any times are likewise conjointly as the retarding forces, and their times of action: for an equal opposing force would, in equal time, destroy the impelling force. The velocities generated or destroyed in any times are directly as the forces and times; and reciprocally as the bodies or masses. In all motions uniformly accelerated, when the force and body are given, the space described during a certain time is the half of that which the body, moving uniformly with the last acquired velocity, would describe in an equal time; and the spaces described by a body uniformly accelerated are as the squares of the times; hence the velocities acquired being as the times, we shall find the spaces described to be the squares of the velocities. Therefore, either the velocities, or the times, are as the square roots of the whole of the described spaces. And this applies equally to motions uniformly retarded.

Of variable motions in general. By this we immediately refer to those forces which act incessantly, but always in different degrees of strength; of this we have an instance in the release of springs from heavy pressure; whence they gradually recover the form in which they were made. A carriage set in motion, though the horses may appear to act uniformly, nevertheless occasions less exertion to them, when it has acquired its due degree of velocity. For bodies in a state of rest are, in a manner, disposed to remain so; and bodies in motion are disposed, in a certain degree, to continue so, as will be subsequently shewn: therefore we find the first effort to be considerable; while, on the other hand, it often requires much resistance on the part of the horses, even on level ground, to discontinue that motion of which their forces were the cause. Besides this illustration, we find that bodies are very sensibly affected by the forms of those spaces over which they have to pass, admitting the ascents to be equal, and the whole to be perfectly level, and free from impediments; which, indeed, must ever be understood, while treating of the motion of bodies, especially by comparison. If a body X should have to pass over the point A, fig. 6, along the plane A B, its motion would be uniformly continued by the power C; but if the surface were concave, as A D B, then the first part of the motion would be more rapid than the lattter; because the commencement of the concave space being more horizontal than the latter, or upper part, would permit the force to act more powerfully on the body D. On the other hand, if the line of ascent were convex, as at A E B, the first part of the ascent, being steepest, would be slowest; and the latter, in consequence of its regular approach to the horizontal, would be proportionately rapid. Thus we see that C is an uniform force on the plane A B; an accelerating force on the convex ascent A E B; and a retarding force on the concave ascent A D B: we therefore deduce, that accelerating and retarding motions may be described by arcs of which the axes are easily ascertained.

There is a kind of fluctuating or alternate force to be found in the action of forcing pumps. In these the compression of the fluid, and of the intermediate air, demands a greater force, in proportion as the piston descends; and, *vice versa*, as it ascends; the gradual increase of compression, furnished by the return of the fluid into the lower part of the cylinder, causes a gradual diminution of resistance to the upward motion, and consequently acts as an accelerating force.

When bodies at rest fall from heights, the times employed are, respectively, as the square roots of the cubes of the heights from which those bodies fall. We may, perhaps, form a ready estimate of this circumstance, when we recollect that gravity gives to all falling bodies an accelerating force. In the latitude of London, a heavy body falls nearly sixteen one-twelfth feet in the first second; which velocity is not only doubled in the next second, so as to amount to $32\frac{1}{2}$ feet, but quadrupled by means of the additional force gained by the continued action of gravity; the third second of time will give $96\frac{1}{4}$ for its increase, and the fourth second will give $128\frac{2}{5}$. In this we suppose the bodies not to be impelled downwards by any force, (exclusive of gravity) but to be in a state of rest, and allowed to descend simply by their own weight: for instance, by cutting the line that suspends a weight.

As bodies gain velocity in falling, so they lose velocity when projected upwards. If a body be impelled upwards, with the same force it had acquired in falling, its velocity upwards would gradually decrease in the exact ratio that it increased in descending, and with such a power it would reach to that height whence it had fallen, but no further. Hence, by ascertaining either the time of ascent, or of descent, the height will be discovered. It is worthy of notice, that the acquired velocities are as follow: 2, 4, 6, 8, 10, &c. upon each preceding second respectively; the spaces for each time being 1, 3, 5, 7, &c. respectively, and their constant differences 2. These laws of acceleration were ascertained, by Galileo, to prevail equally in the motion of bodies along inclined planes, which may, indeed, be fully proved by observing the progress of a ball as it descends a hill: but this will not hold good unless the body be at perfect liberty; for in cases of interruption, each gradation must be considered as the incipient motion; were it otherwise, no carriage could descend a long declivity without the certainty of being dashed to pieces, nor ascend a hill at the same pace throughout.

The force which accelerates or retards the motion of a body upon an inclined plane is, to the force of gravity, as the height of the plane to its length; or as the sine of the plane's elevation to the radius; and if the diameter of a circle be perpendicular to the horizon, and chords be drawn from either extremity, the time of descent down all the chords will be equal; and each will be equal to the time of free descent through the vertical diameter. In the circle, fig. 7, the line A B is a vertical diameter, the chords A C, A D, A E, and E B, are all of different lengths, and of different inclinations from the horizon. It is evident that, in every instance, the shortest chords have the least deviation from the horizontal; consequently they must retard the progress of a body passing down them much more than those which approach to the vertical; the latter, obviously, give a more free passage to the body; and as they become more vertical, approach nearer to the free descent at A B.

When a body descends along any number of contiguous planes, it will ultimately acquire the same velocity as would have been acquired by falling perpendicularly through the height of the whole number of planes. The times of descents along similar arcs, similarly situated, are as the square roots of those arcs; or as the square roots of the radii of their respective circles. And if a body, being at rest, is suffered to fall down a curved surface which is perfectly smooth, the velocity acquired will be equal to that which would result from falling the same perpendicular height. It will require an incipient force to urge the body back to the height whence it fell, equal to that which it had acquired on reaching the bottom of the curve. Therefore a body falling from O, fig. 8, to the bottom P of the curve O P S, would have power to re-ascend (excluding friction) to S, which is level with O; and it would rise from P to S in the same space of time it occupied in falling from O to P; in either case the time occupied would be the same as from X to P. When treating of the pendulum this will be more obviously demonstrated.

It was for a long time supposed, that a body would move more rapidly in a direct line, not being vertical, than by any other course; but it has been ascertained, that any curve, not exceeding 60 degrees, is a quicker descent than its chord; and that a curve of 90 degrees is a quicker descent thau any tangent laying between the same parallels. Thus, in fig. 9, the curve A B C is of quicker descent than the chord A C, and the curve M A B C gives a quicker descent than the tangent F G, or H I, or K L, laying between the same parallels, M K and C D.

With regard to the motions of projectiles, we refer the reader to that article.

Of central forces we have already given an article, but shall observe here, in addition, that all bodies, when put in motion, would preserve their respective velocities, and their original directions, were they not acted upon by other forces. When a force acts equally for a limited distance, and then is superseded by the actions of another force, the body will describe a polygon in its track: but if the original force be gradually weakened, the body will then describe a curve, bending towards the centre of attraction, resulting from the operation of a deflecting force, which, by its pressure, causes the body to bend from its original direction. When a body is constantly attracted towards a centre, it is under the influence of a centripetal force; and when it is disposed to fly from that centre, it is under the bias of a centrifugal force. These two latter constitute what are termed central forces. The projectile force is the original direction of an impelled body, forming a tangent with the curve occasioned by the deflecting force. The track of a body under the influence of a centripetal force, is called its trajectory, or orbit. The radius vector is a line drawn from the centre to which the force is referred, or wherein it is supposed to act, to any point in the trajectory where the body is found. A body moving regularly on a trajectory, or orbit, which returns into itself, is, on its return to the incipient point whence the motion began, said to have made a period; and the time occupied is called its periodical time. It must be understood, that a body can neither set itself in motion, nor avert its own course; such effects must be the result of forces exteriorly applied; also we must state, that the motion of each body is naturally in a right line, but by the impulse of some one or more powers its course will deviate into a curve. Thus, a pebble in a sling, or a glass full of water placed within a hoop that is turned swiftly round, will follow the course of the sling or hoop, respectively; but when liberated, or improperly checked, they will fly off in a right line, which they must preserve if not opposed by the air, &c.

We invariably find, that, when a boat is pushed off from the shore, a certain bias towards the place quitted is felt by every person on board. If any thing should be overset at that instant, unless pressed towards any other point, it will fall towards that shore. On arriving at the opposite bank, if the boat is allowed to run against it, a disposition to fall towards that bank will be manifested by every person, and by every matter at liberty, within the boat. Hence we find, that all bodies at rest are disposed to remain so; and that, when bodies are set in motion, they would continue to move, were they not obstructed by either a mechanical, or an invisible, agent. All bodies moving in orbits have a disposition to fly out of them; and those which describe orbits of the smallest diameter have rotatory motions quicker than those which take a greater range. If one body moves round another, both will describe curves round their common centre of gravity. The centrifugal force of a revolving body is in direct proportion to the quantity of matter multiplied into the velocity. The centripetal forces in circles are as the squares of the velocities directly, and of the radii inversely: therefore, when the centripetal force, and the distance from the centre, are given, the velocity is given. The mutual attraction of bodies does not affect their centre of gravity; and if, while two bodies act on each other, they be projected in opposite and parallel directions, with velocities in proportion to their respective distances from the centre of gravity, they will describe similar figures around that centre. It is on these principles (which involve an immense collection of cases and circumstances), that the science of astronomy, and whatever relates to the wonderful correspondence we observe in all the operations of the grand universal system, is founded.

In rotatory motions we are always to consider, that every atom which is at rest requires a certain power to cause its removal: and that, when one part of a wheel moves, the whole must move; therefore the power must be such as is equal to move the whole. Hence we find, that, in a well balanced wheel, the motion is easy, because there are as many atoms disposed to descend as there are to be raised; consequently, the opposing atoms are held in equilibrio. We must observe, however, that the resistance to motion is greater as we approach the centre; for a power which would give a wheel motion when applied at its perimeter, or exterior, would be inadequate to set it in action if applied near to the axis. Therefore, powers applied at the greatest distance from the centre have more force than such as are applied nearer to the centre: their effects will be in exact ratio with the squares of their distances from the centre, while the imparted velocity will diminish in exact proportion with the accession of force. Of this we see innumerable instances in clocks, cranes, and other machines, in which one wheel is made to move another, or in any system of wheels. We cannot, indeed, have a more familiar demonstration than is afforded by the greater facility with which the hind wheel of a coach revolves, compared with the fore wheel, which, being so much smaller, has the power (*i. e.* the earth) so much nearer its axis, and consequently revolves with an increase of velocity proportioned to its difference of diameter.

Before we quit this article it may be proper to observe, that the principles of gyration and of oscillation have a close connection with the foregoing points. The powers of windlasses, winches, or cranes, jacks, &c. all depending upon the application of a power at more or less distance from the centre. Thus we find the common steelyard is affected by the removal of the pea, or shifting resistance, along a scale, whereon the power is indicated to augment, according as it recedes from the point of oscillation. But we see, that, in scales equally removed from that centre, the perpendicular distances of the weight, or of the goods to be weighed, do not in any degree change the power, when the two points of suspension are equidistant from the centre of oscillation; and that the two scales, together with their suspending chords, &c. are perfectly counterbalanced. A reference to fig. 10 will exhibit, that, provided the two arms, or suspending points, A A, be equally removed from the point of oscillation, C, it matters not whether the scales be at equal distances below A A respectively, or whether one scale be at D and the other at E, provided all their respective parts be perfectly equipoised; but if one arm should be longer, so as to remove one scale further from the centre of oscillation, by giving unequal distances, C A and C F, between the two parts of suspension, their state of equilibrium would be thereby totally destroyed.

We shall now finally observe, that in every branch of mechanics it will be found that equable motion is the surest, the safest, and the most durable; and that, in proportion as the forces, and the resistances thereto, are broken or fluctuating, so will the former be diminished and the latter be increased. Hence experience shews us, that windmills wear more than water-mills, and that animal powers are apt to tear machinery to pieces. We can command an uniform supply of force where water is the power; but hitherto no means have been found so completely to regulate either the quantity of wind, or the paces of cattle.

DYNASTY, among ancient historians, signifies a race or succession of kings of the same line or family: such were the dynasties of Egypt. The Egyptians reckon thirty dynasties within the space of 36525 years; but the generality of chronologers look upon them as fabulous. And it is very certain that these dynasties are not continually successive but collateral.

DYSENTERY. See MEDICINE.

DYSOREXY, among physicians, denotes a want of appetite proceeding from a weakly stomach.

DYSPEPSY, a difficulty of digestion, for which physicians prescribe bitters.

DYSPNOEA, a difficulty of breathing, usually called asthma.

DYSURY, in medicine, a difficulty of making urine, attended with a sensation of heat and pain. It is distinguished from a strangury, as in the last the urine is voided by only a drop, as it were, at a time, but, however, with pain; and from an ischury, as in this disorder there is an almost total suppression of urine.

DYTISCUS, in natural history, a genus of insects of the order Coleoptera. Antennæ setaceous; feelers six, filiform; hind-legs formed for swimming, fringed on the inner side, and nearly unarmed with claws. Nearly two hundred species of this genus have been enumerated. This has sometimes obtained the name of water-beetle, it being an aquatic genus, and rarely seen in flight except during the evening. One of the largest European species is the D. marginalis, about an inch long, of an ochre colour: the whole insect is of a polished surface on the upper part, and the wing-shells are each marked by two rows of scarcely perceptible impressed points. This insect is not uncommon is stagnant waters, where its larva also resides, which is of a very extraordinary shape, and so unlike the animal into which it is at length transformed, that no one, not conversant in entomology, would suppose it to have the most distant relationship to it. It is of a bold and ferocious disposition, committing great ravages, not only among the weaker kind of water-insects, as well as water-newts, tadpoles, &c.; but even among fishes, of which it frequently destroys great numbers in a season, and is therefore justly considered as one of the most mischievous animals that can infest a fish-pond. A larva of this kind has been known to seize on a young tench of three inches in length, and to kill it in a minute. When arrived at its full growth, the larva betakes itself to the banks of the water it inhabits, and, forming an oval hollow in the soft earth or clay, in a few days changes into a chrysalis much resembling that of the genus scarabæus, and of a whitish colour. From this, in the space of about three weeks, proceeds the complete insect. Many other much smaller species of this genus may be found in ponds. There have been enumerated forty-nine species of British dystici.

E.

E, The fifth letter of the alphabet, and second vowel, has different pronunciations in most languages. The Greeks have their eta, η, and epsilon ε, or long and short *e*. The French have their *e* open, pronounced much like our *a* in the words *face* and *make;* their *e* masculine, pronounced not unlike our *y* at the end of words, as *liberté, liberty;* their *e* feminine, or mute, very weakly if at all pronounced, added generally at the end of words, either to distinguish the feminine gender, or lengthen the syllable; and their *e* before an *m* or *n*, which sounds like our *a* in the word *war:* these are all exemplified in the words *empechée* or *enfermée*. In English there are three kinds of *e, viz.* the open or long *e*, as in the words *bear, wear;* the close or short *e*, as in *wet, kept;* and mute *e*, which serves to lengthen the syllable, as in *love, came,* &c.

As a numeral, E stands for 250. In music it denotes the tone *e-la-mi*. In the calendar it is the fifth of the dominical letters. And in sea-charts it distinguishes all the easterly points; thus, E. alone, denotes east, E. by S. and E. by N. east by south, and east by north.

EAGLE. See Falco,

Eagle, in astronomy. See Aquila.

Eagle, in heraldry, is accounted one of the most noble bearings. They are generally borne with their wings and tails expanded. This posture is best fitted to fill up the escutcheon.

EALDERMAN. See Earl.

EAR. See Anatomy and Comparative *anatomy*.

Ear, in music, implies that sensible, clear, and true perception of musical sounds, by which we are offended at dissonance, and pleased with harmony. To have an ear, which is a common phrase, is to be capable of distinguishing the true intonation from the false, to be sensible of metrical precision, and to feel all the nicer changes of artificial combination.

Ear *pick*, an instrument of ivory, silver, or other metal, somewhat in form of a probe, for cleaning the ear.

Ear *wax*. See Cerumen.

Ear *wig*. See Forficula.

EARING, in the sea language, is that part of the bolt-rope, which, at the four corners of the sail, is left open, in the shape of a ring. The two uppermost parts are put over the ends of the yard arms, and so the sail is made fast to the yard; and into the lowermost earings, the sheets and tacks are seized or bent at the clew.

EARL, a British title of nobility, next below a marquis, and above a viscount. Earls were anciently called *comites*, because they were wont *comitari regem*, to wait upon the King for council and advice. The Germans call them *graves*, as landgrave, margrave, palsgrave, rheingrave; the Saxons ealdermen, unless that title might be more properly applied to our dukes; the Danes, eorlas; and the English, earls. The title, originally, died with the man. William the Conqueror first made it hereditary, giving it in fee to his nobles, and allotting them for the support of their state the third penny out of the sheriff's court, issuing out of all pleas of the shire whence they had their title. But now the matter is quite otherwise; for whereas heretofore *comes* and *comitatus* were correlatives, and there was no comes or earl but had a county or shire for his earldom, of latter years the number of earls increasing, and no more counties being left, divers have made choice of some eminent part of a county, as Lindsey, Holland, Cleveland, &c; some of a lesser part, as Strafford, &c.; others have chosen for their title some eminent town, as Marlborough, Exeter, Bristol, &c.; and some have taken for their title the name of a small village; their own seat or park, as Godolphin, Clarendon, &c. An earl is created by cincture of sword, mantle of state put upon him by the King himself, a cap and a coronet put upon his head, and a charter in his hand. All the earls of England were formerly denominated from some shire, town, or place, except three; two of whom, *viz.* Earl Rivers and Earl Paulet, take their denomination from illustrious families; the third is not only honorary, as all the rest, but also officiary, as the Earl Marshal of England.

Earl *Marshal of England*, is a great officer, who had anciently several courts under his jurisdiction, as the court of chivalry, and the court of honour. Under him is also the herald's office, or college of arms. He hath some pre-eminence in the court of Marshalsea, where he may sit in judgment against those who offend within the verge of the King's court. This office is of great antiquity in England, and anciently of greater power than now; and has been for several ages hereditary in the most noble family of Howard.

EARNEST, a part of the price paid in advance to bind parties to the performance of a verbal agreement. The party is then obliged to abide by his bargain, and is not discharged upon forfeiting his earnest, but may be sued for the whole money stipulated, and damages; and by the statute of frauds 29, c. 2. c. 3, no contract for sale of goods not to be delivered immediately to the value of 10*l.* or more, is valid, unless contract is made by the parties, or those lawfully authorised by them, or earnest is given.

EARTH, the vast mass or planet we inhabit. The scientific and theoretical attempts which have been made to ascertain the form and internal composition of the earth, have produced less certain results than could be wished. With respect to the grand outline we may conclude, without much danger of error, that it is spherical; which observation is supported by the appearance of the moon, the nearest body to the earth. We may illustrate this supposition by drawing a true circle, and filling its circumference with a capricious outline, sometimes touching and at others receding from it. The cause of the inequalities, which we denominate mountains and vallies, seems to be the natural consequences of the composition of the earth, the action of the air and water ever changing the position of the softer materials, and having but little effect on the hardest. Thus, on the borders of the sea, large tracts of land are known to crumble into it, and that even mountains are undermined: Mont Blanc has recently afforded a most melancholy proof. Besides the above causes, there are others volcanic, and arising from the earthquakes produced by them. Still greater changes in the surface of the earth have taken place at periods beyond the records of history, except in the single instance of the scriptures and the deluge, which is demonstrated by the discovery of substances, evidently peculiar to the sea only, in the highest mountains, where it is impossible to account for their arrival, but by supposing that the spots where they are found were raised by strong internal pressure from the centre, under the bottom of the sea, which doubtlessly presents a surface very similar to the parts we inhabit.

Before the invention of instruments calculated to ascertain geographical doubts with precision, and the circumnavigation of the globe, the ancients imagined the earth flat or cylindrical; but the moderns with greater truth, derived from superior means, pronounce it almost spherical, founding their opinion upon the following just grounds; the circular shadow of the earth in eclipses of the moon, the general appearance of the planetary system in all parts of the earth being the same, and the observations made in circumnavigating it concurring with those which must result from a globular form. That great philosopher, Sir Isaac Newton, was led by accident to suppose from the revolving of the earth round its axis, and the laws of hydrostatics, that it is an oblate spheroid, flattened at the poles. Professor Jameson admits the truth of this supposition, and says, "The spheroidal figure of the earth is a proof of its original fluidity. This important conclusion was never disputed; the only question has been, whether this fluidity was the effect of fire or water. Rocks, which have been formed or altered by the action of heat, are most distinctly different from those that constitute the great mass of the crust of the globe; consequently, this fluidity cannot be attributed to the agency of heat." Whether the conjectures on the opposite hypothesis are founded on a tenable basis, cannot be ascertained to demonstration; but it may not be amiss to let the Professor speak further on the subject. "The only other agent we are acquainted with, that is capable of producing this fluidity, is water; and we have the strongest evidence that it has been the active agent. In chap. 2, when mentioning the effects of water on the surface of the globe, we described several mechanical and chemical depositions which are daily taking place, as it were, under the eye; and we may now add, that a comparison of their structure, with that of the great fossil masses of which the crust of the earth is composed, evinces so complete an agreement, as entitles us to infer, with great certainty, that these also have been formed by the same agent. As the highest mountains are composed of rocks, possessing a structure resembling those fossils which have been formed by water, we naturally conclude, that the ocean must have formerly stood very high over these mountains. Further, as the most elevated mountains are composed of rocks, such as granite, gneiss, mica-slate, clay-slate, and others, which extend around the whole globe, and have been formed during the same period of time; it follows irresistibly, that the ocean must have formerly covered the whole earth at the same time."

In order to clear the surface of the earth of this superabundance of water, which militates against the existence of life but in one species of the animated system, and equally against every species of vegetation, our theorist observes, "It was reserved for Werner to give this theory stability. With his usual acuteness, he soon discovered that the important documents for the illustration of this great phenomenon were not to be sought for in the formations that have taken place within the limits of human history, but in the mountains themselves, those mighty aquatic formations. His investigations were attended with complete success; for he discovered, 1st, That the outgoings of the newer strata are generally lower than the outgoings of the older, from granite downwards to the alluvial depositions, and this not in particular spots, but around the whole globe. 2nd, That the primitive part of the earth is entirely composed of chemical precipitations, and that mechanical depositions do not appear until a later period, that is, in the transition class; and that from this point they continue increasing, through all the succeeding classes of rocks, to the newest, or the alluvial, which are almost entirely mechanical deposits. These most important observations ascertain, in a satisfactory manner, the universal diminution of the water from the surface of the earth."

To obviate the difficulty above noticed, the Professor supposes animals to have been created as the earth was cleared to receive them; but the superfluous water is still in want of a receptacle capacious enough to contain it: such are the unfortunate consequences of theory. Newton has certainly proceeded upon the best data, and his calculations are almost universally correct and convincing.

When M. Richer visited Cayenne, he found a clock he then possessed, of particular excellence, which had gone perfectly true at Paris, lost daily two minutes and twenty-eight seconds; the situation of the island is about five degrees from the equator, and although the heat of a climate lengthens pendulums, and impedes their motion, yet that of Cayenne was by no means sufficient to produce so considerable a difference, which cannot otherwise be accounted for than by admitting less pressure of gravity to have caused it. In the revolution of the earth, its parts recede from the axis, and the equatorial particularly, consequently the polar press internally, and raise the former, till an equilibrium occurs; hence the form of an oblate spheroid, the shorter axis of which passes through the poles. Pursuing the lights afforded him by nature in a superior degree, Newton calculated the different diameters, and found that the equatorial exceeds the polar 34 miles and one-fifth. This assertion was combated by several philosophers on the continent, but it was fully confirmed subsequently, by the admeasurements and observations of two deputations of mathematicians, who visited the vicinity of the northern and southern poles in 1735, and agreed in pronouncing them flattened, making the difference between the diameters as 266 to 265, or as 179 to 178. Many calculations of profound subtlety have since been made, but as most of the calculators contradict each other, too much reliance ought not to be placed on either; those may be found in various publications, and particularly in the Philosophical Transactions, to which brevity compels us to refer the very curious reader.

The magnitude of the earth is subject to the same uncertainty as the exact figure of it; but repeated endeavours have been made to ascertain it with some degree of precision. According to Diogenes Laertius, Anaximander was the first who attempted this difficult task; it may be supposed with no great success, as he lived 550 years before the Christian æra, though his result was adopted till the period when Erastosthenes flourished. Aristotle, in speaking of this subject, says, mathematicians make the circuit of the earth 40,000 stadia, probably including the measurement of Anaximander. Certain Arabian philosophers, by the command of their monarch Almaimon, afterwards proceeded to the plains of Mesopotamia, where they went through the process then best known, and found that the circumference of the globe was from 20,160 to 20,340 miles.

Professor Snell, of Leyden, measured considerable distances between the parallels about 1620, and thus found one degree amounted to 19 Dutch miles, and the whole circumference to 6,840 miles.

Richard Norwood measured the space between London and York with a chain, fifteen years afterwards, and on the 11th of June, 1635, old style, he took the sun's altitude at the meridian, with a sextant of five feet radius, and found a degree of 69 miles, one half, and 14 poles, whence he inferred that the diameter of the earth is about 7,966 miles, and the circuit 25,036 miles. This measurement, though far superior to those of the ancients, was tried by several French mathematicians, who suspected some slight errors, by the King's command, with a quadrant of $3\frac{1}{6}$ feet radius, French measure, when they ascertained a degree consisted of 542,360 feet. M. Cassini, jun. acting under the same authority, used a quadrant of 10 feet radius, in 1700, with which he obtained the latitude, and one of $3\frac{1}{8}$ feet for taking the angles of the triangles, by which experiment he found the degree to be nearly $69\frac{1}{2}$ English miles.

From these and other attempts of a similar nature, to obtain the length of one degree of the meridian which is to be multiplied by 360, the following mean is generally adopted.

The earth's circumference, 25,000 miles.

The diameter, $7,957\frac{3}{4}$.

The superficies, 198,944,206 square miles.

The solidity, 26,393,000,000 cubic miles.

It is conjectured, besides, from the measurement of the most approved maps, that the unexplored portions of the earth and seas contain 160,522,026 square miles, the inhabited part of the former 38,922,180, thus divided, Europe 4,456,065, Asia 10,768,823, Africa 9,654,807, and America 14,110,874.

The attentive and skilful observer of the works of nature, whether when employed in examining the most wretched or the most sublime, will find that judgment, and infinite wisdom and ingenuity, has equally prevailed throughout. Can it then be supposed for a moment, that the internal parts of the earth we inhabit has received less attention from the Creator, than those objects which are under our immediate and unimpeded inspection? Were it possible to entertain a thought so erroneous, we possess strong proofs to the contrary, which convince us that order and regularity reign beneath us in the same degree as around us. Before the industry, or, more properly speaking, the avarice of man, had led him to penetrate as far as his limited powers will permit towards the centre, he had but few opportunities of ascertaining, and that only from analogy, how the different strata of the earth was disposed, and connected or held together by the vast masses of stone, which may be called the bones of this vast body. As scientific men were gradually admitted to the knowledge of the secrets of the earth by the exertions of the miner, in the same proportion did all ideas of a chaos vanish, and we are now convinced, though their excavations are mere punctures in the globe, that, were it possible to penetrate through, it would tend to prove that self-existing causes, originating immediately from the Creator, are constantly employed in preserving the whole from derangement, and what we term decay, which, in truth, is simply a change of form, and not annihilation. The celebrated miner, Agricola, was the first who recorded the internal properties of the earth, between whose time and that of Werner some discoveries were made as to its structure; Lehman formed the idea of primitive and secondary classes of mountains. Cronstad conjectured the age of several mineral repositories. Hamilton, Dolomieu, and Spallanzani, have gone to very successful and satisfactory lengths in ascertaining the operations of volcanos, the nature of the materials which support them, and the substances they eject. Saussure has increased our knowledge of rocks, Williams of the independent formation of coal, and Werner has profited by every preceding observation, and, possessing a cultivated genius of his own, united them into a system, which approaches nearer to the truth than the nature of the subject would lead us to expect. Unfortunately, the labour and expense of penetrating to any great depth into the earth ever has, and ever must, limit our knowledge of the extent of strata, and its similarity in different latitudes; but from the opportunities already afforded by mines, we are led to conclude that those lines of matter spread through vast spaces, if not throughout the globe; many theories have been attempted, to account for their varieties and capricious elevations and depressions from a horizontal direction. Dr. Woodward, who deeply considered the subject, supposes all the terrestrial masses disposed in strata to have been dissolved by the waters of the deluge, which subsiding, the most ponderous fell to the bottom, and the rest settled in gradations suited to their specific weights. This solution naturally disposes the strata uniformly horizontal, and he accounts for the breaks in the lines and fissures every where observable, by the action of volcanos, earthquakes, &c. &c. Buffon's fancies of corners torn from the sun by comets, and the earth lignified by fire, barely deserve notice, and make a disgraceful contrast with Woodward's ingenious conjectures. The surface of the earth is known by every enlightened person to be composed of a confused mass of vegetable, and, in some slight degree, of animal substances, below which, Jameson says, there are four different kinds of structure: "The first is that which is to be observed in hand specimens; it is the smallest kind of structure, and occurs in what are termed mountain-rocks or stones. The second kind of structure, or that of mountain-masses, is more on the great scale, and is not to be observed in hand specimens, but only in single masses of rock. To this structure belongs stratification, and the seams of distinct concretions. The third kind of structure is that of rock formations, or those great masses of which the crust of the earth is composed. To examine this kind of structure, we must traverse considerable tracts of country. The fourth kind of structure is that of the earth itself, which is formed by the junction of various formations. To examine this structure, we must travel through many countries."

When, in passing through long tracts of land, we observe loose rocks, firm rocks, clay, sand, &c. &c. in succession, in those instances the strata of the earth lay almost perpendicular, in large masses of rocks, which present nearly a plain front, the inclination of the strata is distinctly visible, and in some cases their agreement with others opposed to them demonstrate, that they have been separated by some convulsion of the earth.

The gravity of a portion of the earth was calculated by Dr. Maskelyne in the years 1774 and 1775, at the mountain Schehallien, and its attraction on a plummet ascertained on each side; besides which, he computed the quantity of matter contained in it by a considerable number of sections in various directions; and the result being afterwards compared with the acknowledged magnitude and attraction of the earth, he found that the density was as 9 to 5 of common stone, and as 9 to 2 water; whence it was inferred that large quantities of metal lay concealed within it. Before this period little was known of the gravity or density of the earth, though the relative densities of that and others of the planets had been ascertained with tolerable precision. From the data thus acquired, the quantity of matter in the earth is known to be equal to the product of its density by its magnitude; the force of attraction on the surface has been proved by experiments, that substances fall $16\frac{1}{12}$ feet in one second of time; and hence, that if any place within or beyond it may be known, as in the former case the force is at its distance from the centre, and in the latter as the square of its distance from the same point.

The earth has three motions: that which gradually occasions the precession of the equinoxes; that round its axis, which causes the succession of day and night, accomplished in 24 hours; and that of the whole mass round the sun in a wide orbit, of which the luminary of day is the centre: in the latter its axis is constantly parallel to itself, and inclined in the same angle to its path; thus producing the visible and perceptible alteration from spring to summer, and from that period to winter. This annual motion of the earth round the sun is performed between the orbits of Venus and Mars with the former, and that of Mercury within its own, or between it and the sun in the centre, and those of Mars, Jupiter, Saturn, &c. above it or without, which are called from this circumstance superior planets, and the rest inferior. The time occupied in performing this revolution is 365 days, 6 hours, and 49 minutes, or a tropical year, calculated from an equinox or solstice to the same again; the sideral year, as computed from any fixed star to the same point, and seen from the sun, makes the revolving of the earth to occupy 365 days, 6 hours, and 9 minutes: the figure of the orbit is elliptical, with the sun in one focus: the supposed distance is 95 millions of miles, admitting the sun's parallax to be $8\frac{2}{3}''$, or the angle beneath which the semidiameter of the earth would appear from the sun; "and the eccentricity of the orbit, or distance of the sun in the focus from the centre of this elliptic orbit, is about $\frac{1}{60}$ of the mean distance."

There are nine descriptions of earth, which are, barytes, strontian, lime, magnesia, alumina, yttria, glucina, zirconia, and silica. Every substance is an earth which is insoluble in water, or becomes so when combined with carbonic acid, with little taste or scent under the above circumstances, and incapable of alteration by fire when in a pure state, then capable of being turned to white powder, and not exceeding 4.9 in specific gravity.

The word earth is generally applied to the whole mass of the globe, and always to the mould which supports the growth of vegetables; the latter has been attentively examined by various chemists, and found to consist of several substances, without any regularity in their arrangement.

EARTHQUAKE. The dreadful consequences attending sudden and violent tremblings of the earth, are sufficient reasons for attempting to account for their causes, but, as from the nature of those it is utterly impossible to ascertain them accurately, rational conjecture must be accepted in place of actual observation. Every writer on the effects of volcanic eruptions concurs in attributing earthquakes to their internal operations, which become less frequent in their neighbourhood after violent explosions through the craters; indeed, it must be obvious on the first thought, that the furious efforts of fire, hot air, and steam, exclusive of electric matter, cannot but produce convulsive motion in the substances which confine them, and of more or less extent and violence, in proportion to the cause. When a free passage is obtained, the agitation gradually subsides, and is only increased at intervals by the escape of accumulated matter. Sir William Hamilton, who carefully examined all the visible phenomena produced by the earthquakes of 1783, in Calabria, is decidedly of opinion that they originated from under the sea, situated between the coast of Calabria and the island of Stromboli, or near the city of Oppida, which he illustrates, by forming a circle round those points, and remarking that the most destructive effects were there, whence they became gradually less ruinous. Mount Stromboli had been unusually quiet for some time previous to this calamitous period, a circumstance highly favourable to his conjecture, founded besides on the experience of remote ages, when, according to Strabo, Campania was subject to frequent and dreadful earthquakes, which were less common and ruinous after Vesuvius had become the means of dispersing the confined matter. Since that fortunate æra, the vicinity of the above mountain has suffered more from the lava and ashes than earthquakes.

If stronger proofs were necessary, that volcanic eruptions cause this phenomenon, the rising of hills near Ætna, or any other volcano, and the Lipari Islands, are sufficient demonstrations how severely the earth must be convulsed by subterraneous fires; those consequences are not, however, always visible, earthquakes often occurring without any other effect than the overturning of slightly built edifices, an undulating or shaking motion, and a deadened sound; but it by no means follows, that the origin of such were not to be attributed to fire, the vapours caused by which may roll through cavities, actually pass from a very great distance to a volcanic mountain, or escape unperceived through the sea or obscure vents.

The electric fluid being known to reside in the earth in very considerable quantities, and always seeking an equilibrium, great abundance may sometimes collect through various causes in a particular spot, whence it will be attracted to another less charged with this astonishing fluid; when the tremendous conflict between it and the air is remembered during a storm in our atmosphere, we must readily admit that it may produce a strong concussion in the earth, and probably be the origin of the slight earthquakes peculiar to some countries.

Another cause of inconsiderable tremblings may, perhaps, proceed from the operations of subterraneous streams, which, rushing through caverns, and undermining vast bodies of earth and stone, those fall and shake the neighbouring parts in proportion to their bulk and weight. When the motion of the sea, during an earthquake, had destroyed the support of Port Royal, in Jamaica, the town sunk into it; in the same manner new cavities occurring through the fall of earth, the surface must necessarily sink in the same degree, if it is within the influence of the cause.

Frezier is of opinion that earthquakes should be ascribed to an effect of the waters, which appear to moisten the earth, in passages similar to the veins of living bodies. "Now the waters may occasion earthquakes after several manners, either by dissolving the salt scattered through the earth, or by penetrating through porous lands, mixed with stones which they insensibly loosen; and the fall or removal thereof must cause a stroke or shock, such as is felt in earthquakes. Lastly, the water penetrating some sulphurous bodies must there cause a fermentation, and then the heat produces foul exhalations, which infect the air when they open the earth."

This extract from a narrative of the dreadful earthquakes at Lima in 1746, is illustrated by the experiment of M. Lemery, related in the Memoirs of the French Academy of Sciences for 1700; that gentleman having mixed equal quantities of filings of iron and sulphur, and tempered them with water into the consistence of paste, buried them; they some time afterwards agitated the earth, and finally burst into a flame. To confirm this effect of fire, however generated in the bowels of the earth, we shall quote the following paragraph from that accurate modern observer Spallanzani, who was indebted to Professor Bottis for the facts contained in it, which relate to the production of seven small mountains by the eruption of Vesuvius in 1760. After repeated concussions of the earth, which were felt fifteen miles round Vesuvius, the sides of the fiery mountain opened in the territory of the Torre del Greco, and fifteen volcanos appeared, eight of which were soon after covered by a torrent of lava, which rushed from one of them; the other seven remaining entire, and incessantly ejecting from their mouths vast quantities of ignited substances, which, falling almost perpendicularly around the volcanos, produced, in the short space of ten days, seven small mountains, of various heights, disposed in a right line. During these ejections, the noise which accompanied them sometimes resembled that of violent thunder, and at others the discharge of a number of cannons. Several of the burning stones, even the largest, were thrown to the height of 960 feet, and some fell at a considerable distance from the mouths whence they were thrown. These eructations shook all the neighbouring country, and the roarings of the mountain were dreadful to the inhabitants.

That there are many substances existing within the depth of the earth, which, coalesced, produce fire, cannot be disputed, but that they exist in such amazing quantities as to afford fire for centuries, seems at least problematical; there are therefore but two ways of accounting for their continuance, either that the volatile effluvia of the ignited matter, collected on the sides of volcanic caverns, becomes new fuel; or that heat being necessary for the various properties of the globe, a self-existent fire, coeval with the creation, has been placed within it by the wisdom of the Creator, an idea not of more doubtful evidence than the existence of the electric fluid in visible, or any other of the phenomena of nature by which we are surrounded. (See VOLCANO.) Admitting these premises, another cause of earthquakes occurs; it is well known, that volcanos communicate with the sea, by the frequent discharge of saline water and tufa, or the slime and mud of its bottom, through their craters; this interfering with the operations of the fire, vast bodies of steam must ensue, than which nothing can be more powerful and insinuating; this rushing by the force of violent explosions through every aperture of the various stratas of the surrounding earth, must occasion those horizontal and perpendicular movements and tremblings, so terrific to the inhabitants above; besides, hot steams impregnated with sulphurous vapours often attend earthquakes.

Homer, whose knowledge was extensive, seems to have been aware that the sea caused earthquakes, several instances of which might be quoted from the Iliad:

> "But Neptune rising from the seas profound,
> The God whose earthquakes rock the solid ground." Book xiii. 1. 67.

And in the xxth book, line 77.

> "Beneath stern Neptune shakes the solid ground;
> The forests wave, the mountains nod around;
> Through all their summits tremble Ida's woods,
> And from their sources boil her hundred floods."

Indeed, the sudden eruption of stones and calcined matter seem unquestionably the effect of water flying off in steam, and carrying every loose object with it. The sea, or water of any great extent, always indicates the commencement of an earthquake, before it is otherwise perceived; this circumstance doth not proceed from any cause peculiar to the component parts of the water, but merely from the motion of the earth under the bottom, which is not felt by a person on the adjacent shore, probably from its gliding steadily in one direction, and returning in the same manner; but water, ever seeking a level, will rise at the remotest influence from the land, as that inclines towards it, and then rush precipitately back to its previous level, as far as it can be attained, before another inclination of the earth prevents it. The sea is observed to retire before the eruptions of Vesuvius, which is evidently caused by the rising of the earth during the first efforts of the matter endeavouring to escape out of the mountain; when that is discharged, the water flows back again impetuously, plainly indicating that the earth has again sunk to its original place; the same effect was noticed at Lisbon, as far as related to the dreadful agitation of the sea, from which vessels received violent shocks at fifty leagues distance; indeed, the effects of that earthquake, so fatal to the city above named in 1755, were felt throughout Europe and America.

Having detailed some of the probable causes of earthquakes, it will be proper to mention the indications of their approach in those countries where they are most prevalent, which is in Mexico, Peru, Jamaica, and the neighbouring islands; Italy, particularly in Sicily; Asia Minor, and Portugal; they are felt in almost every other country, but so slightly as seldom to occasion serious injury. Beginning near their visible causes, where they are necessarily most frequent, it may be observed, that when a long interval has occurred from the last eruption of a volcano, there is just reason for alarm that the succeeding will be introduced by violent concussions of the earth. There are some phenomena which attend earthquakes of decided certainty, others may happen accidentally near the time of their approach, and be attributed erroneously to them; such as very dry and hot seasons, which undoubtedly take place frequently where shocks are but little known, and dark atmospheres caused by unusual vapours; of the latter, many instances are recorded without the least calamity following; indeed, the case of Lisbon is directly in point against this being universally an indication of earthquake, for the morning of that dreadful day was particularly fine, and the sun shone with the utmost brilliancy. Neither is the sudden ebbing and flowing of the sea, or rivers, always to be depended upon as the forerunner of convulsions of the earth, though it is uniformly the consequence of them, as such effects have been observed without any assignable cause. Electrical phenomena sometimes attend them, in violent streams of lightning, the aurora borealis, meteors, &c. but as these are common appearances, they afford no just cause of alarm, if a trembling of the earth doth not very soon succeed.

If the clear water of deep wells suddenly becomes heated and impregnated with soil, and an unusual stillness of the air prevails, and cattle evince great restlessness and terror, well founded apprehensions may be entertained of an approaching earthquake, which will commence with slight trembling motion, perceivable in the most fleshy parts of the body, accompanied by a deep hollow sound, indescribable, yet resembling distant thunder, combined with the roar of numerous cannons. The most violent and dangerous shocks are undulatory, horizontal, and perpendicular, the two latter are most dreadful in their consequences, by throwing down the strongest edifices, and making those horrible chasms which engulph every object within their boundaries, emit pestilential vapour, heated water, sand, smoke, and flames: each particular shock seldom exceeds a minute in duration, but they often follow one another with great rapidity.

Such are the indications and peculiarities attending earthquakes; the following short narratives of their consequences, in different places, will enable the reader, who has happily escaped feeling, to justly understand them.

"There is no part of the world perhaps so subject to earthquakes as Peru; nor any part of Peru more liable to them than Lima and its neighbourhood. On Monday, October 20, 1687, N. S. at 4 o'clock in the morning, there occurred a most horrible earthquake, which threw down some houses, and buried several persons under their ruins. An hour after there was another shake, accompanied with the same noise; and at six o'clock, when they thought they had been all in safety, came a third shock, with great fury and a rushing noise; the sea, with hideous roaring, swelled beyond its bounds; the bells rang of themselves; and the destruction was so great, that no building was left standing. The noise was so dreadful, says P. Alvarez de Toledo, (who sent the account from thence,) that those in the fields assure us the cattle were in great astonishment: he adds, Callao, Canete, Pisco, Chaucay, and Los Chorillos, are all ruined: above 5000 dead bodies are already found, and they find more daily."

Lima was destroyed in the night of October 28, 1746, the anniversary of St. Simon and St. Jude. "According to the best regulated clocks and watches, this fatal catastrophe befel the place thirty minutes after ten at night; on this occasion the destruction did not so much as give time for fright, for at one and the same instant almost, the noise, the shock, and the ruin, were perceived together; so that in the space only of four minutes, during which the greatest force of the earthquake lasted, some persons were buried under the ruins of the falling houses, and others crushed to death in the streets by the tumbling of the walls, which, as they ran here and there, fell upon them. The earth struck against the edifices with such violent percussions, that every shock beat down the greater part of them; and these tearing along with them vast weights in their fall (especially the churches and high houses,) completed the destruction of every thing they encountered with, even of what the earthquake had spared. The shocks, although instantaneous, were yet successive; and at intervals men were transported from one place to another, which was the means of safety to some, whilst the utter impossibility of moving preserved others."

The second edition of Mr. Swinburne's Travels in the Two Sicilies contains the ensuing most affecting letter, written by a person who witnessed the scenes he described.

"On the 5th of February, at 19 hours and 3 quarters, we felt a shock that began by an upward heaving motion, which gave the alarm, and time to most persons to run out of their houses: some fled to the windows and balconies; others took refuge under the arches of the doors. This upright motion of the earth was soon succeeded by shaking and rocking, during which we beheld our houses tumbling on all sides. The walls and towers of the castle were split asunder, and overturned upon the town; the buildings below were crushed to atoms, and 150 persons perished in this fall. At night a considerable part of the inhabitants, chiefly of the class of sailors, followed the example of the prince, and repaired to the beach; they there pitched tents, or lay down in their barks, hoping to pass the night in perfect security at a distance from all buildings. The sky was bright and serene, the sea lulled in a profound calm, and all these poor people were indulging in sweet sleep a short respite from their woes. In this treacherous state of things, a little after midnight the whole promontory of Campala fell at once into the sea, without any previous earthquake. The sea fled back before this mass towards the Golilla del Faro, where it carried off 28 persons with their boats and houses; then returning with redoubled fury across its natural channel, flowed on the shore of Sylla 30 palms above its usual level, and three miles along the coast. As it fell back again, it swept away into the abyss 2,475 persons, who were lying on the sands or in boats. Horrible were the shrieks of the survivors, who happened to be above the reach of the surge, and tremendous was the alarm given over all the surrounding hills, where the remainder of the inhabitants were dispersed for safety. No cries, no lamentations, were heard from those that were thus hurried off; they had no power or time to utter any."—"The same instant (says Mr. S.) was fatal to the whole province, and the devastation caused by the repeated shocks was much more terrible in many places than at Scylla; they raged with fury from Cape Spartivento to Amantea, above the gulph of St. Eufemia, and also affected that part of Sicily which lies opposite to the southern extremity of Italy. Those of the 5th and 7th of February, and of the 28th of March, 1783, were the most violent, and completed the destruction of every building throughout the abovementioned space. Not one stone was left upon another south of the narrow isthmus of Squillace; and, what is more disastrous, a very large proportion of the inhabitants was killed by the falling of their houses; near 40,000 lives were lost. Some persons were dug out alive, after remaining a surprising length of time buried in the rubbish. Messina became a mass of ruins: its beautiful Palazzatta was thrown in upon the town; its quay cracked into ditches full of water. Reggio almost destroyed. Tropea greatly damaged. Every other place I visited in the province levelled to the ground.

"Before and during the concussion the clouds gathered, and then hung immoveable and heavy over the earth. At Palmi the atmosphere wore so fiery an aspect, that many people thought part of the town was burning. It was afterwards remembered, that an unusual heat had affected the skin of several persons just before the shock; the rivers assumed a muddy, ash-coloured tinge, and a sulphureous smell was almost general. A frigate passing between Calabria and Lipari felt so severe a shock, that the steersman was thrown from the helm, and the cannons were raised up on their carriages, while all around the sea exhaled a strong smell of brimstone. Stupendous alterations were occasioned in the face of the country: rivers choaked up by the falling in of the hills were converted into lakes; whole acres of ground, with houses and trees upon them, were broken off from the plains and washed many furlongs down the deep hollows which the course of the rivers had worn; there, to the astonishment and terror of beholders, they found a new foundation to fix upon, either in an upright or an inclining position. In short, every species of phenomenon incident to these destructive commotions of the earth was to be seen, in its utmost extent and variety, in this ruinated country."

EASEL *pieces*, a denomination given by painters to such pieces as are contained in frames, in contradistinction from those painted on ceilings, &c.

EASEMENT, a service on convenience, which one neighbour has of another by grant, or prescription, as a way through his ground, a sink, or the like.

EASING, in the sea-language, signifies the slackening a rope, or the like: thus to ease the bow-line or sheet, is to let them go slacker; to ease the helm, is to let the ship go more large, more before the wind, or more larboard.

EAST, one of the four cardinal points of the world; being that point of the horizon, where the sun is seen to rise when in the equinoctial.

EASTER, a festival of the christian church, observed in memory of our Saviour's resurrection.

In the primitive ages of the church, there were very great disputes about the particular time when this festival was to be kept. The Asiatic churches kept their Easter upon the very same day the Jews observed their passover; and others on the first Sunday after the first full moon in the new year. This controversy was determined in the council of Nice, when it was ordained that Easter should be kept upon one and the same day, which should always be a Sunday, in all christian churches throughout the world.

But though the Christian Churches differed as to the time of celebrating

Easter, yet they all agreed in shewing particular respect and honour to this festival: hence, in ancient writers, it is distinguished by the name of *dominica gaudii, i. e.* Sunday of joy. On this day prisoners and slaves were set free, and the poor liberally provided for. The eve, or vigil, of this festival was celebrated with more than ordinary pomp, which continued till midnight, it being a tradition of the church that our Saviour rose a little after midnight; but in the east, the vigil lasted till cock-crowing.

It was in conformity to the custom of the Jews, in celebrating their passover on the fourteenth day of the first month, that the primitive fathers ordered, that the fourteenth day of the moon, from the calendar new moon which immediately follows the twenty-first of March, at which time the vernal equinox happened upon that day, should be deemed the paschal full moon, and that the Sunday after should be Easter-day; and it is upon this account that our rubric has appointed it upon the first Sunday after the first full moon immediately following the twenty-first day of March. Whence it appears, that the true time for celebrating Easter, according to the intention of the council of Nice, was to be the first Sunday after the first full moon following the vernal equinox, or when the sun entered into the first point of Aries; and this was pope Gregory's principal view in reforming the calendar, to have Easter celebrated according to the intent of the council of Nice.

Having first found the epact and dominical letter, according to the method delivered, see CHRONOLOGY and EPACT, Easter-day may be found by the two following rules.

1. To find Easter-limit, or the day of the paschal full moon, counted from March 1 inclusive, the rule is this: add 6 to the epact, and if this sum exceeds 30, take 30 from it; then from 50 subtract this remainder, and what is left will be the limit; if the sum of the epact, added to 6, does not amount to 30, it must be subtracted from 50, and the remainder is the limit required; which is never to exceed 49, nor fall short of 21.

2. From the limit and dominical letter, to find Easter-day: add 4 to the dominical letter: substract this sum from the limit, and the remainder from the next higher number which contains 7 without any remainder; lastly, add this remainder to the limit, and their sum will give the number of days from the first of March to Easter-day, both inclusive.

Thus, to find Easter-day for the year 1808, for instance. First find the epact 3, which added to 6 gives 9: and as this sum does not amount to 30, it must be subtracted from 50, and the remainder 41 is the limit. Then adding 4 to 2, the number of the dominical letter B, subtract this sum, *viz.* 6, from the limit 41, and the remainder 35 from 42, the next superior number that contains 7 a certain number of times without any remainder, and there remains 7, which, being added to the limit 41, gives 48 for the number of days from the first of March to Easter-day, both inclusive: hence, allowing 31 for March, there remains the 17th of April for Easter-day. Here follows the operation at length.

$3 + 6 = 9$
$50 - 9 = 41$ = paschal limit
Dominical letter B $= 2$
$2 + 4 = 6$
$41 - 6 = 35$
$42 - 35 = 7$
$41 + 7 = 48$, from which subtracting
31, the number of days in March,
—
17, there remains 17, the day of April answering to Easter-day for the year 1808.

EASTLAND *company*, under charter from queen Elizabeth in 1579, traded to the east country, meaning the ports in the Baltic, but by statute 25 Car. II. c. 7. all persons may use the Eastland trade; and they may be admitted a free member of the company for 40s.

EAU *de Luce*, a fragrant liquor, possessing and retaining a milky opacity, made chiefly of mastic dissolved in alcohol, to which are added, elemi and aqua ammoniæ puræ. See Nicholson's Journal.

EBENUS, in botany, a genus of the Diadelphia Decandria class and order. Essential character: calyx with teeth, the length of the corolla; wings scarcely any; seed one, rough with hairs. There are two species, *viz.* E. cretica, Creton ebony, and E. pinnata, pinnated ebony: the former grows naturally in Crete, and some islands of the Archipelago; the latter is found in Barbary and the Levant.

EBIONITES, in church history, heretics of the first century, so called from their leader Ebion. They held the same errors with the Nazarenes, united the ceremonies of the Mosaic institution with the precepts of the gospel, observed both the Jewish Sabbath and Christian Sunday, and in celebrating the Eucharist made use of unleavened bread. They abstained from the flesh of animals, and even from milk. In relation to Jesus Christ, some of them held that he was born, like other men, of Joseph and Mary, and acquired sanctification only by his good works. Others of them allowed that he was born of a virgin, but denied that he was the word of God, or had any existence before his human generation. They said he was, indeed, the only true prophet; but yet a mere man, who, by his virtue, had arrived at being called Christ, and the son of God. They also supposed that Christ and the devil were two principles, which God had opposed to each other. Of the New Testament they only received the gospel of St. Matthew, which they called the gospel according to the Hebrews. See the article NAZARENES.

EBONY is an exceedingly hard and heavy kind of wood, susceptible of a very fine polish, and, on that account, used in mosaic and inlaid works, for toys, &c. It is of divers colours, most usually black, red, and green; produced chiefly in the island of Madagascar and the Mauritius. Travellers give very different accounts of the tree that yields the black ebony; some say that it is a sort of palm tree, others a cytisus, &c. M. Flacourt tells us, that it grows very high and big, its bark being black, and its leaves resembling those of the myrtle, of a deep, dusky, green colour. Black ebony is much preferred to that of other colours. The best is a jet black, free from veins and rind, very massive, astringent, and of an acrid pungent taste. It yields an agreeable perfume when laid on burning coals; when green, it readily takes fire from the abundance of its fat. Green ebony, besides Madagascar and the Mauritius, likewise grows in the Antilles, especially in the isle of Tobago. The tree that yields it is very bushy; its leaves are smooth, and of a fine green colour. Beneath, its bark is a white rind about two inches thick; all under which, to the very heart, is a deep green, approaching towards a black, though sometimes streaked with yellow veins. Its use is not confined to inlaid work, it is likewise good in dying, as yielding a fine green tincture.

Ebony is now less used than anciently, since the discovery of giving other hard woods a black colour. There is a sort of ebony coming from the West Indies, which is either black or white. This bears a flower resembling that of the English broom, seldom rises above eighteen feet, and in the largest part of the stem does not exceed five inches diameter. It is a fine timber wood, has a smooth even grain, which takes a good polish, and is very proper for bed-posts, and a variety of turnery ware; for which purposes the black is generally preferred, the heart of which is the complexion of jet. There is likewise a bastard ebony, growing in the West India islands, called mountain ebony, which is of a dark brown. See AMERIMUM.

EBULLITION. See BOILING.

ECHINEIS, the *remora*, in natural history, a genus of fishes of the order Thoracici. Generic character: head furnished on the top with a flat, oval, transversely grooved shield: gill-membrane, with ten rays, according to Gmelin, and six, according to Shaw; body not scaled. There are three species, the echineis remora, or Mediterranean remora, is of the length of from twelve to eighteen inches. Among the ancients its peculiarity of structure and habits was connected with the most incredible and marvellous circumstances, which are, however, detailed with all possible gravity and faith, by their most profound naturalists. Pliny states, that the force of the tide, the current, and the tempest, joining in one grand impulse with oars and sails, to urge a ship onwards in one direction, is checked by the operation of one small fish, called remora, by the Roman authors, which completely counteracts this apparently irresistible accumulation of power, and compels the vessel to remain motionless in the midst of the ocean. He credits the prevailing report that Anthony's ship, in the battle of Actium, was kept motionless by the exertion of the remora, notwithstanding the efforts of several hundred sailors; and that the vessel of Caligula was detained between Astura and Antium by another of these fishes found sticking to the helm, and whose solitary efforts could not be countervailed by a crew of 400 able seamen, till several of the latter, on examining into the cause of the detention, perceived the impediment, and detached the remora from its hold. The emperor, he adds, was not a little astonished, that the fish should hold the ship so fast in the water, and when brought upon the deck appear to possess no power of detention over it whatever. This confiding naturalist expresses himself as perfectly convinced that all fishes possess a similar power, and states, as a notorious example, the detention of Periander's ship by a porcellane, near the Cape of Gnidos. Quitting, however, the fables of antiquity, it may be observed, that the fins of the remora are particularly weak, and thus prevent its swimming to any considerable distance, on which account it attaches itself to various bodies, inanimate or living, being found not only fastened to ships, but to whales, sharks, and other fishes; and with such extreme tenacity is this hold maintained, that, unless the effort of separation be applied in a particular direction, it is impossible to effect the disunion without the destruction of the fish itself. As the remora is extremely voracious, and far from fastidious in its food, it may attach itself to vessels and large fishes, with a view to secure that ample subsistence, which must arise to it from the superfluity with which it is in such circumstances almost inevitably furnished. This fish will often adhere to rocks, and particularly in boisterous and tempestuous weather. The apparatus for accomplishing this adhesion consists of an oval area on the top of the head, traversed by numerous dissepiments, each of which is fringed at the edge by a row of very numerous perpendicular teeth, or filaments, while the whole oval space is strengthened by a longitudinal septum. It is reported by some authors, that, in the Mozambique channel, a species of remora is employed by the natives of the coast in their pursuit of turtles with great success. A ring is fixed near the tail of the remora, with a long cord attached to it, and when the boat has arrived as nearly as it well can to the turtle sleeping on the surface of the water, the remora is dismissed, and immediately proceeds towards the turtle, which it fastens on so firmly, that both are drawn into the boat with extreme facility. For a representation of the Mediterranean remora, see Pisces, Plate IV. fig. 3.

ECHINOPHORA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ. Essential character: lateral flowers male; central hermaphrodite; seed one, immersed in an involucle. There are two species, *viz.* E. spinosa, prickly sea-parsnip, and E. tennifolia, fine-leaved sea-parsnip. Natives of the sea coast of Europe and Apulia.

ECHINOPS, in botany, *globe thistle*, a genus of the Syngenesia Polygamia Segregata class and order. Natural order of Compositæ Capitatæ. Cinarocephalæ, Jussieu. Essential character: calyx one-flowered; corolla tubular, hermaphrodite; receptacle bristly; down obscure. There are five species. These are herbaceous plants, some of them large and lofty; leaves alternate, thorny and pinnatified; the heads of flowers are usually solitary at the ends of the stem and branches.

ECHINORYNCHUS, in natural history, a genus of the Vermes Intestina; body round; proboscis cylindrical retractile, and crowned with hooked prickles. These animals are found fixed very firmly to the viscera of various animals, generally the intestines, and often remain on the same spot during the whole life of the animal; they are mostly gregarious, and are easily distinguished from the tænia by their round inarticulate body. They are divided into sections: A. infesting mammalia; of this E. gigas is found in the intestines of swine, especially those that have been fed in styes; it is gregarious, and from 12 to 18 inches long. B. infesting birds. C. infesting reptiles. D. infesting fish. There are about 50 species.

ECHINUS, *sea urchin*, in natural history, a genus of the Vermes Mollusca; body roundish, covered with a bony sutured crust, and generally furnished with moveable spines; mouth placed beneath, and mostly five-valved. These are divided into sections, chiefly distinguished by the situation of the vent. A. has the vent vertical; tentacula every where simple. B. vent placed beneath; mouth without tentacula. C. vent lateral; mouth with pencilled tentacula. Each of these sections is subdivided. There are more than 100 species, besides varieties. They are all inhabitants of the sea, and many of them have been found in a fossil state; many are esculent, and they are in general armed with five sharp teeth; the pores are each furnished with a retractile tentaculum, by which the animal affixes itself to any object and stops its motion; the spines are connected to the outer skin by very strong ligaments, and are the instruments of motion.

ECHINUS, in architecture, a moulding carved and enriched with the egg and dart. See Ovolo.

ECHITES, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; follicles two, long and straight; seeds downy; corolla funnel form, with the throat naked. There are twenty-two species. These plants have something singular in their habit, which proclaims them at first sight. The nectareous glands, and the downy-seeds in follicles, are of great importance in determining the character; whilst the corolla, varying much in the different species, is of no consequence in this respect. The stigmas in all are glued to the inside wall of the cone formed by the anthers, and which separates at the explosion of the pollen, whilst the outer wall of the cone continues undissolved; the fecundation in the greater part being accomplished within the closed tube of the corolla, but in the rest within the cone stretched beyond the tube. These plants are mostly inhabitants of the West Indies. They have not yet been introduced into cultivation in Europe.

ECHIUM, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: corolla irregular, with the throat naked. There are twenty-one species, of which E. fruticosum, shrubby vipers bugloss, rises with a shrubby stalk two or three feet high, dividing at top into several branches: leaves sessile, hairy, light green. The flowers are produced singly between the leaves at the ends of the branches; they are of a purple colour, and in shape much like those of the Cretan sort. They appear in May and June; the seeds do not ripen in England. Native of the Cape of Good Hope.

ECHO, a sound reverberated or reflected to the ear from some solid body. See ACOUSTICS.

ECHO, in architecture, a term applied to certain kinds of vaults and arches, most commonly of elliptical and parabolical figures, used to redouble sounds, and produce artificial echoes.

ECHO, in poetry, a kind of composition wherein the last words or syllables of each verse contain some meaning, which, being repeated apart, answers to some question or other matter contained in the verse, as in this beautiful one fron Virgil:

Crudelis mater magis, an puer improbus ille?
Improbus ille puer, crudelis tu quoque mater.

The elegance of an echo consists in giving a new sense to the last words; which reverberate, as it were, the motions of the mind, and by that means affect it with surprise and admiration.

ECHO, in music, is frequently found in church voluntaries, over those passages of repetitions which are performed on the swell, and intended as echoes to the great organ.

ECHOMETER, among musicians, a kind of scale or rule, with several lines thereon, serving to measure the duration and length of sounds, and to find their intervals and ratios.

ECLECTICS, ancient philosophers, who without attaching themselves to any particular sect, selected whatever appeared to them the best and most rational from each.

ECLIPSE, the deprivation of the light of the sun, or of some heavenly body, by the interposition of another heavenly body between our sight and it. Thus, eclipses of the sun happen by the moon's intervening between it and the earth; by which means the shadow of the moon falls upon the earth, when the latitude of the moon does not prevent it, by elevating the moon above, or depressing it below the earth. On the other hand, an eclipse of the moon can only happen when the earth is interposed between the sun and it; for then, if the latitude of the moon does not prevent it, the shadow of the earth may fall on the moon, and thereby cause either a partial or total eclipse. A total eclipse of the sun or moon is when their whole bodies are obscured; and a partial one is when part only of their bodies is darkened: again, a central eclipse is when it is not only total, but the eclipsed body passes through the centre of the shadow. See ASTRONOMY.

As total solar eclipses are by no means common, we shall give an interesting description of one, by Dr. Stukeley, sent to his friend the celebrated Dr. Edmund Halley.

"According to my promise, I send you what I observed of the solar eclipse, though I fear it will not be of any great use to you. I was not prepared with any instruments for measuring time or the like, and proposed to myself only to watch all the appearances that nature would present to the naked eye upon so remarkable an occasion, and which generally are overlooked, or but grossly regarded. I chose for my station a place called Haradon Hill, two miles eastward from Amsbury, and full east from the opening of Stonehenge avenue, to which it is as the point of view. Before me lay the vast plain where that celebrated work stands, and I knew that the eclipse would appear directly over it; besides, I had the advantage of a very extensive prospect every way, this being the highest hill hereabouts, and nearest the middle of the shadow; full west of me, and beyond Stonehenge, is a pretty copped hill, like the top of a cone, lifting itself above the horizon; this is Clay-hill near Warminster, 20 miles distant, and near the central line of darkness, which must come from thence, so that I could have notice enough before hand of its approach. Abraham Sturgis and Steven Ewens, both of this place, and sensible men, were with me. Though it was very cloudy, yet now and then we had gleams of sunshine, rather more than I could perceive at any other place around us. These two persons, looking through smoked glasses, while I was taking some bearings of the country with a circumferentor, both confidently affirmed the eclipse was begun, when by my watch I found it just half an hour after 5; and, accordingly, from thence the progress of it was visible, and very often to the naked eye, the thin clouds doing the office of glasses. From the time of the sun's body being half covered, there was a very conspicuous circular iris round the sun, with perfect colours. On all sides we beheld the shepherds hurrying their flocks into fold, the darkness coming on; for they expected nothing less than a total eclipse for an hour and a quarter.

"When the sun looked very sharp like a new moon, the sky was pretty clear in that spot; but soon after a thicker cloud covered it, at which time the iris vanished, the copped hill beforementioned grew very dark, together with the horizon on both sides, that is to the north and south, and looked blue; just as it appears in the east at the declension of day. We had scarce time to tell, then, when Salisbury steeple six miles offsouthward became very black; the copped hill quite lost, and a most gloomy night with full career came upon us: at this instant we lost sight of the sun, whose place among the clouds was hitherto sufficiently distinguishable, but now not the least trace of it to be found, no more than if really absent: then I saw by my watch, though with diffiulty, and only by help of some light from the northern quarter, that it was 6 hours 35 minutes: just before this the whole compass of the heavens and earth looked of a lurid complexion, properly speaking; for it was black and blue, only in the earth upon the horizon the blue prevailed; there was likewise in the heavens among the clouds much green interspersed, so that the whole appearance was really very dreadful, and as symptoms of sickening nature.

"Now I perceived us involved in total darkness and palpable, as I may aptly call it; though it came quick, yet I was so intent that I could perceive its steps, and feel it as it were drop upon us, and fall on the right shoulder (we looking westward) like a great dark mantle or coverlet of a bed thrown over us, or like the drawing of a curtain on that side; and the horses we held in our hands were very sensible of it, and crouded close to us, startling with great surprise; as much as I could see of the men's faces that stood by me had a horrible aspect; at this instant I looked around me, not without exclamations of admiration, and could discern colours in the heavens, but the earth had lost its blue, and was wholly black; for some time among the clouds there was visible streaks of rays, tending to the place of the sun as their centre; but immediately after, the whole appearance of earth and sky was entirely black: of all things I ever saw in my life, or can by imagination fancy, it was a sight the most tremendous.

"Toward the north-west, whence the eclipse came, I could not in the least find any distinction in the horizon between heaven and earth, for a good breadth of about 60 degrees or more; nor the town of Amsbury underneath us, nor scarce the ground we trod on: I turned myself round several times during this total darkness, and remarked at a good distance from the west, on both sides, that is to the north and south, the horizon very perfect: the earth being black, the lower part of the heavens light; for the darkness above hung over us like a canopy, almost reaching the horizon in those parts, or as if made with skirts of a lighter colour; so that the upper edges of all the hills were as a black line, and I knew them very distinctly by their shape or profile; and northward I saw perfectly that the interval of light and darkness in the horizon was between Martinsal hill and St. Ann's hill; but southward it was more indefinite: I do not mean that the verge of the shadow passed between those hills, which were but 12 miles distant from us: but so far I could distinguish the horizon, beyond it not at all: the reason of it is this: the elevation of ground I was upon gave me an opportunity of seeing the light of the heavens beyond the shadow: nevertheless, this verge of light looked of a dead, yellowish, and greenish colour; it was broader to the north than south, but the southern was of a tawny colour; at this time, behind us, or eastward toward London, it was dark too, where otherwise I could see the hills beyond Andover; for the foremost end of the shadow was past thither; so that the whole horizon was now divided into four parts, of unequal bulk and degrees of light and dark; the part to the north-west broadest and blackest, to the south-west lightest and longest. All the change I could perceive during the totality was, that the horizon by degrees drew into two parts, light and dark; the northern hemisphere growing still longer, lighter, and broader; and the two opposite dark parts uniting into one, and swallowing up the southern enlightened part.

"As at the beginning the shade came feelingly upon our right shoulders, so now the light from the north, where it opened as it were: though I could discern no defined light or shade upon the earth that way, which I earnestly watched for, yet it was manifestly by degrees, and with oscillations, going back a little and quickly advancing further; till at length, upon the first lucid point appearing in the heavens where the sun was, I could distinguish pretty plainly a rim of light running along side of us a good while together, or sweeping by at our elbows from west to east; just then having good reason to suppose the totality ended with us, I looked on my watch, and found it to be full three minutes and a half more. Now the hill tops changed their black into blue again, and I could distinguish a horizon where the centre of darkness was before: the men cried out they saw the copped hill again, which they had eagerly looked for; but still it continued dark to the south-east, yet I cannot say that ever the horizon that way was undistinguishable; immediately we heard the larks chirping, and singing very briskly, for joy of the restored luminary, after all things had been hushed into a most profound and universal silence. The heavens and earth now appeared exactly like morning before sun-rise, of a greyish cast, but rather more blue interspersed; and the earth, so far as the verge of the hill reached, was of a dark green or russet colour.

"As soon as the sun emerged, the clouds grew thicker, and the light was very little amended for a minute or more, like a cloudy morning slowly advancing. After about the middle of the totality, and so after the immersion of the sun, we saw Venus very plainly, but no other star. Salisbury steeple now appeared. The clouds never removed, so that we could take no account of it afterward, but in the evening it lightened very much. I hasted home to write this letter; and the impression was so vivid upon my mind, that I am sure I could for some days after have wrote the same account of it, and very precisely. After supper I made a drawing of it from my imagination, upon the same paper I had taken a prospect of the country before.

"I must confess to you, that I was (I believe) the only person in England that regretted not the cloudiness of the day, which added so much to the solemnity of the sight, and which incomparably exceeded, in my apprehension, that of 1715, which I saw very perfectly from the top of Boston steeple, in Lincolnshire, where the air was very clear; but the night of this was more complete and dreadful: there, indeed, I saw both sides of the shadow come from a great distance, and pass beyond us to a great distance; but this eclipse had much more of variety and majestic terror; so that I cannot but felicitate myself upon the opportunity of seeing these two rare accidents of nature in so different a manner: yet I should willingly have lost this pleasure for your more valuable advantage of perfecting the noble theory of the celestial bodies, which last time you gave the world so nice a calculation of; and wish the sky had now as much favoured us for an addition to your honour and great skill, which I doubt not to be as exact in this as before."

ECLIPTA, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compound Flowers. Corymbiferæ, Jussieu. Essential character: receptacle chaffy; down none; corollets of the disk four cleft. There are five species, natives of the East and West Indies.

ECLIPTIC, in astronomy, a great circle of the sphere, supposed to be drawn through the middle of the zodiac, making an angle with the equinoctial of about 23° 30′, which is the sun's greatest declination: or, more strictly speaking, it is that path or way among the fixed stars, that the earth appears to describe, to an eye placed in the sun.

By a long series of observations, the shepherds of Asia were able to mark out the sun's path in the heavens; he being always in the opposite point to that which comes to the meridian at midnight, with equal, but opposite, declination. Thus they could tell the stars among which the sun then was, although they could not see them. They discovered that this path was a great circle of the heavens, afterwards called the ecliptic, which cuts the equator in two opposite points, dividing it, and being divided by it into two equal parts. They farther observed, that when the sun was in either of these points of intersection, his circle of diurnal revolution coincided with the equator, and therefore the days and nights were equal. Hence the equator came to be called the equinoctial line, and the points in which it cuts the ecliptic were called the equinoctial points, and the sun was then said to be in the equinoxes. One of these was called the vernal, and the other the autumnal equinox. See Equinoxes.

Ecliptic, *obliquity of*, is the angle which its plane makes with that of the equinoctial. The inclination of the equator to the ecliptic is measured by the arch of a great circle intercepted between their poles, which was taken with very great accuracy by Dr. Maskelyne, in the year 1769, and found to be 23° 28′ 10″, or 23° 46944. It was formerly found by Dr. Bradley to be 23° 28′ 30″, who supposed that there was a gradual approach of the ecliptic to the equinoctial, at the rate of 1′ in 100 years. The mean obliquity of the ecliptic is augmented by 9″, when the moon's ascending node is in the vernal equinox. It is, on the contrary, diminished 9″, when the node is in the autumnal equinox, and it is equal to the mean, when the node is in the colure of the solstices. This change of the inclination of the earth's axis to the plane of the ecliptic was called the nutation of the axis by Sir Isaac Newton.

Dr. Bradley discovered a general and periodical motion in all the stars, which alter a little their relative situations. To form an idea of this motion, let us suppose that each star describes annually a small circumference parallel to the ecliptic, whose centre is the mean position of the star, and whose diameter, as seen from the earth, subtends an angle of about 40″; and that it was in that circumference as the sun in its orbit, but so that the sun always precedes it by 90°. This circumference, projected upon the surface of the celestial sphere, appears under the form of an ellipse, more or less flattened, according to the height of the star above the equator, the smaller axis of the ellipse being to the greater axis as the sine of that height to the radius. These periodical movements of the stars have received the name of aberrations of the fixed stars. See Aberration.

Ecliptic, in geography, a great circle on the terrestial globe, not only answering to, but falling within the plane of the celestial ecliptic. See Globes, *use of*.

ECLOGUE, in poetry, a kind of pastoral composition, or a small elegant poem, in a natural simple style.

The eclogue, in its primary intention, is the same thing with the idyllium, but custom has made some difference between them, and appropriated the name of eclogue to pieces wherein shepherds are introduced, and idyllium to those written like eclogues, but without any shepherds in them. The eclogue then is properly an image of pastoral life, upon which account the matter is low, and its genius humble. Its business is to describe the loves, sports, piques, jealousies, intrigues, and other adventures of shepherds; so that its character must be simple, the wit easy, and the expression familiar. Then the true character of the eclogue is simplicity and modesty; its figures are neat, the passions tender, the motions easy, and though sometimes it may have little transports and despairs, yet it never rises so high as to be fierce or violent. Its narrations are short, descriptions little, the thoughts ingenious, the manners innocent, the language pure, the verse flowing, the expressions plain, and all the discourse natural.

ECONOMY, *political*. Political economy is the science which treats of the wealth of nations. Its object is to ascertain, in the first place, wherein wealth consists, and then to explain the causes of its production, and the principles on which it is distributed through the different orders of society. It likewise endeavours to point out the tendency, which any political regulations may have to favour or to injure the productions or most advantageous distribution of wealth. Such is its peculiar object, and consequently, though writers on political economy may frequently treat on the more important topics of national security, freedom, and happiness, these are then passing the strict limits of their science.

Political economy, in some of its branches, has engaged the attention of speculative men in all ages; but it is only in very recent times that the truths it exhibits have been collected, arranged, and demonstrated with such precision, as to entitle it to the name and dignity of a science.

The writers on political economy may be arranged in two great classes; the former composed of those who regard commerce, and the latter of those who regard agriculture as the principal source of national wealth. Almost all the older writers belong to the former class. The most considerable English writers of this class are, Dr. d'Avenant and Sir John Stewart, and their principles are interwoven in the elaborate history of Commerce, by Anderson. The decisions of the English legislature have usually been guided by the principles of these writers.

The commercial system of political economy is very perspicuously explained, and very ably examined, in the fourth book of Smith on the Wealth of Nations.

The agricultural system is of comparatively recent origin. It was first brought into vogue by Mons. Quesnia, a celebrated French physician. His ideas were adopted and diffused by several very able writers, and are thought to be most clearly explained in "L'Ordre Natural de Societes Politiques," by Mercier de la Rivière. The writings of Quesnai have been published, with remarks and illustrations, in a work entitled "Physiocratie," by Dupont de Nemours. The followers of Quesnai are styled the economists. There is no English writer of celebrity by whom these principles have been adopted in their whole extent; but they are stated, and in some degree controverted, in the last chapter of the fourth book of Smith.

By far the greatest work on political economy is the treatise on "The Wealth of nations," by Adam Smith. The acuteness of later writers may have discovered some inconsiderable errors in the reasonings; may have shewn that some portions of it are not so completely finished as the rest; and that some well grounded objections may be urged against parts of its arrangement; but the most able judges unanimously regard it as a work at once original, accurate, and profound; as just in its principles, and perspicuous in its illustrations; and as entitling Smith, among other writers on political economy, to the same distinguished rank which among astronomers is held by Newton.

A striking and very important difference between the old and new systems of political economy consists in the former calling, upon all occasions, for the regulation and controul of laws, and regarding the legislature as best qualified to estimate the value of any particular branches of trade, or modes of conducting business; while by the latter the merchant is supposed to be the best judge of the most eligible method of conducting his own affairs. The former is a system of restrictions and encouragements, in which little is left to the choice and sagacity of individuals; in the latter it is supposed that national wealth, which is the aggregate of individual wealth, will increase most rapidly, where, while private property is rendered sacred by the laws, talent and enterprise are under the least possible restraint.

EDDY *tide*, or *Eddy water*, among seamen, is where the water runs back contrary to the tide; or that which hinders the free passage of the stream, and so causes it to return again.

Eddy *wind*, is that which returns, or is beat back from a sail, mountain, or any thing that may hinder its passage.

EDGE, in general, denotes the side or border of a thing; but is more particularly used for the sharp side of some weapon, instrument, or tool. Thus we say, the edge of a sword, knife, chissel, &c. In the sea language, a ship is said to edge in with another, when making up to it.

EDGINGS, among gardeners, the series of small but durable plants set round the edges or borders of flower-beds, &c. The best and most durable plant for this use is box, which, if well planted and rightly managed, will continue in strength and beauty for many years. The seasons for planting these are the autumn, and very early in the spring; and the best species for this purpose is the dwarf Dutch box.

EDICT, in matters of polity, an order or instrument, signed and sealed by a prince, to serve as a law to his subjects. We find frequent mention of the edicts of the Prætor, the ordinances of that officer in the Roman law. In the French law, the edicts are of several kinds : some importing a new law or regulation ; others, the erection of new offices, establishments of duties, rents, &c. and sometimes articles of pacification. In France, edicts are much the same as a proclamation is with us, but with this difference, that the former have the authority of a law in themselves, from the power which issues them forth ; whereas the latter are only declarations of a law, to which they refer, and have no power in themselves.

Edicts can have no room in Britain, because that the enacting of laws is lodged in the Parliament, and not in the King.

Edicts are all sealed with green wax, to show that they are perpetual and irrevocable.

EDITOR, a person of learning, who has the care of an impression of any work, particularly that of an ancient author. Thus, Erasmus was a great editor ; the Louvain doctors, Scaliger, Petavius, F. Sirmond, Bishop Walton, Mr. Hearne, Mr. Ruddiman, &c. are likewise famous editors.

EDULCORATION, in chemistry, a term applied to the process of washing out from a precipitate any excess of acid or alkali, or compound salt, that may adhere to it. The usual method is by filtration, repeated with different waters, till the last portions that drain are wholly tasteless, and produce no change on the usual tests. This method is tedious, and often ineffectual, and the following adopted in its stead. When the precipitate is deposited, instead of throwing it on a filter, pour it into a silver crucible, and boil it with water; after this, withdraw it from the fire, allow it a few minutes to subside, and draw off the clear liquor ; then add fresh water to the residue, and boil it again, and proceed thus till all the soluble impurities are got rid of.

EEL. See MURÆNA.

EEL *spear*, a forked instrument with three or four jagged teeth, used for catching of eels : that with the four teeth is best, which they strike into the mud at the bottom of the river, and if it strike against any eels, it never fails to bring them up.

EFFECTS, in commerce, law, &c. the goods possessed by any person, whether moveable or immoveable.

EFFERVESCENCE, in chemistry, is a rapid disengagement of gas taking place within a liquid ; in consequence of this, numerous bubbles rise to the surface, forming a head of froth, and bursting with a hissing noise. There is some resemblance between effervescence and fermentation ; the latter is, however, slower and more durable. Hence chemists formerly applied the term fermentation to all the phenomena which are at present denoted by effervescence. Gas produced by effervescence is by means of single or double elective affinity: in the one case it is generally carbonic acid gas, in the other it is either nitrous gas or hydrogen. Gas can have but little affinity with the fluid in which it is immersed, in order to produce effervescence. Thus, carbonic and muriatic acids are both gases, and are both extricated from alkaline combinations by sulphuric acid, yet a solution of carbonate of potash in water will produce a vehement effervescence with sulphuric acid, while muriate of potash in the same circumstances will occasion none at all, the carbonic acid having a very slight affinity for water acidulated by sulphuric acid, while the muriatic acid will combine with the same very readily.

EFFLORESCENCE, in chemistry, is the formation of a powdery crust, or of minute crystals, on the surface of any substance. This term is applied to two distinct phenomena. Salts are either unalterable in the air, or they attract moisture from it, and are resolved into a fluid, or they yield part of their water of crystallization to the air, and are reduced to powder. This effect, at its commencement, is called efflorescence, and such salts are denominated efflorescent. There is, however, another kind of efflorescence, which is discernible in iron pyrites, or new mortar ; and in these cases it implies the appearance of a superficial covering of minute hair-like crystals, and is occasioned by the chemical changes that take place on the surface of the substance where these crystals appear. Thus sulphuret of iron is changed by efflorescence into sulphate of iron or green vitriol; but sulphate of soda, when subjected to the efflorescence first mentioned, though changed in form, remains the same in composition, except that it has lost part of its water. The one destroys crystals, the other produces them. See Aikin's "Mineralogical and Chemical Dictionary."

EFFLUVIUM, in physiology, a term much used by philosophers and physicians, to express the minute particles which exhale from most, if not all, terrestrial bodies, in form of insensible vapours. Sometimes, indeed, these effluvia become visible, and are seen ascending in form of smoke; constituting what, in animals and plants, makes the matter of perspiration.

Nothing can exceed the subtility of the odoriferous effluvia of plants and other bodies. Mr. Boyle tells us, that having exposed to the open air a certain quantity of asafoetida, he found its weight diminished only the eighth part of a grain in six days: hence if we suppose, that during all that time a man could smell the asafoetida at the distance of five feet, it will appear that its effluvia cannot exceed the $\frac{1}{262500000000000000}$ part of an inch in magnitude.

The effluvia of mineral substances are called steams; and when collected in mines, or other close places, damps. See Gas.

Malignant effluvia are assigned by physicians as the cause of the plague, and other contagious diseases; as the jail-distemper, hospital-fever, and the like.

EFT. See Lacerta.

EGGS. The eggs of hens and of birds, in general, are composed of several distinct substances. 1. The shell or external coating, which is composed of carbonate of lime .72, phosphate of lime .2, gelatine .3; the remaining .23 are, perhaps, water. 2. A thin, white, and strong membrane, possessing the usual characters of animal substances. 3. The white of the egg, for which see Albumen. 4. The yolk, which appears to consist of an oil of the nature of fat oils, united with a portion of serous matter sufficient to render it diffusible in cold water, in the form of an emulsion, and concrescible by heat. Yolk of egg is used as the medium for rendering resins and oils diffusible in water. An oil of eggs is procured by expression from the yolks of eggs, previously roasted, to deprive the serous part of its fluidity. A slight empyreuma is given to the oil by this treatment, which might probably be avoided by applying no greater heat than, on trial, might be found sufficient to coagulate the serum.

The products afforded by the several parts of eggs subjected to destructive distillation are nearly the same as are obtained by that method from other animal matters.

Mr. Reaumur found that eggs might be preserved during months or years by being covered with mutton-suet, or any other fat substance. And Mr. Parmentier observed that eggs of hens that have had no connection with a cock kept much better than those which are fecundated: he adds too, that they are not inferior in size or flavour, and that the hens lay quite as many: so that those who keep fowls for the sake of eggs alone should have hens only, without any cocks. He recommends the common hen as the most productive, and the black legged as superior to the yellow.

EGYPTIANS, or Gypsies, a wandering tribe of people, whose origin is very obscure; they inhabit different countries of Europe, and are every where remarkable as thieves, fortune tellers, &c. By the laws of England, gipsies were formerly subject to imprisonment and forfeiture of goods, but they are now considered chiefly as rogues and vagabonds, and are described as such in the vagrant act. 4 Black. 166.

EHRETIA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ, Borragineæ, Jussieu. Essential character: berry two-celled; seeds solitary, two-celled; stigma emarginate. There are five species. These are trees or shrubs; the leaves in some are smooth, in others scabrous; the flowers in panicles, terminating, and axillary. E. tinifolia, Tinus-leaved Ehretia, is an upright tree, from twenty to thirty feet in height, with an oblong thick head; branches unarmed, roundish, subdivided; leaves alternate, veined, about four inches long, on short petioles; calyx five-parted, with minute, ovate, segments; corolla a little larger than the calyx, with acute segments finally rolled back: filaments longer than the corolla: style scarcely shorter than the stamens, oval-shaped, bifid; stigmas simple; berry spherical. This plant is a native of Cuba and Jamaica; flowering in February.

EHRHARTA, in botany, a genus of the Hexandria Monogynia class and order. Essential character: calyx a two-valved, one-flowered glume; corolla double, each two-valved; the outer compressed. There are five species, of which E. cartilaginea is a very beautiful smooth grass; it has a perennial fibrous root; culms erect, jointed about two feet high; leaves sheathing, the lower ones a hand in length, the upper ones much shorter: disk smooth; edge cartilaginous and crenate; panicle oblong, consisting of fifteen or twenty flowers; peduncles capillary, loose, flexuose, in threes, pairs, or solitary, simple, or sometimes a little branched, growing thicker at the top; nectary and filaments white; anthers yellow. This plant was first observed at the Cape by Thunberg.

EIDER *down*. See Down.

EIGNE, the eldest, or first born.

EIRE *or* EYNE, signifies the court of justice itinerant. Eyer is also taken to signify the justice seat. See Justices *in eyne*.

EJECTMENT, is a mixed action, by which originally a lessee for years, when ousted, recovered his term and damages. It is a real action in respect of the lands, but personal in respect of the damages. Since the disuse of real action, it is become the common method of trying the title to lands or tenements.

The modern method of proceeding in ejectment entirely depends on a string of legal fictions; no actual lease is made; no actual entry by the plaintiff; no actual ouster by the defendant; but all are merely ideal, for the purpose of trying the title. To this end a lease for a term of years is stated in the proceedings, to have been made by him who claims title to the plaintiff, who is generally a fictitious person; though it ought to be a real person to answer for the defendant's costs. In this proceeding, which is the declaration (for there is no other process in this action,) it is also stated that the lessee, in consequence of the demise to him made, entered into the premises: and that the defendant, who is also now another fictitious person, and who is called the casual ejector, afterwards entered thereon and ousted the plaintiff; for which ouster the plaintiff brings this action. Under this declaration is a notice, supposed to be written by this casual ejector, directed to the tenant in possession of the premises; in which notice the casual ejector informs the tenant of the action brought by the lessee, and assures him, that as he, the casual ejector, has no title to the premises, he shall make no defence, and therefore he advises the tenant to appear in court, at a certain time, and defend his own title; otherwise he, the casual ejector, will suffer judgment to be had against him, by which the actual tenant will inevitably be turned out of possession.

The ancient way of proceeding was by actually sealing a lease on the premises, by the party interested, who was to try the titles; and this method is still in use in several cases.

First, where the house or thing for which ejectment is brought is empty.

Secondly, when a corporation is lessor of the plaintiff, they must give a letter of attorney to some person to enter and seal a lease on the land; for a corporation cannot make an attorney, or a bailiff, except by deed, nor can they appear but by making a proper person their attorney by deed; therefore, they cannot enter and demise upon the land as natural persons can.

Thirdly, when the several interests of the lessors of the plaintiff are not known; for in that case it is proper to seal a lease on the premises, lest they should fail in setting out in their declaration the several interests which each man possesses.

Fourthly, where the proceedings are in an inferior court, they must proceed by actually sealing a lease, because they cannot make rules, confess lease, entry, and ouster; inasmuch as inferior courts have not authority to imprisonment for disobedience to their rules. It is a general rule, that no person can, in any case, bring an ejectment, unless he have in himself, at the time, a right of entry; for although, by the modern practice, the defendant is obliged by rule of court to confess lease, entry, and ouster; yet that rule was only designed to expedite the trial of the plaintiff's right, and not to give him a right which he had not before.

The damages recovered in these actions, though formerly their only intent, are now usually very small and inadequate, amounting to one shilling, or some other trifling sum. In order, therefore, to complete the remedy, when the possession has been long detained from him that has right, an action of trespass also lies, after a recovery in ejectment, to recover the mesne profits which the tenant in possession had wrongfully received; which action may be brought in the name of either the nominal plaintiff in the ejectment, or his lessor, against the tenant in possession, whether he be made party to the ejectment, or suffer judgment to go by default. An ejectment cannot be brought after the lessor of the plaintiff, or his ancestor, has been out of possession 20 years. See Limitation.

EKEBERGIA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Trihilatæ. Meliæ, Jussieu. Essential character: calyx-four-parted; petals four; nectary like a garland, surrounding the germ; berry containing five oblong seeds. There is but one species, *viz.* E. capensis, a tree with abruptly or unequally pinnate leaves; the common petiole flatted; the flowers panicled and axillary.

ELÆAGNUS, in botany, English *oleaster*, a genus of the Tetrandria Monogynia class and order. Natural order of

Elæagni, Jussieu. Essential character: corolla none; calyx four-cleft, bell-form, superior; drupe below the calyx. There are nine species.

ELÆIS, in botany, a genus of the Appendix Palmæ. Natural order of Palms. Essential character: male, calyx six-leaved, corolla six-cleft; stamens six. Female, calyx six-leaved; corolla six-petalled; stigmas three; drupe fibrous; nut one to three valved. There is but one species, *viz.* E guienensis It is called in the West Indies the oily palm. The fruit of this tree was first carried from Africa to America by the negroes. It grows in great plenty on the coast of Guinea, and also in the Cape de Verd islands.

From this fruit the inhabitants of the West-India islands draw an oil, in the same manner as it is extracted from olives. They also extract a liquor from the body of the tree, which when fermented has a vinous quality, and will inebriate. The leaves are wrought by the negroes into mats, on which they repose.

ELÆOCARPUS, in botany, a genus of the Polyandria Monogynia class and order. Natural order of Guttiferæ, Jussieu. Essential character: calyx five-leaved; corolla five-petalled, jagged; anthers two-valved at the tip; drupe with a curled shell. There are six species, mostly natives of the East Indies.

ELÆODENDRUM, in botany, *olive wood*, a genus of the Pentandria Monogynia class and order. Essential character: corolla five-petalled; drupe ovate, with a two-celled nut. There are two species, of which E. orientale is a moderate sized twiggy shrub, or tree, a native of the oriental regions: leaves ovate lanceolate, smooth, slightly waved, sometimes inclining to a subserrated appearance on the upper parts of the shoots; flowers borne towards the ends of the branches, of a pale green colour, supported on shortish pedicles, each of which springs from a longer common pedicle.

ELASTICITY, that disposition in bodies by which they endeavour to restore themselves to the posture from whence they were displaced by any external force. The principal phenomena observable in elastic bodies are: 1. That an elastic body (*i. e.* a body perfectly elastic, if any such there be) endeavours to restore itself with the same force with which it is pressed or bent. 2. An elastic body exerts its force equally towards all sides, though the effect is chiefly found on that side where the resistance is weakest, as is evident in the case of a gun exploding a ball, a bow shooting out an arrow, &c. 3. Elastic bodies, in what manner soever struck, or impelled, are inflected, and rebound after the same manner: thus a bell yields the same musical sound, in what manner or on what side soever it be struck; the same of a tense or musical chord; and a body rebounds from a plane in the same angle in which it meets or strikes it, making the angle of incidence equal to the angle of reflection, whether the intensity of the stroke be greater or less. 4. A body perfectly fluid, if any such there be, cannot be elastic, if it be allowed that its parts cannot be compressed. 5. A body perfectly solid, if any such there be, cannot be elastic; because, having no pores, it is incapable of being compressed. 6. The elastic properties of bodies seem to differ, according to their greater or less density or compactness, though not in an equal degree: thus metals are rendered more compact and elastic by being hammered; tempered steel is much more elastic than soft steel; and the density of the former is to that of the latter as 7809 to 7738: cold condenses solid bodies, and renders them more elastic; whilst heat, that relaxes them, has the opposite effect: but, on the contrary, air and other elastic fluids, are expanded by heat, and rendered more elastic.

Some philosophers account for elasticity from the principles of corpuscular attraction and repulsion: thus, if a steel spring, wire, or piece of very thin glass, be bent out of its natural position, the particles on the convex part are forced from the intimate union they had before; and, on the concave part, they are forced nearer together, or harder upon each other, than in the natural state: in both which cases there will be a considerable resistance to overcome, and consequently require a superior force. During this state of the particles, they may be said to be under a sort of tension on one side, and compression on the other: and since by this force they are not drawn out of each other's attraction, as soon as the force is remitted, or ceases to act, the attractive power reduces the particles and unbends the wire. Now it is well known that many substances are composed of such fibrous parts or filaments which resemble fine wires, and are interwoven and disposed in such a manner, as in sponge, for instance, that they cannot be compressed without being bent or wrested from their natural position; whence all bodies will in such cases exert a spring or force to restore themselves, in the same manner that the bent wire did. Others attribute the elasticity of all hard bodies to the force of the air included within them: and so they make the elastic force of the air the principle of elasticity in all other bodies. See PNEUMATICS.

All substances that we know of are in some degree or other elastic, but none of them perfectly so; such are most metals, semi-metals, stones, and animal and vegetable substances, however they may differ in degree.

We may consider all elastic bodies to be made up of such strings or fibres as A B (Plate IV. Miscel. fig. 9.) or rather of elastic strata parallel to each other, represented by A B in the ball D C. If this ball be struck at D by a hard or elastic body, all the strata will be bent in towards C, as expressed by the dotted lines, whilst the ball is flattened or dented at D. But the strata quickly restoring themselves, the surface of the ball re-assumes its first figure, and that more or less exactly, according as the elasticity is more or less perfect.

The great law of perfectly elastic bodies is, that their relative velocity will remain the same before and after collision; that is, perfectly elastic bodies will recede from one another after the stroke, with the same velocity that they came together. Many curious phenomena may be explained from this property in bodies.

If the ivory ball A, (fig. 10.) weighing two ounces, strike with the velocity 16 against B at rest, weighing also two ounces, the body B will move forward after the stroke with the velocity 16, A remaining at rest in its place. The reason of this is, that the body A loses one half of its motion by striking the equal body B, and the other half by the elasticity of B recovering its former figure. From this experiment, several curious phenomena arise: thus, if a row of shovel-board pieces (that is, metalline cylinders of about half an inch in height, and two inches diameter) be laid upon a smooth table, and you take a single piece, and drive it against the row, the last piece of the row will fly off; for if A (fig. 11.) strike the row of pieces, B, C, D, E, F, G, H, I, in the direction A *a*, then will the last piece I fly off to *i* with the same velocity that A struck B: and whatever be the velocity of A, no other piece but the last piece I will fly off. But if you take two pieces, as A and B, (fig. 12.) and strike them together against the row C, D E, F, G, H, I, the two last pieces, H and I, will fly off from the other end of the row, with the same velocity that A and B made the stroke.

If three or more pieces are made use of to make the stroke, the very same number will fly off from the other end of the row; and it is to be observed, that the same will happen with equal elastic balls, suspended in a row by strings of the same length.

Again, if the elastic body A, (fig. 13.) weighing four ounces, strike the quiescent body B, weighing only two ounces, with a velocity equal to 12; then will the velocity of A, after the stroke, be 4, and that of B 16. Just the reverse of this happens when a lesser body strikes against the greater: in which case, the striking, or lesser body, will be reflected with one-fourth of its first motion, and the greater be carried forward with a motion which is as 16.

The magnitude and motions of spherical bodies perfectly elastic, and moving in the same right line, and meeting each other, being given, their motion after reflection may be determined thus: let the bodies be called A and B, and the respective velocities *a* and *b*; then, if the bodies tend the same way, and A, moving swifter than B, follows it, the velocity of the body A, after the reflection, will be $\frac{aA - aB + 2bB}{A+B}$, and that of the body B $= \frac{2aA - bA + bB}{A+B}$; but if the bodies meet, then changing the sine of *b*, the velocity of A will be $\frac{aA - aB - 2bB}{A+B}$; and that of B $= \frac{2aA + bA - bB}{A+B}$: and if either of these happen to come out negative, the motion after the stroke tends the contrary way to that of A before it; which is also to be understood of the motion of the body A in the first case.

ELATE, in botany, a genus of the Appendix Palmæ. Natural order of Palms. Essential character: male, calyx three-toothed; corolla three-petalled; anthers six, sessile. Female, calyx one-leafed; corolla three-petalled; pistil one; stigmas three; drupe one-seeded. There is but one species, *viz.* E. sylvestris, prickly leaved elate. This palm grows to the height of fourteen feet, covered with an ash-coloured crust, closely united with a hard whitish wood; pinnate leaves break out from the top of the trunk only, in a decussated order, the old ones dropping off as the young ones break forth. The flowers are concealed in stiff, green, coriaceous spathes; they are small, several on the same peduncle; petals whitish green; they have no smell, but a rough taste. The fruit is like a wild plum, with a hard woody point at top, covered with the calyx at bottom. The nut or stone is oblong, marked longitudinally with a deep furrow, containing a bitter kernel. The poorer sort of people chew the nut in the same manner as the areca nut, with the leaf of the beetle and quicklime. The elephants are very fond of the fruit branches, which are sweet. It is a native of the East Indies.

ELATER, in natural history, a genus of insects of the order Coleoptera: antennæ filiform, lodged in a groove under the head and thorax: underside of the thorax terminating in an elastic spine, placed in a cavity of the abdomen; by which means the body, when placed on the back, springs up and recovers its natural posture. This genus, which is extremely numerous, is divided into two sections, *viz.* A. feelers hatchet-shaped; and B. feelers clavate, the club round. Of the latter only three species are mentioned, but of the former two hundred at least have been enumerated. In point of size, the European species are not comparable to those which are natives of the tropical regions. Among the most remarkable may be mentioned E. flabellicornis, which is more than two inches long, and is a native of India, and of many parts of Africa. E. noctilucus, found in South America, and called there cocujas, is not so large as the last, but the spots on the thorax, like those on the abdomen of the glow-worm, are highly luminous, diffusing through the night a brilliant splendour, by which the smallest print may be read, and eight or ten of them in a phial will afford a light equal to that of a common candle. Many species of the elater are natives of our own country; but they are seldom distinguished by any brilliancy of colour, and are far inferior in size to the exotic ones. E. tesselatus, so called from the manner in which it is marked, is not uncommon in the fields during the middle of summer. The larvæ of these insects are of a slender form, and devour the roots of the grasses. That insect, so destructive to newly sown French beans, the wire-worm, is thought to be the larvæ of the E. obscurus.

ELATERIUM, in botany, a genus of the Monoecia Monandria class and order. Natural order of Cucurbitaceæ. Essential character: male, calyx none; corolla salver-shaped. Female, calyx none; corolla salver-shaped; capsule inferior, one-celled, two-valved. There are two species.

ELATINE, in botany, a genus of the Octandria Tetragynia class and order. Natural order of Inundatæ. Caryophyllæ, Jussieu. Essential character: calyx four-leaved; petals four; capsule four-celled, four-valved, flatted. There are two species. These are annual aquatic herbs, very low and spreading; the flowers axillary and small.

ELDERS, among the Jews, were persons of great age, experience, and wisdom; the denomination is known in the Presbyterian discipline. They are officers, who, with the ministers and deacons, compose the sessions of the kirk. The elder's business is to assist the minister in visiting the congregation upon occasion, to watch over the morals of the the people of his district, and to give them private reproof in case of any disorder; but if the scandal be gross, or the person obstinate, he lays the thing before the session. The elders are chosen from among the most substantial, knowing, and regular people, by the session or consistory of the kirk. There is a ruling elder in every session; he should be a man of spotless character, and of principal consideration and interest in his parish: he is chosen out of the kirk session: the congregation is to approve of the choice: the minister ordains him before the congregation: he may be chosen to assist in any church judicatory, and in all manner of government and discipline has an equal vote with the minister.

ELECTION, in law, is where a person has a choice of one or more things which happen upon several occasions; as where he has by law two remedies, and must take only one: thus, a creditor, in cases of bankruptcy, may either prove his debt under the commission, or proceed at law, but in this case he is compelled to make his election: where also a person having obtained a judgment is entitled to execution, he may either take his remedy against the goods or the person of his debtor; but if he proved against the person in the first instance, he cannot afterwards have recourse to the goods, but if he take the goods, and these should be found inadequate to his demand, he may afterwards take the body.

ELECTION *of bishops*. See BISHOPS.

ELECTION *of ecclesiastical persons*. If any person having a voice, take any reward for an election, in any church, college, school, &c. it shall be void: and if any such societies resign their places to others for reward, they incur a forfeiture of double the sum; and the party giving, and the party taking it, are thereby rendered incapable of such place. 31 Eliz. c. 6. See BISHOPS.

ELECTION *of members of Parliament*. Qualification of the candidates. A member cannot sit in parliament until twenty-one years of age; and must not be alien born; nor one of the twelve judges, who sit in the lords as attendants upon the house; but persons who have judicial places in the other courts, ecclesiastical or civil, are eligible; the clergy are not eligible, because they might sit in the convocation; nor persons attainted of treason or felony.

By the 30 Charles II. st. 2, c. 1, and 1 Geo. I. c. 13, in order to prevent papists from sitting in either house of parliament, no person shall sit or vote in either house till he hath, in the presence of the house, taken the oaths of allegiance, supremacy, and abjuration; sheriffs of counties, and mayors and bailiffs of boroughs, are not eligible in their respective jurisdictions, as being returning officers; but a sheriff of one county may be chosen knight of another.

By several statutes, no person concerned in the management of any duties or taxes, created since 1692, except the commissioners of the treasury; nor any of the officers following, *viz.* commissioners of prizes, transports, sick and wounded, wine licenses, navy and victualling; secretaries or receivers of prizes; comptrollers of the army accounts; agents for regiments; governors of plantations; officers of Minorca or Gibraltar; officers of the excise and customs; clerks or deputies in the several offices of the treasury, exchequer, navy, victualling, admiralty, pay of the army or navy, secretaries of state, salt, stamp, appeals, wine-licenses, hackney-coaches, hawkers and pedlars, nor any persons that hold any new office under the crown, created since 1705, are capable of being elected. But this shall not extend to, or exclude, the treasurer or comptroller of the navy; secretaries of the treasury; secretary to the chancellor of the exchequer; secretaries of the admiralty; under secretary of state; deputy pay-master of the army; or any person holding any office for life, or so long as he shall behave himself well in his office. 15 Geo. II. c. 22.

By 6 Anne, c. 7. s. 26, any member accepting an office of profit under the crown, except an officer of the army or navy accepting a new commission, his election shall be void: but he may be re-elected. Persons having pensions from the crown during pleasure are incapable of being elected. 6 Anne, c. 7. s. 25.

By the 22 Geo. III. c. 45, no contractor with the officers of government, or with any other person, for the service of the public, shall be elected, or sit in the house, as long as he holds any such contract, or derives any benefit from it; but this does not extend to contracts with corporations, or with companies, which then consisted of ten partners; or to any person, to whom the interest of such a contract shall accrue by marriage or operation of law, for the first twelve months; and if any person disqualified by such a contract shall sit in the house, he shall forfeit 500*l.* for every day; and if any person, who engages in a contract with governmennt, admit any member of parliament to a share of it, he shall forfeit 500*l.* to the prosecutor. No person shall sit or vote in the House of Commons for a county, unless he has an estate, freehold or copyhold, for his life, or some greater estate, of the clear yearly value of 600*l.*; nor for a city or borough, unless he have a like estate of 300*l.*; and any other candidate, or two electors, may require him to make oath thereof at the time of election, or before the day of the meeting of parliament; and before he shall vote in the House of Commons, he shall deliver in an account of his qualification, and the value thereof, under his hand, and make oath of the truth of the same; but this shall not extend to the eldest son or heir apparent of a peer, or of any person qualified to serve as knight of a shire, nor to the members of either of the two universities. 9 Anne, c. 5. 33 Geo. II. c. 20. Qualifications of electors. No person shall be admitted to vote under the age of twenty-one years: this extends to all members, as well for boroughs as counties. 7 and 8 Will. c. 25.

Every elector of a knight of a shire shall have freehold to the value of 40*s.* a year within the county, which is to be clear of all charges and deductions, except parliamentary and parochial taxes. No person shall vote in right of any freehold granted fraudulently, to qualify him to vote; and every person who shall prepare or execute such conveyance, or shall give his vote under it, shall forfeit 40*l*. 10 Anne, c. 25. No person shall vote for a knight of the shire, without having been in the actual possession of the estate for which he votes, or in the receipt of the rents or profits to his own use, above twelve calendar months, unless it come to him by descent, marriage, marriage-settlement, devise, or promotion to a benefice or office. 18 Geo. II. c. 1. No person convicted of perjury shall be capable of voting at an election. No person shall vote in respect of an annuity or rent-charge, unless registered with the clerk of the peace twelve calendar months before; such annuity or rent charge must issue out of freehold estate. No person shall vote for a knight of the shire, in respect of any messuages, lands, or tenements, which have not been charged to the land-tax six calendar months before. 20 Geo. III. c. 17. No person shall vote for any estate holden by copy of court-roll. 31 Geo. II. c. 14.

In mortgaged, or trust-estates, the mortgagor, or *cestuy que* trust, shall vote, and not the trustee or mortgagee, unless they be in actual possession. All conveyances to multiply voices, or to split votes, shall be void; and no more than one voice shall be admitted for one and the same house or tenement.

The right of election in boroughs is various, depending entirely on the several charters, customs, and constitutions of the respective places. By 2 Geo. II. c. 24, this right of voting, for the future, shall be allowed according to the last determination of the House of Commons concerning it.

And no person, claiming to vote in right of his being a freeman of a corporation (other than such as claim by birth, marriage, or servitude) shall be allowed, unless he have been admitted to his freedom twelve calendar months before, 3 Geo. III. c. 15. All undue influence whatever upon the electors is illegal, and strongly prohibited. As soon as the time and place of election within counties or boroughs are fixed, all soldiers quartered in the place are to remove, at least one day before the election, to the distance of two miles or more, and not to return till one day after the poll be ended; except in the liberty of Westminster, or other residence of the royal family, in respect of his Majesty's guards, and in fortified places. 8 Geo. II. c. 30. By the 7th and 8th Will. c. 4. to prevent bribery and corruption, no candidate, after teste of the writ of summons, or after a place becomes vacant in parliament time, shall, by himself, or by any other ways or means on his behalf, or at his charge, before his election, directly or indirectly, give, or promise to give, to any elector, any money, meat, drink, provision, present, reward, or entertainment, to or for any such elector in particular, or to any county, city, town, borough, port, or place in general, in order to his being elected, on pain of being incapacitated. To guard still more against gross and flagrant acts of bribery, it is enacted by 2 Geo. II. c. 24, explained and enlarged by 9 Geo. II. c. 38, and 16 Geo. III. c. 11, that if any money, gift, office, employment, or reward, be given, or promised to be given, to any voter, at any time, in order to influence him to give or withhold his vote, as well he that takes, as he that offers, such a bribe, forfeits 500*l*. and is for ever disabled from voting and holding any office in any corporation, unless, before conviction, he will discover some other offender of the same kind, and then he is indemnified for his own offence.

If the election shall not be determined upon view, with consent of the freeholders there present, but a poll shall be demanded, the same shall commence on the day on which such demand is made, or on the next day at farthest (if it be not Sunday, and then on the day after) and shall be proceeded in from day to day (Sundays excepted) until finished, and shall not continue more than fifteen days (Sundays excepted); and the poll shall be kept open seven hours at least each day, between eight in the morning and eight in the evening, 25 Geo. III. c. 84. The sheriff shall allow a cheque-book for every poll-book for each candidate, to be kept by their inspectors at the place of taking the poll, 19 Geo. II. c. 28. By the 34 Geo. III. c. 73, in order to expedite the business at elections, the returning officers are enabled, on request of the candidates, to appoint persons to administer to voters the oaths of allegiauce, supremacy, the declaration of fidelity, the oath of adjuration, and the declaration or affirmation of the effect thereof, previously to their coming to vote; and to grant the voters certificates of their having taken the said oath; without which certificate they shall not be permitted to vote, if they are required to take the oaths.

Every freeholder, before he shall be admitted to poll for a knight of the shire, shall, if required by a candidate or any elector, make oath of his qualification to vote; in which case the sheriff and clerks shall enter the place of his freehold, and the place of his abode, as he shall disclose the same at the time of giving his vote; and shall enter *jurat* against the name of every such voter who shall have taken the oath, 10 Anne, c. 23. s. 5. After the election, the names of the persons chosen shall be written in an indenture, under the seals of the electors, and tacked to the writ.

The election being closed, the returning officer in boroughs returns his precept to the sheriff, with the persons elected by the majority. And the sheriff returns the whole, together with the writ for the county, and the names of the knights elected thereupon, to the clerk of the crown in Chancery, before the day of meeting, if it be a new parliament; or within fourteen days after the election, if it be an occasional vacancy; and this under the penalty of 500*l.* If the sheriff do not return such knights only as are duly elected, he forfeits, by stat. Henry VI. 100*l.* and the returning officer of a borough for a like false return 40*l.* and by the late statutes they are liable to an action at the suit of the party duly elected, and to pay double damages, and the like remedy shall be against an officer making a double return. If two or more sets of electors make each a return of a different member (which is called a double election) that return only, which is signed and sealed by the returning officer to whom the sheriff's precept was directed, is good; and the members by him returned shall sit, until displaced on petition. On petition to the House of Commons, complaining of an undue election, forty-nine members shall be chosen by ballot, out of whom each party shall alternately strike out one, till they are reduced to thirteen, who, together with two more, of whom each party shall nominate one, and who are called the nominees, shall be a select committee for determining such controverted election, 10 and 11 Geo. III. c. 16 and 42. See Parliament.

Election, is a term frequently used in mathematics, to signify the several different ways of taking any number of things proposed, either separately, or as combined in pairs, in threes, in fours, &c.; not as to the order, but only as to the number and variety of them. Thus, of the things *a, b, c, d,* &c. the elections of

$$\left.\begin{array}{l}\text{One thing}\\ \text{Two things}\\ \text{Three things}\end{array}\right\}\text{ are }\left\{\begin{array}{l}(a)\ 1=2^1-1\\ (a, b, ab)\ 3=2^2-1\\ (a, b, c, ab, ac, bc, abc)\ 7=2^3-1\end{array}\right.$$

And generally of any number n, all the elections are $2n-1$; that is, one less than the power of 2, whose exponent is n; the number of single things to be chosen, either separately, or in combinations, thus, when $n=12$, the answer is $2^{12}-1=4096-1=4095$.

ELECTIVE *attraction*. The attractions which take place in the chemical operations of art and nature are, for the most part, effected under circumstances of such complexity, that it is extremely difficult to deduce the general laws by which they are governed, or even the particular habitudes of the bodies so acted upon. In general it appears to us, from the facts, that some among the bodies upon which we make our experiments are attracted by each other, and enter into combination, while others seem to have no disposition to form this union, (See Chemistry) and from this principal observation the attractions of chemistry have been called elective attractions, or elective affinities. See Attraction.

The phenomena of attraction, as distinguished under the heads of simple elective attraction, and double or more complex elective attraction, have been sketched under our article Chemistry. It is clear, that no results of this nature can be foretold, or indicated, unless the order and energy of the powers of bodies upon each other be first known. Geoffroy, in his table of simple elective attractions, first led the way in this research; and he was followed by Bergman, who greatly improved both the tables and the method of philosophizing, in his treatise on the elective attractions; and, lastly, that most perspicuous chemist, Berthollet, has pursued the subject to a much greater extent, in his "Statique Chimique," of which we have an indifferent translation by Lambert.

We have, at the article last quoted, made mention of the variations in results of combination arising from the proportion of the principles, the influence of solvents, of cohesion, of elasticity, of efflorescence, and from the compounded nature of the principles themselves, the state of saturation, the effect of heat, &c. These variable considerations must necessarily render all tables of the effects of attraction inapplicable, excepting with allowances; but they may nevertheless be considered as exhibiting very valuable summaries of facts. A like uncertainty must be considered as belonging to all numerical or other inferences of the relative energies of the elective attractions; for determining which, it must be confessed, our means are far from being adequate, even if we were fully acquainted with the disturbances, to which it is probable they are subject from the Galvanic action. See Galvanism.

Tables I. to VI. contain in substance the two tables of Attractiones Electivæ Simplices, placed at the end of Bergman's treatise upon elective attractions, with such corrections and additions as subsequent discoveries have rendered necessary. These tables require no other explanation, than that the substances enumerated are considered to be simple, as far as relates to the facts exhibited in these sketches. The order of position denotes, that the higher any substance stands in any column, the stronger is its elective attraction to the substance at the head of that column. The under part of each table exhibits the attractions in the dry way, and must be considered as entirely distinct from the upper part.

ELECTIVE ATTRACTION.

TABLE I. SIMPLE ELECTIVE ATTRACTIONS.

ACIDS.

IN THE HUMID WAY.

Sulphuric Acid.	Sulphurous Acid.	Nitric Acid.	Boracic Acid.	Succinic Acid.	Acetous Acid.
Barytes	Barytes	Potash	Lime	Barytes	Barytes
Strontian	Lime	Soda	Barytes	Lime	Potash
Potash	Potash	Barytes	Strontian	Potash	Soda
Soda	Soda	Strontian	Magnesia	Soda	Strontian?
Lime	Strontian	Lime	Potash	Ammonia	Lime
Magnesia	Magnesia	Magnesia	Soda	Magnesia	Ammonia
Ammonia	Ammonia	Glucine	Ammonia	Alumine	Magnesia
Glucine	Glucine	Yttria	Glucine	Metallic oxides	Metallic oxides
Yttria	Alumine	Alumine	Alumine	Water	Glucine
Alumine	Zircon	Zircon	Zircon	Alcohol	Alumine
Zircon	Metallic oxides	Metallic oxides	Metallic oxides		Zircon
Metallic oxides		Water	Water		Water
Water		Alcohol	Alcohol		Alcohol
Alcohol					
	N. B. The carbonic acid follows the same order in the humid way.	N. B. The muriatic, oxy-muriatic, and nitro-muriatic follow the same order.	N. B. The oxalic, tartarous, sebacic, phosphoric, & arsenic, follow the same order: so do the fluoric and tungstic, substituting silex for metallic oxides.	N. B. The citric and benzoic follow the same order, except that lime should come before barytes, and for the citric, Zircon should be added after alumine.	

Camphoric Acid.
Lime
Potash
Soda
Barytes
Ammonia
Alumine
Magnesia

Prussic Acid.
Potash
Soda
Ammonia
Lime
Barytes
Strontian
Magnesia
Alumine
Metallic oxides
Water
Alcohol

Molybdic Acid.
Sulphur?
Potash
Soda
The earths
Metallic oxides

Chromic Acid.
Fixed alkalies
Oxide of lead
Oxide of copper

IN THE DRY WAY.

Sulphuric Acid.	Sulphurous Acid.	Nitric Acid.	Boracic Acid.
Potash		Barytes	Lime
Soda		Strontian	Barytes
Barytes		Potash	Strontian
Strontian		Soda	Magnesia
Lime		Lime	Potash
Magnesia		Magnesia	Soda
Zircon		Metallic oxides	Metallic oxides
Metallic oxides		Ammonia	Ammonia
Ammonia		Alumine	Alumine
Alumine			
		N. B. The muriatic, oxy-muriatic, nitro-muriatic, and acetous, follow the same order in the dry way.	N. B. The fluoric, benzoic, sebacic, phosphoric, & arsenic, follow the same order in the dry way.

ELECTIVE ATTRACTION.

TABLE II. SIMPLE ELECTIVE ATTRACTIONS.

ALKALIES AND EARTHS.

IN THE HUMID WAY.

Potash.	Barytes.	Strontian.	Lime.	Magnesia.	Alumine.	Silex.
Acids, sulphuric	Acids, sulphuric	Acids, sulphuric	Acids, oxalic	Acids, oxalic	Acids, sulphuric	Fluoric acid
nitric	oxalic	phosphoric	sulphuric	phosphoric	nitric	Potash
muriatic	succinic	oxalic	tartarous	sulphuric	muriatic	Soda
sebacic	fluoric	tartarous	succinic	fluoric	oxalic	Barytes
fluoric	phosphoric	fluoric	phosphoric	sebacic	arsenic	Strontian
phosphoric	mucous	nitric	mucous	arsenic	fluoric	
oxalic	molybdic	muriatic	nitric	mucous	tartarous	
tartarous	nitric	succinic	muriatic	succinic	succinic	
arsenic	muriatic	acetous	sebacic	nitric	mucous	
succinic	sebacic	arsenic	suberic	muriatic	citric	
citric	suberic	boracic	fluoric	tartarous	phosphoric	
benzoic	citric	carbonic	arsenic	citric	benzoic	
acetous	tartarous	Water	citric	malic	acetous	
mucous	arsenic	Fat oils	malic	benzoic	boracic	
boracic	benzoic	Sulphur	benzoic	acetous	sulphurous	
sulphurous	acetous	Sulphuretted hydrogen	acetous	boracic	nitrous	
nitrous	boracic		boracic	sulphurous	carbonic	
carbonic	sulphurous		sulphurous	nitrous	prussic	
prussic	nitrous		nitrous	carbonic		
Water	carbonic		molybdic	prussic		
Fat oils	prussic		carbonic	Sulphur		
Sulphur	Water		lithic			
Metallic oxides	Fat oils		prussic			
Soda and ammonia follow the same order, both in the humid and dry way, except that with ammonia the sulphuric acid comes first in both.	Sulphur		Water			
	Sulphuretted hydrogen		Fat oils			
	Phosphorus		Sulphur			
			Phosphorus			

(*The DRY WAY on next page.*)

TABLE II. (CONTINUED.)

CONTINUATION OF TABLE II.

IN THE DRY WAY.

Potash.	Barytes.	Strontian.	Lime.	Magnesia.	Alumine.	Silex.
Acids, phosphoric	Acids, phosphoric		As barytes	As barytes	As barytes	Potash
boracic	boracic					Soda
arsenic	arsenic					Phosphoric acid
sulphuric	sulphuric					Oxide of lead
nitric	nitric					
muriatic	muriatic					
sebacic	fluoric					
fluoric	sebacic					
succinic	succinic					
benzoic	benzoic					
acetous	acetous					
Barytes	Fixed alkalies					
Lime	Sulphur					
Magnesia	Oxide of lead					
Alumine						
Silex						
Sulphur						

ELECTIVE ATTRACTION.

TABLE III. SIMPLE ELECTIVE ATTRACTIONS.

WATER AND COMBUSTIBLE SUBSTANCES.

IN THE HUMID WAY.

Water.	Sulphur.	Saline Sulphurets.	Alcohol.	Ether.
Potash	Oxygen	Oxygen	Water	Alcohol
Soda	Molybdic oxide and acid	Oxide of gold	Ether	Volatile oils
Ammonia	Oxide of lead	silver	Volatile oils	Water
Deliquescent salts	tin	mercury	Ammonia	Sulphur
Alcohol	silver	arsenic	Fixed alkali	
Carbonate of ammonia	mercury	antimony	Alkaline sulphurets	
Ether	arsenic	bismuth	Sulphur	
Sulphuric acid	antimony	copper	Muriats	
Non deliquescent salts	iron	tin	Phosphoric acids	
	Potash	lead		
	Soda	nickel		
	Barytes	cobalt		
	Strontian	manganese		
	Lime	iron		
	Magnesia	Other metallic oxides		
	Phosphorus	Carbon		
	Fat oils	Water		
	Ammonia	Alcohol		
	Ether	Ether		
	Hydrogen ?			

Fat oils.	Volatile oils.
Barytes ?	Ether
Strontian ?	Alcohol
Lime	Fat oils
Metallic oxides	Fixed alkalies
Ether	Sulphur
Volatile oils	Phosphorus
Fixed alkalies	
Ammonia	
Sulphur	
Phosphorus	

IN THE DRY WAY.

Sulphur.	Saline Sulphurets.
Oxygen	Manganese
Potash	Iron
Soda	Copper
Iron	Tin
Copper	Lead
Tin	Silver
Lead	Gold
Silver	Antimony
Cobalt	Cobalt
Nickel	Nickel
Bismuth	Bismuth
Antimony	Mercury
Mercury	Arsenic
Arsenic	Carbon ?
Uranium ?	
Molybdena	
Tillurium	

TABLE IV. SIMPLE ELECTIVE ATTRACTIONS.

OXYGEN AND METALS.

IN THE HUMID WAY.

Oxygen.	Oxide of Gold.	Oxide of Silver.	Oxide of Platina.	Oxide of Mercury.	Oxide of Lead.
Bases of the muriatic and other undecomposed acids	Acids, gallic	Acids, gallic	Acids, gallic	Acids, sebacic	Acids, gallic
Carbon	muriatic	muriatic	muriatic	gallic	sulphuric
Phosphorus	nitric	sebacic	nitric	muriatic	sebacic
Hydrogen ?	sulphuric	oxalic	sulphuric	oxalic	mucic
Sulphur	arsenic	sulphuric	arsenic	succinic	oxalic
Zinc	fluoric	mucous	fluoric	phosphoric	arsenic
Copper	tartarous	phosphoric	tartarous	sulphuric	tartarous
Lead	phosphoric	sulphurous	phosphoric	mucous	phosphoric
Iron	acetous	nitric	sebacic	tartarous	muriatic
Silver	sebacic	arsenic	oxalic	citric	sulphurous
Platina	prussic	fluoric	citric	malic	suberic
Mercury	Fixed alkalies	tartarous	acetous	sulphurous	nitric
Gold	Ammonia	citric	succinic	nitric	fluoric
Nitrous oxide	Sulphureted hydrogen	succinic	prussic	fluoric	citric
Muriatic acid		acetous	carbonic	acetous	malic
Nitrous acid		prussic	Ammonia	benzoic	succinic
Sulphurous acid		carbonic		boracic	acetous
White oxide of manganese		Ammonia		prussic	benzoic
Volatile oils				carbonic	boracic
Alcohol				Ammonia	prussic
					carbonic
					Fixed alkalies
					Fat oils
					Ammonia

IN THE DRY WAY.

	Gold.	Silver.	Platina.	Mercury.	Lead.
Carbon	Mercury	Lead	Arsenic	Gold	Gold
Zinc	Copper	Copper	Gold	Silver	Silver
Iron	Silver	Mercury	Copper	Platina	Copper
Hydrogen	Lead	Bismuth	Tin	Lead	Mercury
Manganese	Bismuth	Tin	Bismuth	Tin	Bismuth
Cobalt	Tin	Gold	Zinc	Zinc	Tin
Nickel	Antimony	Antimony	Antimony	Bismuth	Antimony
Lead	Iron	Iron	Nickel	Copper	Platina
Tin	Platina	Manganese	Cobalt	Antimony	Arsenic
Phosphorus	Zinc	Zinc	Manganese	Arsenic	Zinc
Copper	Nickel	Arsenic	Iron	Iron	Nickel
Bismuth	Arsenic	Nickel	Lead	Alkaline sulphurets	Iron
Antimony	Cobalt	Platina	Silver	Sulphur	Alkaline sulphurets
Mercury at 600°	Manganese	Alkaline sulphurets	Mercury		Sulphur
Arsenic	Alkaline sulphurets		Alkaline sulphurets		
Sugar					
Sulphur					
Gold					
Silver					
Platina					
Mercury at upwards of 1000°					
White oxide of manganese					

ELECTIVE ATTRACTION.

TABLE V. SIMPLE ELECTIVE ATTRACTIONS.

METALS (Continued.)

IN THE HUMID WAY.

Oxide of Copper.	Oxide of Iron.	Oxide of Tin.	Oxide of Bismuth.	Oxide of Nickel.	Oxide of Arsenic.
Acids, gallic	Acids, gallic	Acids, gallic	Acids, oxalic	Acids, oxalic	Acids, gallic
oxalic	oxalic	sebacic	arsenic	muriatic	muriatic
tartarous	tartarous	tartarous	tartarous	sulphuric	oxalic
muriatic	camphoric	muriatic	phosphoric	tartarous	sulphuric
sulphuric	sulphuric	sulphuric	sulphuric	nitric	nitric
mucous	mucous	oxalic	sebacic	sebacic	sebacic
nitric	muriatic	arsenic	muriatic	phosphoric	tartarous
sebacic	nitric	phosphoric	nitric	fluoric	phosphoric
arsenic	sebacic	nitric	fluoric	mucous	fluoric
phosphoric	phosphoric	succinic	mucous	succinic	mucous
succinic	arsenic	fluoric	succinic	citric	succinic
fluoric	fluoric	mucous	citric	acetous	citric
citric	succinic	citric	acetous	arsenic	arsenic
acetous	citric	acetous	prussic	boracic	acetous
boracic	acetous	boracic	carbonic	prussic	prussic
prussic	boracic	prussic	Ammonia	carbonic	Fixed alkalies
carbonic	prussic	Potash		Ammonia	Ammonia
Potash	carbonic	Soda			Fat oils
Soda		Ammonia			Water
Ammonia					
Compound salts.					
Fat oils					

IN THE DRY WAY.

Copper.	Iron.	Tin.	Bismuth.	Nickel.	Arsenic.
Gold	Nickel	Zinc	Lead	Iron	Nickel
Silver	Cobalt	Mercury	Silver	Cobalt	Cobalt
Iron	Manganese	Copper	Gold	Arsenic	Copper
Arsenic	Arsenic	Antimony	Mercury	Copper	Iron
Manganese	Copper	Gold	Antimony	Gold	Silver
Zinc	Gold	Silver	Tin	Tin	Tin
Antimony	Silver	Lead	Copper	Antimony	Lead
Platina	Tin	Iron	Platina	Platina	Gold
Tin	Antimony	Manganese	Nickel	Bismuth	Platina
Lead	Platina	Nickel	Iron	Lead	Zinc
Nickel	Bismuth	Arsenic	Zinc	Silver	Antimony
Bismuth	Lead	Platina	Alkaline sulphurets	Zinc	Alkaline sulphurets
Cobalt	Alkaline sulphurets	Bismuth	Sulphur	Alkaline sulphurets	Sulphur
Mercury	Sulphur	Cobalt		Sulphur	
Alkaline sulphurets		Alkaline sulphurets			
Sulphur		Sulphur			

ELECTIVE ATTRACTION.

TABLE VI. SIMPLE ELECTIVE ATTRACTIONS.

METALS (Concluded.)

IN THE HUMID WAY.

Oxide of Cobalt.	Oxide of Zinc.	Oxide of Antimony.	Oxide of Manganese.	Oxide of Tellurium.	Oxide of Titanium.	Oxide of Uranium.
Acids, oxalic	Acids, gallic	Acids, gallic	Acids, oxalic	Acids, nitric	Acids, sulphuric	Acids, sulphuric
muriatic	oxalic	sebacic	tartarous	nitro-muriatic	nitric	nitro-muriatic
sulphuric	sulphuric	muriatic	citric	sulphuric	muriatic	muriatic
tartarous	muriatic	benzoic	fluoric	Sulphur	prussic	nitric
nitric	mucous	oxalic	phosphoric	Alkalies		phosphoric
sebacic	nitric	sulphuric	nitric	Mercury		acetous
phosphoric	sebacic	nitric	sulphuric			gallic
fluoric	tartarous	tartarous	muriatic			prussic
mucous	phosphoric	mucous	sebacic			carbonic
succinic	citric	phosphoric	arsenic			Sulphur
citric	succinic	citric	acetous			
acetous	fluoric	succinic	prussic			
arsenic	arsenic	fluoric	carbonic			
boracic	acetous	arsenic				
prussic	boracic	acetous				
carbonic	prussic	boracic				
Ammonia	carbonic	prussic				
	Fixed alkalies	carbonic				
	Ammonia	Sulphur				
		Fixed alkalies				
		Ammonia				

IN THE DRY WAY.

Cobalt.	Zinc.	Antimony.	Manganese.	Tellurium.
Iron	Copper	Iron	Copper	Mercury
Nickel	Antimony	Copper	Iron	Sulphur
Arsenic	Tin	Tin	Gold	
Copper	Mercury	Lead	Silver	
Gold	Silver	Nickel	Tin	
Platina	Gold	Silver	Alkaline sulphurets	
Tin	Cobalt	Bismuth		
Antimony	Arsenic	Zinc		
Zinc	Platina	Gold		
Alkaline sulphurets	Bismuth	Platina		
Sulphur	Lead	Mercury		
	Nickel	Arsenic		
	Iron	Cobalt		
		Alkaline sulphurets		
		Sulphur		

In the expression of compound affinities, the sketches must either be made from actual experiment in every instance, or by deduction from the numerical expressions of the forces of attraction. Some of the difficulties of effecting this have been mentioned in the present article; but as a conjectural set of numbers, inferred from such facts as we possess, may be useful, in many instances, to point out the probability of decompositions previously to trial, Guyton Morveau's table of the numerical expression of affinity between the alkalies and soluble earths, and the five principal acids, is here inserted.

TABLE VII. NUMERICAL EXPRESSION OF AFFINITIES.

BY GUYTON MORVEAU.

	Sulphuric acid.	Nitric acid.	Muriatic acid.	Acetic acid.	Carbonic acid.
Barytes. . .	66	62	36	28	14
Potash . . .	62	58	32	26	9
Soda	58	50	31	25	8
Lime	54	44	23	19	12
Ammonia. .	46	38	21	20	4
Magnesia . .	50	40	22	17	6
Alumine . .	40	36	18	15	2

The method of exhibiting simple or compound affinities by symbols, according to Bergman, consists in placing those substances which are applied to each other upon the same horizontal line of direction; the component parts of the substances being placed at the two extremities of a vertical bracket; and the new products, if any, are placed one above the other, at the middle part of a horizontal bracket, connecting their component principles. This will be rendered clearer by an example.

1. Suppose magnesia to be presented to a solution of sulphat of potash, it will be found that no decomposition takes place. These facts are expressed as follows:

Sulphat of potash { Potash
Sulphuric acid   Magnesia.

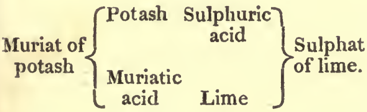
In the above scheme, the sulphat of potash is placed opposite the point of a vertical bracket; and its two component parts, potash and sulphuric acid, are placed within the extremities of the same bracket. Horizontally opposite the sulphuric acid is placed magnesia, to denote that it is presented to that acid. And as these two substances are not connected by a bracket, it is to be understood, from the scheme, that they do not unite, and consequently that the sulphat of potash remains undecomposed.

II. On the contrary, if, to a solution of sulphat of magnesia, potash be added, a decomposition will ensue, which is expressed as follows:

Sulphat of magnesia { Magnesia
Sulphuric acid   Potash
Sulphat of potash

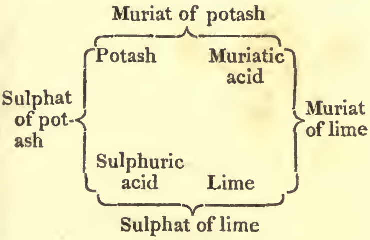
The arrangements in this scheme depend on the same principles as those of the foregoing: but the bracket underneath the sulphuric acid and potash denotes, that these two substances unite, and form sulphat of potash, which is accordingly placed beneath the middle of the bracket. The point of the bracket being turned up, is made to denote, that the compound remains suspended, or in solution. The magnesia is of course disengaged: and half a bracket, with the point downward, is placed over it, to denote, that it falls to the bottom, or is precipitated.

III. The above instances exhibit simple elective attractions: but this method is more particularly applicable to the compound attractions. For example: Suppose a solution of the muriat of potash be added to sulphat of lime, no decomposition will take place. This is expressed as under:



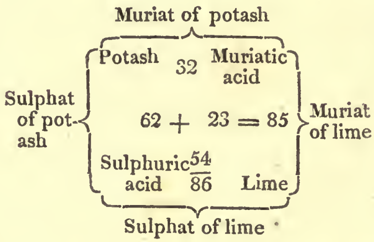
The want of horizontal brackets in this scheme denotes, that the principles presented to each other do not unite, and, consequently, that no decomposition ensues.

IV. On the contrary, if sulphat of potash be presented to the muriat of lime, a mutual decomposition will ensue. Thus,



In this scheme we see, that the principles presented to each other do unite, as is shewn by the horizontal brackets, and form the new compounds, muriat of potash and sulphat of lime; the former of which remains in solution, as is shown by its bracket being turned upward; while the latter, being nearly insoluble, falls down, and is accordingly denoted by a bracket, the point of which is turned downward.

V. By attentively observing this last scheme, it may be seen, that the attractions exerted between the simple substances which are placed over each other are the quiescent affinities, and tend to preserve the original combinations; whereas the attractions between the simple substances which stand opposite to each other are the divellent affinities, and tend to produce new combinations. If we could determine numerically the simple attractions, it is evident, that we might foretel every result which might be produced by the application of compound substances to each other, under like substances; as may be shewn by applying Morveau's numbers to the preceding scheme.



The attraction between the potash and sulphuric acid is expressed by the number 62: and the attraction between the muriatic acid and lime is expressed by the number 23. These are the quiescent affinities, and their sum 85 expresses the tendency to preserve the original forms of sulphat of potash and muriat of lime. On the other hand, the attraction between the potash and muriatic acid is expressed by 32, and the attraction between sulphuric acid and lime by 54. The sum of 32 and 54 amounts to 86, and expresses the divellent affinities, which tend to produce new combinations. And as this last sum exceeds the sum of the quiescent affinities, it follows, that the double decomposition will take place.

VI. These examples have designedly been taken the reverse of each other; but every instance, singly exhibited, does in fact point out both the affirmative and the negative propositions. Thus, from the facts first exhibited, that magnesia does not decompose the combination of potash and sulphuric acid, it likewise follows, that potash does compose the combination of sulphuric acid and magnesia. And accordingly, in the last two schemes of double affinity, it is clearly ascertained, from the mutual decomposition of sulphat of potash and muriat of lime, that the muriat of potash and sulphat of lime will not decompose each other.

The same horizontal bracket, which, in the humid way, was used to denote solution, is used to denote sublimation in experiments in the dry way.

The following schemes from Bergman will require no explanation, after the instances we have exhibited.

ELECTIVE ATTRACTION.

SCHEMES OF ELECTIVE ATTRACTIONS IN THE HUMID WAY.

I.

Sulphat of potash { Potash — 62 — Sulphuric acid } 66 Barytes

Sulphate of barytes

II.

Sulphat of potash { Potash — 62 — Sulphuric acid } 34 Lime

III.

Muriat of soda { Soda — 31 — Muriatic acid } 32 Potash

Muriat of potash

IV.

Muriat of lime { Lime — 23 — Muriatic acid } 31 Soda

Muriat of Soda

V.

Muriat of lime { Lime — 23 — Muriatic acid } 21 Ammonia

VI.

Sulphat of potash

Sulphat of Magnesia { Sulphuric acid 62 Potash — 50 — Magnesia }

Muriat of Potash

VII.

Muriat of Mercury { Muriatic acid 32 potash — Oxide of Mercury }

Sulphat of lime

VII.

Sulphat of iron { Sulphuric acid 54 Lime — Oxide of iron }

Sulphat of potash with excess of acid

IX.

Sulphat of potash { Sulphuric acid — ☝ Potash ☞ } Nitric acid

Nitre

Sulphat of potash with excess of acid

X.

Sulphat of potash { Sulphuric acid — ☝ Potash ☞ } Tartarous acid

ELECTIVE ATTRACTION.

XI.
Muriat of potash
- Muriatic acid
- Potash ☞ Tartarous acid

Nitrat of Soda

XII.
Muriat of soda
- Muriatic acid
- 31
- Soda

Tartarous acid

XIII.
Borat of soda
- Soda 50 Nitric acid
- Boracic acid

XIV.
Sulphat of lime
- Sulphuric acid
- 54
- Lime Oxalic acid

XV.
Sulphat of magnesia
- Sulphuric acid
- 50
- Magnesia Fluoric acid

XVI.
Nitrat of lime
- Nitric acid
- 44
- Lime 54 Sulphuric acid

Sulphat of lime

XVII.
Arsenious acid
- Oxygen
- Arsenic
- Muriatic acid
- Oxygen

Oxygenated muriatic acid

Arsenic acid

Acetit of potash

XVIII.
Sulphuret of potash
- Potash 26 Acetous acid
- Sulphur

Muriat of potash

Sulphat of lime

XIX.
Sulphuret of lime
- Lime . 54 Sulphuric acid
- Sulphur

Nitre

XX.
Sulphat of potash
- Potash 32 Muriatic acid
- 62 + 23=85
- Sulphuric acid $\frac{24}{56}$ Lime

Muriat of lime

Sulphat of lime

XXI.
Sulphat of potash
- Potash 58 Nitric acid
- 62
- Sulphuric acid Oxide of lead

Nitrat of lead

Sulphat of lead

XXII.
Muriat of potash
- Potash 32 Sulphuric acid
- 32 + 54=85
- Muriatic acid $\frac{23}{85}$ Lime

Sulphat of lime

ELECTIVE ATTRACTION.

XXIII.

Nitrat of ammonia

Sulphat of ammonia	Ammonia 38	Nitric acid	Nitrat of mercury
	40		
	Sulphuric acid	Oxide of mercury	

Sulphat of mercury

XXIV.

Nitrat of soda

Common salt	Soda	Nitric acid	Nitrat of silver
	Muriatic acid	Silver	

Muriat of silver

XXV.

Nitre

Acidulous tartrit of potash	Potash	Nitric acid	Nitrat of mercury
	Tartarous acid	Oxide of mercury	

Tartrit of mercury

XXVI.

Nitrat of soda

Borax	Soda	Nitric acid	Nitrat of mercury
	Boracic acid	Oxide of mercury	

Borat of mercury

XXVII.

Acetit of magnesia

Muriat of magnesia	Magnesia	Acetous acid	Acetit of silver
	Muriatic acid	Silver	

Muriat of silver

XXVIII.

Sulphat of lead

Sulphat of silver	Sulphuric acid	Lead	Muriat of lead
	Silver	Muriatic acid	

Muriat of silver

XXIX.

Nitrat of copper

Nitrat of silver	Nitric acid	Copper	Muriat of copper
	Silver	Muriatic acid	

Muriat of silver

XXX.

Muriat of potash

Common salt	Muriatic acid	Potash	Carbonat of potash
	Soda	Carbonic acid	

Carbonat of Soda

XXXI.

Muriat of potash

Muriat of mercury	Muriatic acid	Potash	Carbonat of potash
	Oxide of mercury	Carbonic acid	

Carbonat of mercury

XXXII.

Nitrat of Soda

Nitrat of lead	Nitric acid	Soda	Carbonat of soda
	Oxide of lead	Carbonic acid	

Carbonat of lead

XXXIII.

Carbonat of Magnesia

Sulphat of magnesia	Magnesia	Carbonic acid	Carbonat of soda
	Sulphuric acid	Soda	

Sulphat of Soda

XXXIV.

Muriat of ammonia

Muriat of lime	Muriatic acid	Ammonia	Carbonat of ammonia
	Lime	Carbonic acid	

Carbonat of lime

XXXV.

Alcohol of potash	Alcohol	Ammonia	Carbonat of ammonia
	Potash	Carbonic acid	

Carbonat of potash

XXXVI.

Nitrat of copper

Nitrat of silver	Nitric acid, Oxygen	Copper
	Silver	

XXXVII.

Sulphat of iron

Sulphat of copper	Sulphuric acid, Oxygen	Iron
	Copper	

XXXVIII.

Sulphuret of potash or soda	Sulphur	Lead	Acetat of lead
	Potash or soda	Acetous acid	

Acetat of potash or soda

XXXIX.

Nitre

Solution of oxide of tungsten in potash	Potash	Nitric acid	Nitric acid
	Potash, Oxide of tungsten	Nitric acid	

Oxide of tungsten

SCHEMES OF ELECTIVE ATTRACTIONS IN THE DRY WAY.

ELECTIVE ATTRACTION.

11.

Fluat of lime: Lime, Fluoric acid

Potash

12.

Alloy of gold with silver: Silver, Gold

Sulphur

13.

Sulphuret of lead: Sulphur, Lead

Iron

14.

Combination of silver with sulphuret of alkali: Alkali, Sulphur, Silver

Copper

15.

Common salt: Muriatic acid, Soda

Arsenic

16.

Corrosive muriat of mercury: Mercury, Oxygen, Muriatic acid

Antimony

Muriat of antimony

17.

Sulphat of ammonia

Sulphat of potash: Sulphuric acid, Potash

Ammonia, Arsenic acid: Arseniat of ammonia

Arseniat of potash

18.

Nitrat of ammonia

Nitre: Nitric acid, Potash

Ammonia, Sulphuric acid: Sulphat of ammonia

Sulphat of potash

19.

Corrosive muriat of mercury

Common salt: Muriatic acid, Soda

Mercury, Oxygen, Sulphuric acid: Sulphat of mercury

Sulphat of Soda

20.

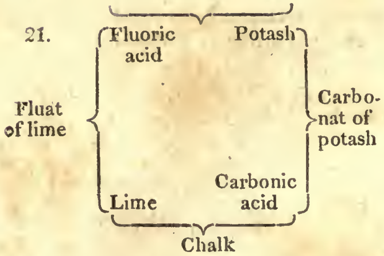
Carbonat of ammonia

Muriat of ammonia: Ammonia, Muriatic acid

Carbonic acid, Lime: Carbonat of lime

Muriat of lime

21.



22.

ELECTRICITY. The word electricity denotes a peculiar state, of which all bodies are susceptible, and which is supposed to depend upon the presence of a substance called the electric fluid. Some of its phenomena were known to the ancients, particularly those attractions and repulsions which a piece of amber, after being rubbed, exhibits, with regard to hairs, feathers, and other small bodies; and the name electricity is derived from the Greek word denoting amber.

This subject is so far from being well understood, even at present, that there is some difficulty even in classing the facts. They may, however, be stated as follows: A body in an electric state attracts other bodies, and these become electric by touching it, and are afterwards repelled. Bodies are capable of being electrified more or less strongly; and when the electric state is considerably strong, the electrified body will throw out luminous sparks or flashes, to other bodies brought near it, and by that means communicate the same electric state to them, without actual contact.

The means by which bodies are rendered electric are so various, that it may be asserted, perhaps without exception, that every change, whether mechanical or chemical, which can take place in them, will at the same time produce electricity, or alter their electric state. When one body is applied to another, and they are afterwards separated; or if they be rubbed together; or if their parts be torn asunder; or if they be heated; or cooled; or evaporated; or congealed; or fused; or if any chemical combination be made to take place between them;—the signs of electricity become manifest, though with differences of intensity dependant on the nature of the bodies, as well as of the processes and the circumstances; some of which have been so far classed as to take the form of science, while others remain to be developed by new researches.

When the electric state is communicated from one body to another, very striking differences are observed in its effects. Some bodies become electrified only in those parts which are near the place of communication, and the electric state is considerably permanent; other bodies transmit the electric energy from part to part with great rapidity and facility. The former of these have been called non-conductors, and the latter conductors of electricity. From the properties here described, it will easily be understood, that a non-conductor cannot be made to exhibit the electric state for any perceptible portion of time, unless it be supported by a non-conductor. In this situation it is said to be insulated.

The state of electricity which is produced by chemical changes in bodies has, within a few late years, greatly engaged the attention of the philosophical world, under the denomination of GALVANISM; which see.

It does not appear that the property of conducting electricity depends altogether on the nature or component parts of the conductors themselves, but rather on their state with regard to heat. Glass, resin, baked wood, atmospheric air, and many other bodies, which are non-conductors in the ordinary temperature of the atmosphere, become conductors when very hot; and on the contrary, ice, cooled to 13° below 0 on Fahrenheit's scale, has all the properties of non-conductors. If we might generalize these facts, analogy would lead us to an induction, that, as the freezing points of bodies differ so greatly among each other, and in some, as in alcohol and the gases, it can only be admitted by supposition,—so there may be in all bodies some temperature peculiar to each, below which its power of conducting electricity may be insensible.

Conductors of electricity at the usual temperature of the atmosphere are, metals, charcoal, water, and very rare air; non-conductors are, glass, gems, resins, amber, sulphur, silk, very dry wood oils, dry air of the usual density, and the barometrical vacuum.

Electricity, or the cause of electric phenomena, is admitted by all philosophers to consist in some peculiar matter, capable of being transmitted from place to place through conducting bodies. The most usual method of producing a strong electric state consists in rubbing a conducting body against a non-conductor, such, for example, as the hand, or a leather cushion, against a tube or cylinder of glass; for the conditions of which see Excitation. The surface of the glass thus becomes electrified, and will afford the electric state by communication to other bodies. An insulated metallic conductor, called the prime conductor, composes part of the machine used for this purpose. See Machine, *electric*.

When the rubber is insulated, it is found to acquire an electric state as well as the cylinder; but the states appear to be of different and opposite natures. For, though the cushion and bodies electrified by communication from it are observed to attract and repel small bodies, and to emit sparks to uninsulated conductors, in very nearly the same manner as is done by the cylinder, and such bodies as have been electrified by it; yet, with regard to each other, they are so different, that communication between the two electricities puts an end to the effects of both; and bodies, which, having been electrified by the cylinder, are in a state to be repelled by it, are so far from being affected in the same way by the cushion, that they are, on the contrary, attracted by it, and *vice versa.*

When sealing-wax is rubbed by the hand, it acquires upon its surface the opposite electricity to that which glass obtains by the same treatment; and hence the two electricities have been called the vitreous and resinous electricities by philosophers, whose attention was directed principally to the non-conductor. But Dr. Franklin, who took notice of the state of the insulated rubber, adopted the hypothesis of one single electric fluid, and supposed it to be redundant, or positive, on the glass; and deficient, or negative, on the rubber.

In each hypothesis the matter of all bodies is supposed to attract the electric matter, and each single fluid to be repulsive of itself. In the hypothesis of two electric fluids, these are supposed to attract each other, and to become neutralized by union or combination. Each of these hypotheses will agree with most of the phenomena; and each presents its difficulties: but there are no decisive experiments which can entitle either to a preference. We shall use the terms positive and negative in this work, because most commonly adopted.

The kind of electricity produced by friction on the surface of the non-conductor depends, apparently, much less on the peculiar nature of the body, than on the mechanical structure of the surfaces. Thus the same rubber will produce the positive state on smooth glass, and the negative on rough or unpolished glass; and sealing-wax will acquire the positive state, if rubbed by the amalgamed leather usually applied in our machines.

A body electrified in one state tends to produce the opposite state in another body, if brought near it so as not to communicate; and these opposite states diminish each other's apparent power or intensity, so as to admit of a much greater accumulation of electricity than could else have taken place. This may be better described by stating the fact along with one of the hypotheses. Suppose, for example, an insulated conductor to be positively electrified, or to contain more than the natural or ordinary quantity of electricity, this surplus will repel some of the natural quantity from another insulated conductor brought near it, and will drive that surplus out, if a communication be made with the earth; and in consequence of the negative state thus produced in this last, there will be an accumulation on the side of the first conductor nearest to the second, by virtue of the diminished repulsion of its electricity. The first conductor may, therefore, be made to receive still more, and this effect may be carried on, until a spark or explosion shall take place through the non-conducting air. If glass be interposed, the spark will be rendered more difficult, and the accumulation, which is called the charge, may be made still greater. And if the conductors be removed, the charge may still remain at the surfaces of the glass; that is to say, the accumulation on the one surface, and the deficiency on the other, by a want of what would else have naturally remained there. And if a circuitous conducting communication be made between the two sides, the charge will pass with an explosion. See JAR, *electric*, and SHOCK.

These are the principal facts of electricity. For the apparatus, instruments, manipulation, and other results, see MACHINE and MACHINERY, *electrical*.

ELECTROMETERS, certain instruments by which the intensity of an electric state is shewn. They operate either by means of the repulsion between two moveable bodies, or by measuring the distance to which the spark can be communicated. See MACHINERY, *electric*.

ELECTROPHORE, or ELECTROPHORUS, an instrument contrived by Sig. Volta for taking a small electric charge, by induction, from a resinous plate, and afterwards transferring it as a simple spark. See MACHINERY, *electric*.

ELECTUARY. See PHARMACY.

ELEEMOSINARIUS, in law, the almoner, who received the eleemosinary rents and gifts, and duly distributed them to pious and charitable uses.

ELEGIA, in botany, a genus of the Dioecia Triandria class and order. Natural order of Calamariæ. Junci, Jussieu. There is but one species, *viz.* E. juncea.

ELEGIT, in law, is a writ of execution, either upon a judgment for debt or damages, or upon a forfeiture of the recognizance taken in the king's court, by which the plaintiff is put in possession of one half the debtor's lands, which he is possessed of at the time, to hold them till his debt is paid out of the profits. By the common law, a man could only have satisfaction of goods, chattels, and the present profits of lands, by the writs of *fieri facias* or *levari facias*; but not the possession of the lands themselves. The statute 13 Edw. I. c. 18. therefore granted this writ, which is called an *elegit*, because it is in the election of the plaintiff, whether he will sue out this writ or one of the former.

ELEGY, a mournful and plaintive kind of poem. As elegy, at its first institution, was intended for tears, it expressed no other sentiments, it breathed no other accents, but those of sorrow. With the negligence natural to affliction, it sought less to please than to move; and aimed at exciting pity, not admiration. By degrees, however, elegy degenerated from its original intention, and was employed upon all sorts of subjects, gay or sad, and especially upon love. Ovid's book of Love, the poems of Tibullus and Propertius, notwithstanding they are termed elegies, are sometimes so far from being sad, that they are scarcely serious. The chief subjects, then, to which elegy owes its rise, is death and love. That elegy, therefore, ought to be esteemed the most perfect in its kind, which has somewhat of both at once; such, for instance, where the poet bewails the death of some youth or damsel falling a martyr to love.

ELEMENTS, a term used by the earlier chemists nearly in the same sense as the moderns use the term first principle. The chief and indeed very essential difference between them is, that the ancients considered their elements as bodies possessing absolute simplicity, and capable of forming all other bodies in their mutal combination; whereas the first principles of the moderns are considered as simple, merely in respect to the present state of the art of analyzing bodies: that is to say, the ancients almost totally overlooked the imperfections of the art in their general deductions; but the moderns pretend to keep it in view.

The experiments made in the infancy of chemistry had for their object the phenomenon of combustion, referred by them to a substance called fire; the extraction of elastic fluid, considered to be of the same nature as the immense mass which composes the atmosphere; water, neither compoundable nor destructible by any experiments then known or understood; and the substances not volatile in the strongest heat of furnaces, confounded by them, with a few exceptions, under the general term of earth. In this way they obtained four elements, or first principles, fire, air, water, and earth.

Subsequent experiments and inquiries have multiplied the number of elements, and have alternately shewed the inutility of any exclusive general arrangement of bodies as absolutely simple, because not yet analysed. See CHEMISTRY.

ELEMI, a resin, commonly called gum elemi, is supposed to be the produce of a large tree, called in the Linnæan arrangement amyris elemifera, a native of Carolina, and the warmer parts of America. The true elemi is supposed to come from Ethiopia. The resin is of a yellowish green; it comes to us in cylindrical cakes, covered with palm leaves. When distilled in a water bath, elemi affords about $\frac{1}{16}$th of essential oil, in which all the fragrance of the substance resides, the residue is inodorous and brittle. It is used in medicine as a liniment, and is employed in the arts as an ingredient in some varnishes.

FLEPHANT. See ELEPHAS.

ELEPHANTOPUS, in botany, *elephant's foot*, a genus of the Syngenesia Polygamia Segregata class and order. Natural order of Compositæ. Capitatæ Corymbeferæ, Jussieu. Essential character: calyx four-flowered; corolla tubular, hermaphrodite; receptacle naked; down bristle form. There are four species. The American species are two: E. carolinianum, and E. tomentosa.

The stems of these plants are woody; involucres three-leaved, containing three calyxes, sometimes large, boat-shaped, in very loose corymbs, and on long pedicles; frequently smaller, in the shape of bractes, and axillary, sessile, and in spikes.

ELEPHAS, the *elephant*, in natural history, a genus of Mammalia of the order Bruta. Generic character: no fore-teeth in either jaw; tusks of the upper jaw elongated, none in the lower; proboscis very long and prehensile; body with few hairs. This animal is not to be met with in its natural state throughout Europe or America, and is to be found in its greatest perfection of size and strength between the river Senegal and the Cape of Good Hope in Africa. Its height is, generally, from twelve to fifteen feet. Its ears are so large, that from the shoulder of a middle sized man they will extend to the ground. In a state of tranquillity these are pendulous, but during the agitation of passion they are erected, and pointed forwards with extreme intenseness. Its legs resemble massy pillars, above five feet in height, and sometimes sixteen inches in diameter. The most curious characteristic of the elephant is its proboscis, which is an instrument of feeling and of motion, and which it can contract or lengthen at pleasure, and apply with extreme flexibility and promptitude in every possible direction. With this most singular assistance, it grasps every object with both the feeling and tenacity of the human fingers. It thus picks up herbs and roots from the ground, unties the knots of cords, opens gates, and raises, without hesitation and difficulty, from the ground the smallest coins. The nostrils are situated at the end of this instrument, which is the vehicle of its food and the weapon of its defence; and, in a full grown animal, is generally of the length of eight feet, and about five feet in diameter at the base. In the south of Africa, near the territory of the Cape, elephants are seen occasionally in herds even of several hundreds, and the settlers in the Cape territory are often engaged in the diversion, or rather, indeed, the profitable occupation, of shooting them, in which practice has rendered them particularly skilful. It is an occupation, however, of no little adventure and peril, and the most perfect caution must be used to advance near enough to take the fatal aim unperceived, as, if the elephant observes his enemy, he will rush on him, not improbably, to his destruction. The weight of the tusks of a full grown elephant is about a hundred and fifty Dutch pounds, and they are sold for at least as many guilders; so that the temptation to this exercise is not only great to bold spirits, animated by the love of danger, but to mercenary ones, who can be stimulated to exertion merely by the love of gain.

The food of elephants consists of leaves, herbs, roots, the tender branches of trees, especially the plantain tree, and also of grains and fruits. A single one will eat in the course of twenty four hours a hundred and fifty pounds of grass; and the quantity destroyed or spoilt by their trampling must be considered as far greater. As they act in concert, both for forage and protection, they frequently break through the strong fences erected to keep them out, both by the Indians and the Negroes, laying waste, in one night, the most blooming pastures, overturning numerous habitations, blasting the hopes of harvest, defying the most hideous noises of the people to alarm them off, and disregarding the immense fires which are kindled for the same purpose. The usual motion of the elephant is not more rapid than the walk of a horse; but, when urged by fear or anger, his celerity is little inferior to a gallop, and he advances in a straight direction with this speed for a considerable time, without difficulty. In turning himself, however, he labours extremely; when confined within a small compass, and where it is practicable, he always describes a circle of no small extent to accomplish it. In narrow and crooked passes the negroes avail themselves of this great disadvantage, and attack him with corresponding success.

Of all the animals applied by man to promote his ostentation or advantage, none are possessed of more docility, sagacity, and obedience, than the elephant. In the East they have been employed, not only for labour, but for pomp, from the most remote periods of antiquity. They swim with great facility, and have been frequently of the most important service in transporting the baggage of armies over vast rivers. In swimming, the trunk only appears above the surface of the water, effecting all the purposes of respiration. One of these animals will execute the work of several horses, and the promptitude, intelligence, and affection they display to their keeper, are singularly interesting. His voice is distinguished with unfailing accuracy; his tones of approval or anger, of command, attachment, or menace, are most nicely discriminated, and followed by corresponding acts and exertions. They will kneel down to facilitate his mounting on their backs, and assist him also in this operation with their trunk, with which they will likewise frequently sooth and caress him. They are employed in drawing large caravans, and even chariots, in the East, and appear pleased with the splendid and dazzling furniture in which they are often arrayed. They manifest extreme sensibility to honour and disgrace, and, to maintain the character of respectability, fidelity, and strength, with their keeper, have been known, merely on his temporary ejaculation of disgust at the apparent relaxation of their efforts, to renew them with the most extraordinary animation, and even with the most fatal result.

Though formerly applied for the purposes of war, as was particularly the case against Alexander near the Hydaspes, and by Pyrrhus against the Romans, they were frequently more formidable to their owners than to the enemy, and, when wounded, exhibited a scene of extreme turbulence and confusion: and the invention of gunpowder appears to have precluded thata dvantage from their efforts in actual combat, which might in some instances, in former ages, be occasionally derived from them. They are now chiefly employed in India for the purpose of state, or of labour, always forming an indispensable part of the magnificence attending a royal progress in the East. The vast quantities of baggage which are taken in those circuits are carried by some; while others, most splendidly arrayed, convey, in gilded and latticed houses, upon their backs, the ladies of the palace. It is stated, that they are also employed sometimes in the execution of criminals, whether by trampling to death, fracturing the limbs of the unhappy convicts with their trunk, or impaling them on their tusks; following, for these purposes, the signals of their keepers, with complete precision and alertness.

The female produces but one young at a time, after a period of gestation consisting, according to some authorities, of two, and to others, of three years. Elephants are thirty years before they attain their maturity, and are reported to live, even in a state of confinement, upwards of a century. In this state of captivity, however, they have proved, in every instance, barren; and this circumstance obliges eastern princes to supply the waste of accident, disease, and decay, by having annually recourse to the immense forests in which they abound. The hunting of them on these occasions is, indeed, an imperial sport, exciting very considerable interest, and attended with the most elaborate preparation. For the figure of the elephant, see Mammalia, Plate X. fig. 1.

ELEVATION, the same with altitude, or height.

Elevation, *angle of*, in gunnery, that comprehended between the horizon and the line of direction of a cannon or mortar; or it is that which the chase of a piece, or the axis of its hollow cylinder, makes with the plane of the horizon.

ELEVATOR, in anatomy, the name of several muscles, so called from their serving to raise the parts of the body to which they belong.

Elevator, in surgery, an instrument used for raising depressed or fractured parts of the skull. See Surgery.

ELISION, in grammar, the cutting off or suppressing a vowel at the end of a word, for the sake of sound or measure, the next word beginning with a vowel.

ELIXIR, in medicine, a compound tincture extracted from many efficacious ingredients; hence the difference between a tincture and an elixir seems to be this, that a tincture is drawn from one ingredient, sometimes with an addition of another to open it, and to dispose it to yield to the menstruum; whereas an elixir is a tincture extracted from several ingredients at the same time. See TINCTURE.

ELK. See CERVUS.

ELL, a measure of length, different in different countries; but those mostly used in England are the English and Flemish ells, whereof the former is three feet nine inches, or one yard and a quarter, and the latter only twenty-seven inches, or three quarters of a yard. In Scotland, the ell contains 37 $\frac{2}{10}$ English inches.

END OF VOL. IV.

Fig. 1. Cervus *alces: Elk*_ *Fig.* 2. C. *tarandus: rein deer*_ *Fig.* 3. C *axis*_ *Fig.* 4. C. *dama: fallow deer.*

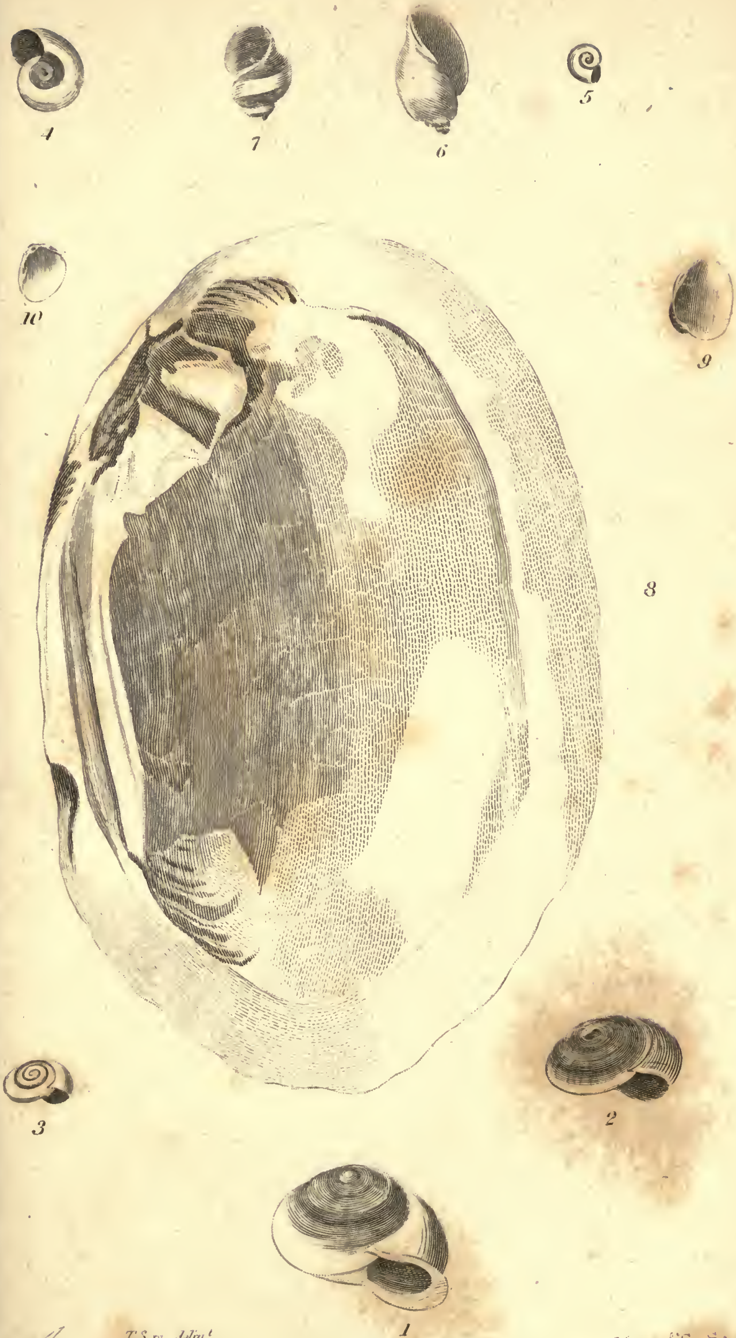
AVES. *Plate V.*

Fig.1. Colymbus *glacialis: great northern diver_Fig.2.C.cristatus: great crested grebe.*
Fig.3. C.*rubricolis: red necked grebe_Fig.4.* Corvus *corax: raven_Fig.5.C monedula jackdaw_Fig 6 C glandarius: jay_Fig.7.* Crax *alector: crested curassow.*

Fig. 1. Chætodon *plectorhenchus: pleatnose Chætodon*_*Fig. 2.* Cottus *cataphractus: mailed Bull head*_*Fig. 3.* Cyclopterus *pavonius: Pavonian sucker*_*Fig 4.* Cyprinus *carpio: large scaled Carp*_*Fig. 5.* Delphinus *delphis: Dolphin.*

SERPENTES.

Fig. 1. Acrochordus *dubius: doubtful Acrochordus* *Fig. 2.* Boa *canina: canine Boa*
Fig. 3. Crotalus *horridus: banded rattle snake.*



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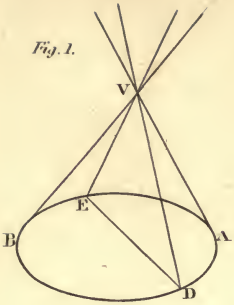

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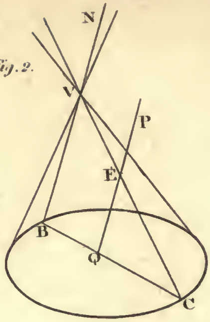

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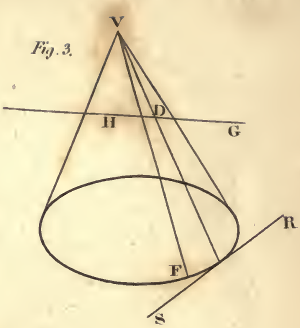

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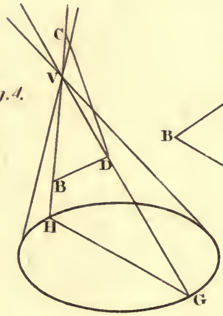

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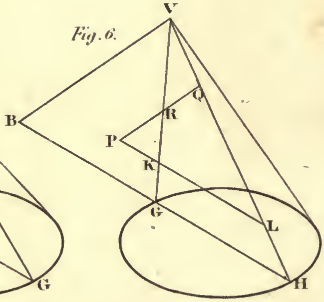

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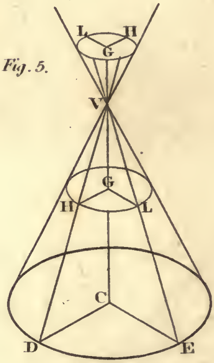

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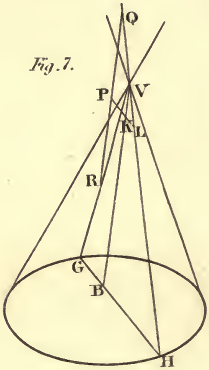

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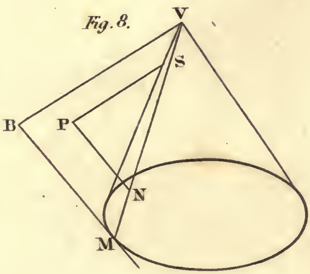
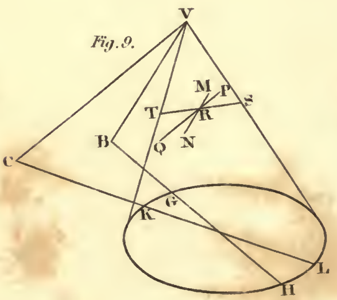


Fig. 9.



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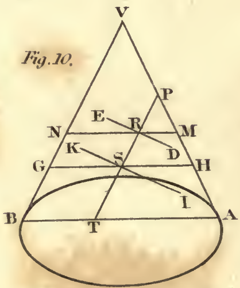

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Fig. 11.

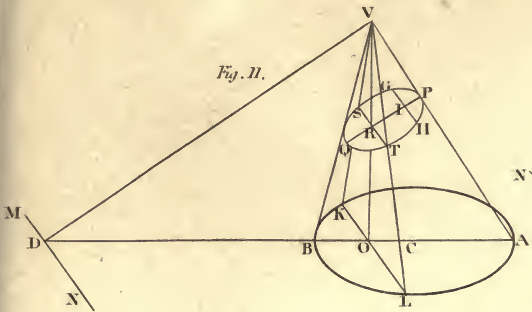
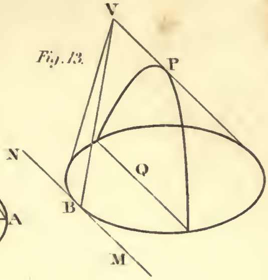


Fig. 13.



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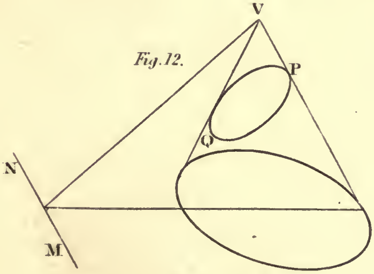

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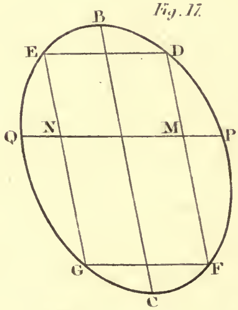

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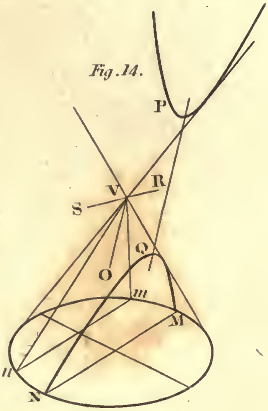

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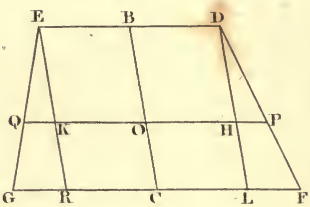
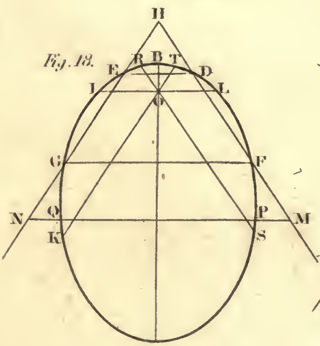


Fig. 16.

Fig. 18.



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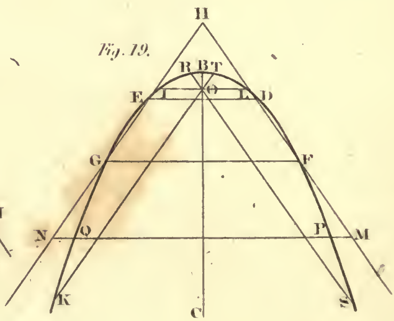

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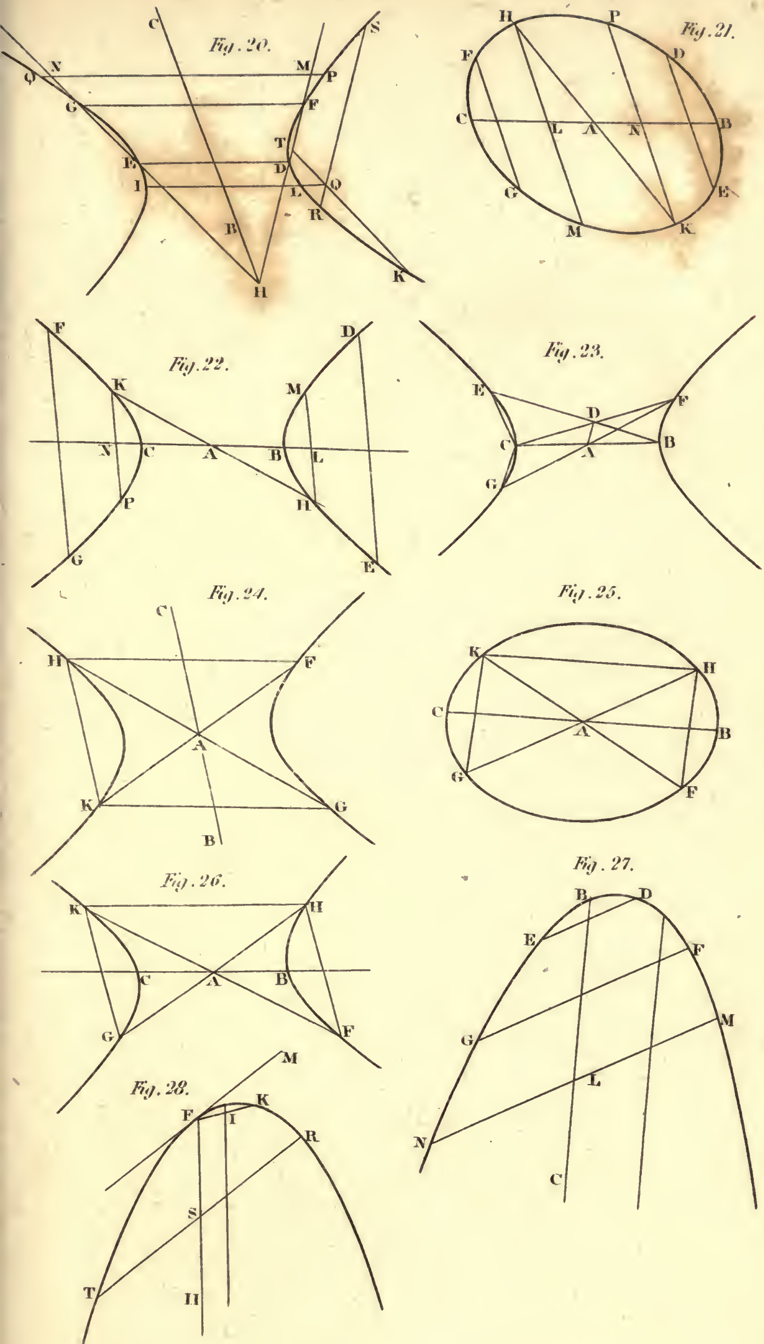

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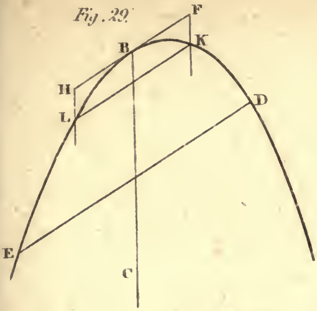
Fig. 29.



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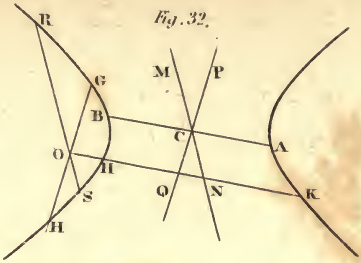

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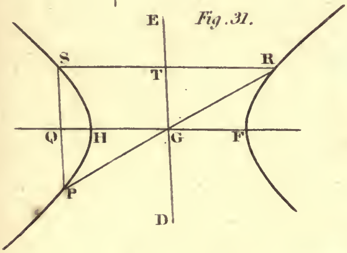

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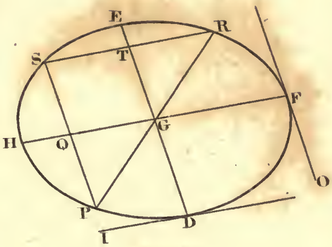

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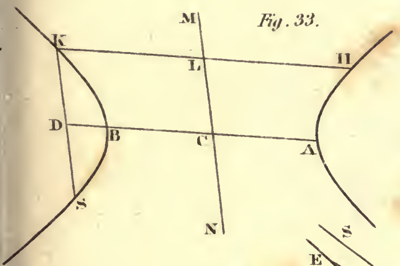

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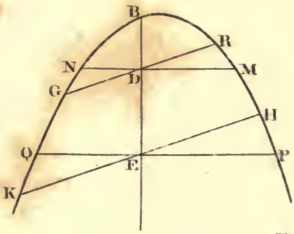

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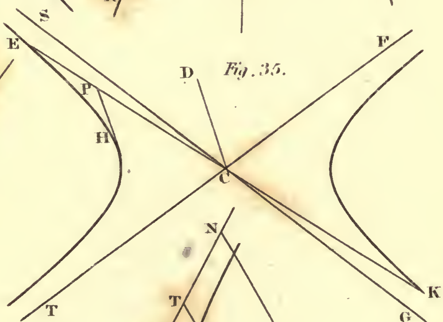
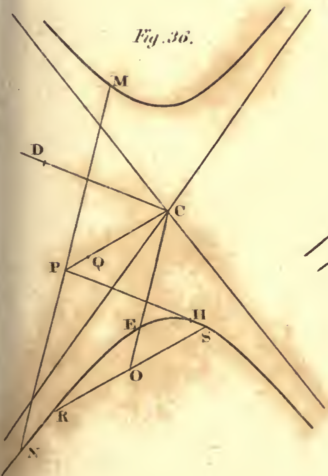


Fig. 36.



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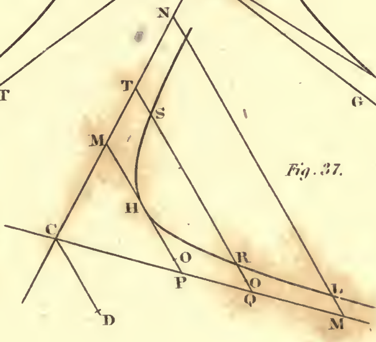

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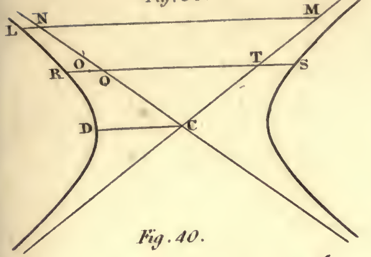
Fig. 38.



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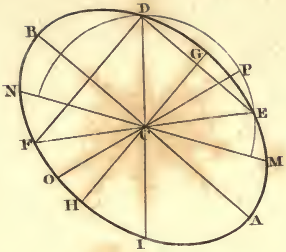

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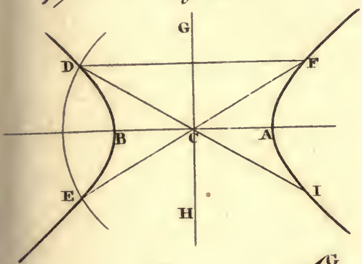

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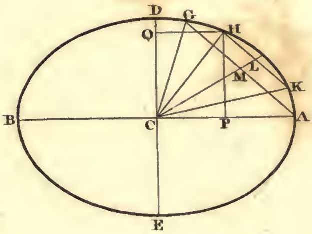

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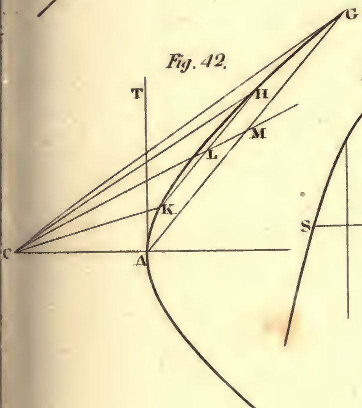

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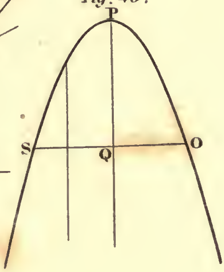

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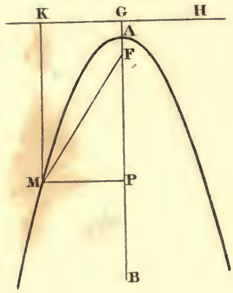

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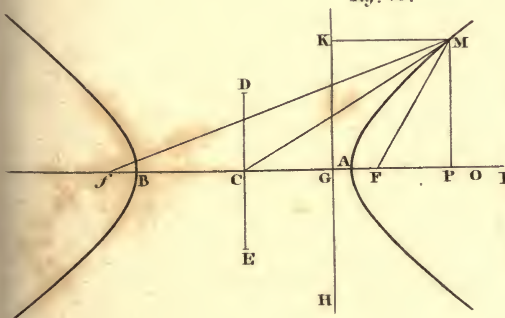

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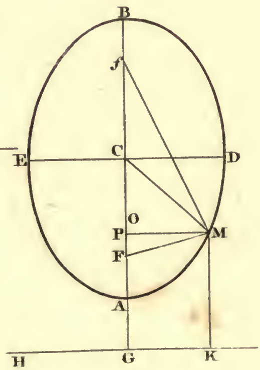

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CRANES.

Fig. 2.

Fig. 1.

Fig. 3.

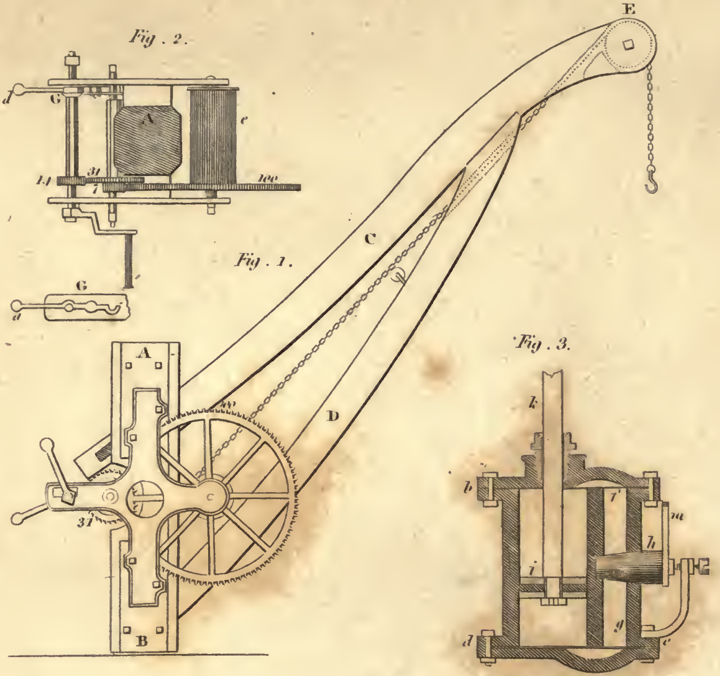
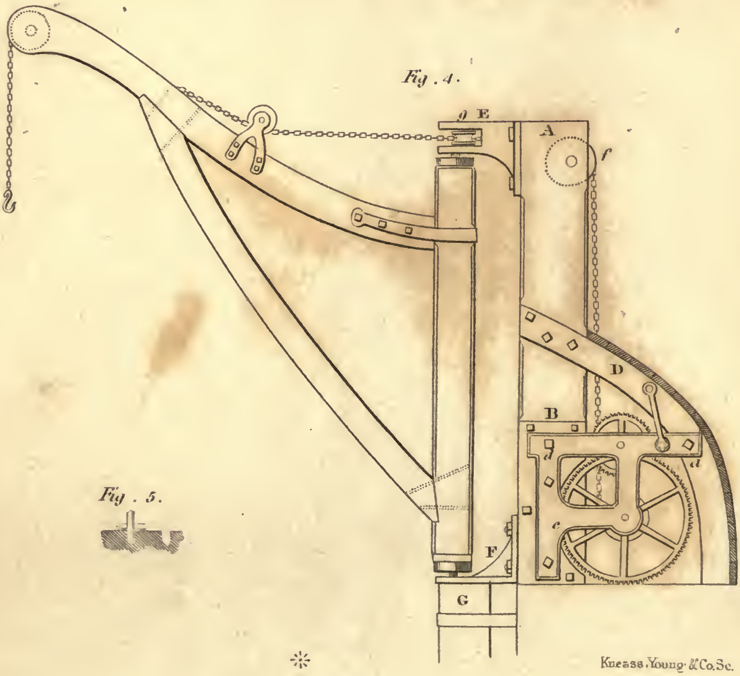


Fig. 4.

Fig. 5.



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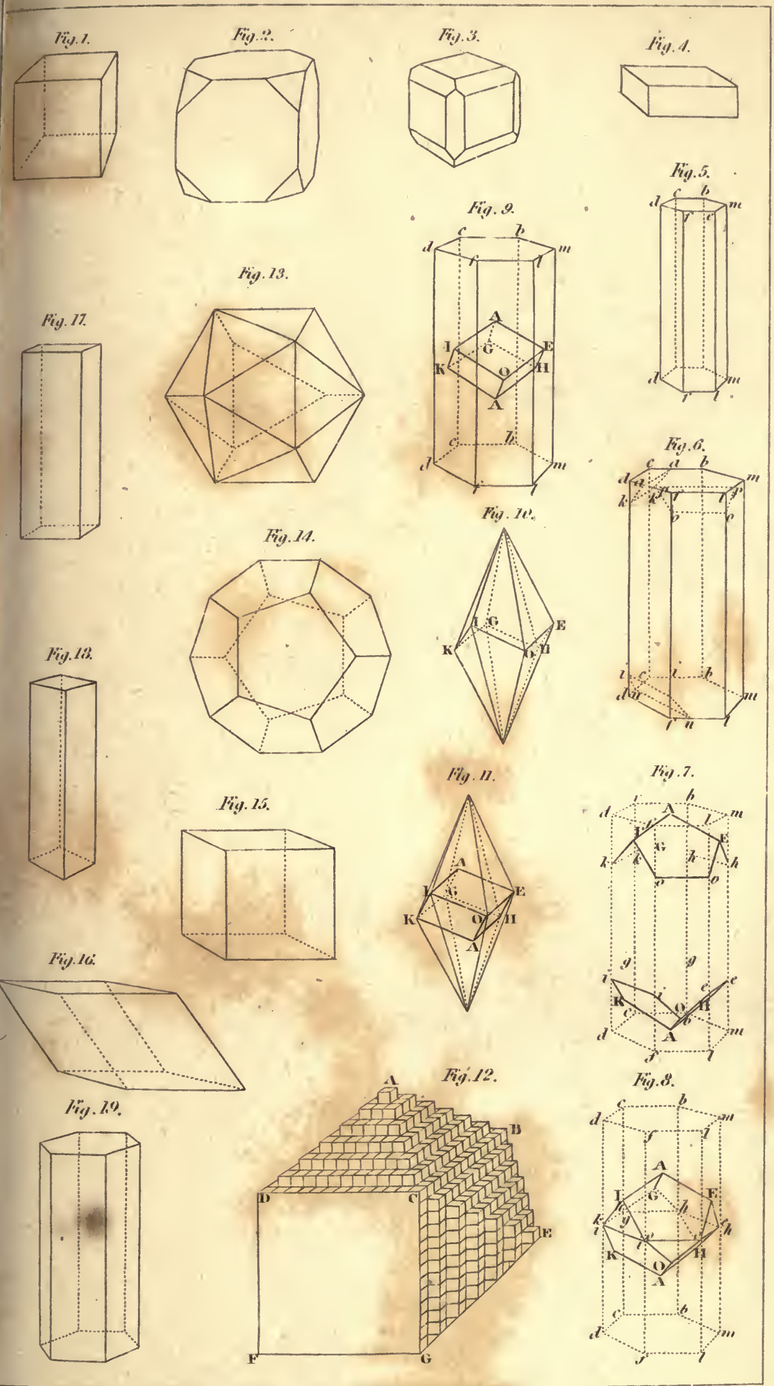
CRYSTALLOGRAPHY.



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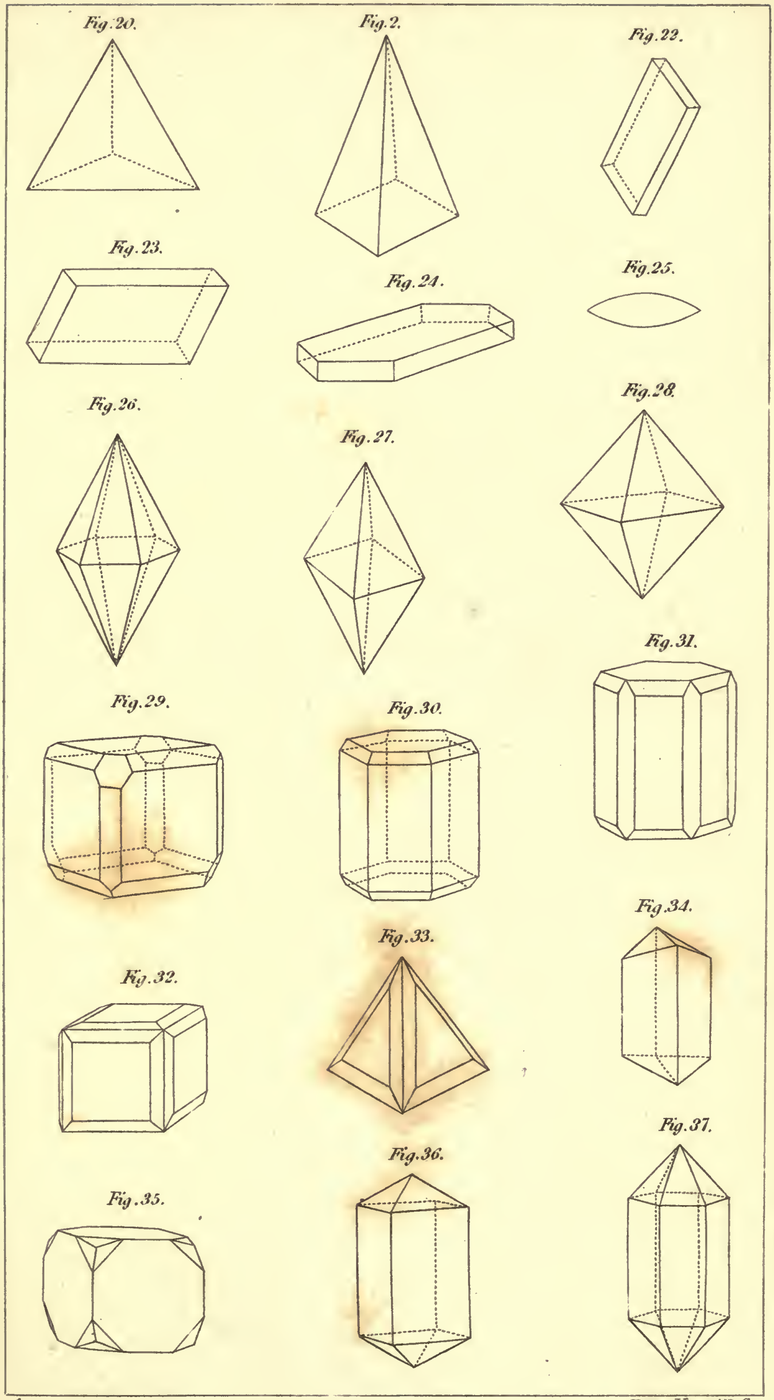

4

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DIALLING.

Fig. 1.

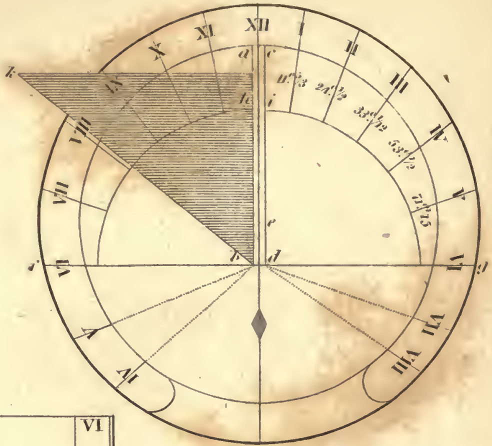
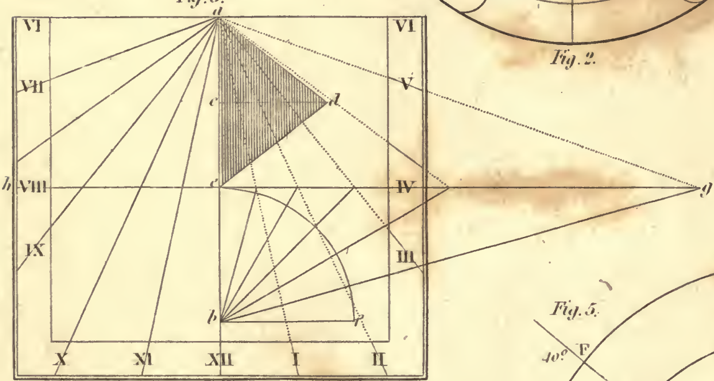


Fig. 2.

Fig. 3.



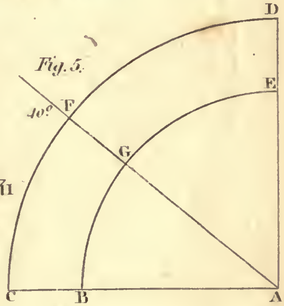


Fig. 5.

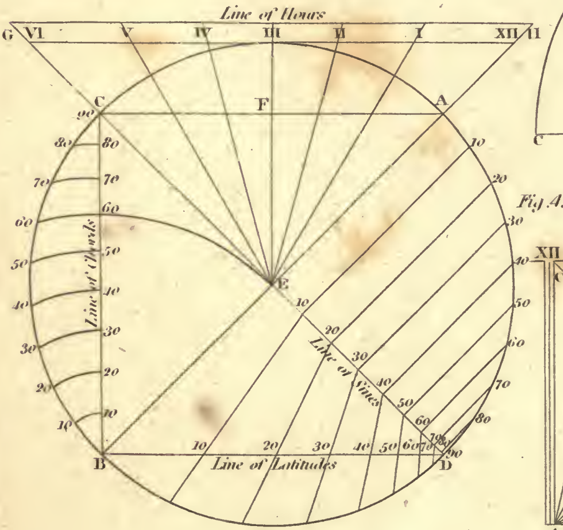


Fig. 4.

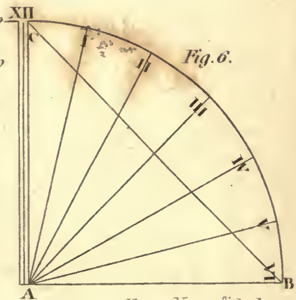


Fig. 6.

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4

DIVING BELL.

Fig. 1.

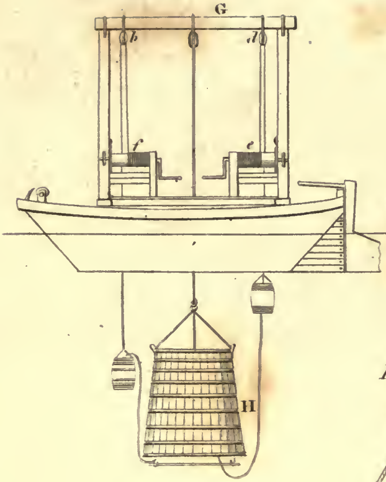


Fig. 2.

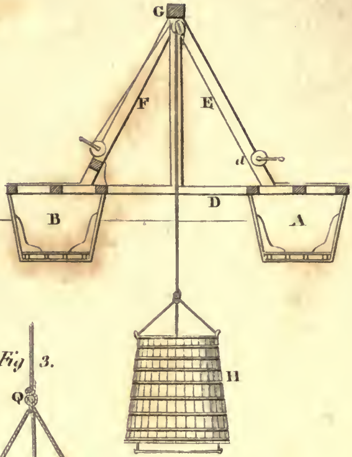


Fig 3.

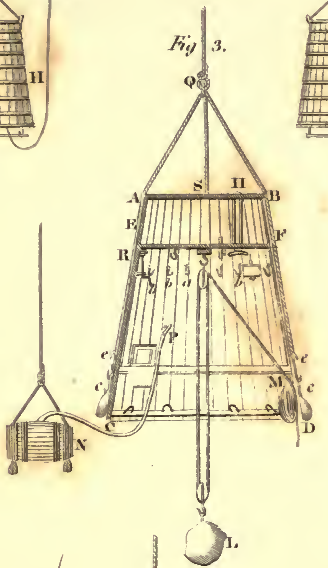
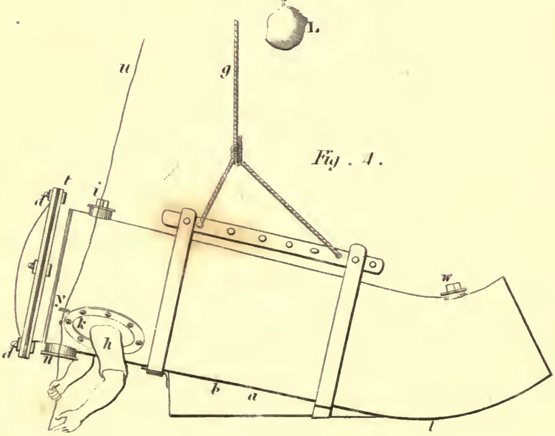
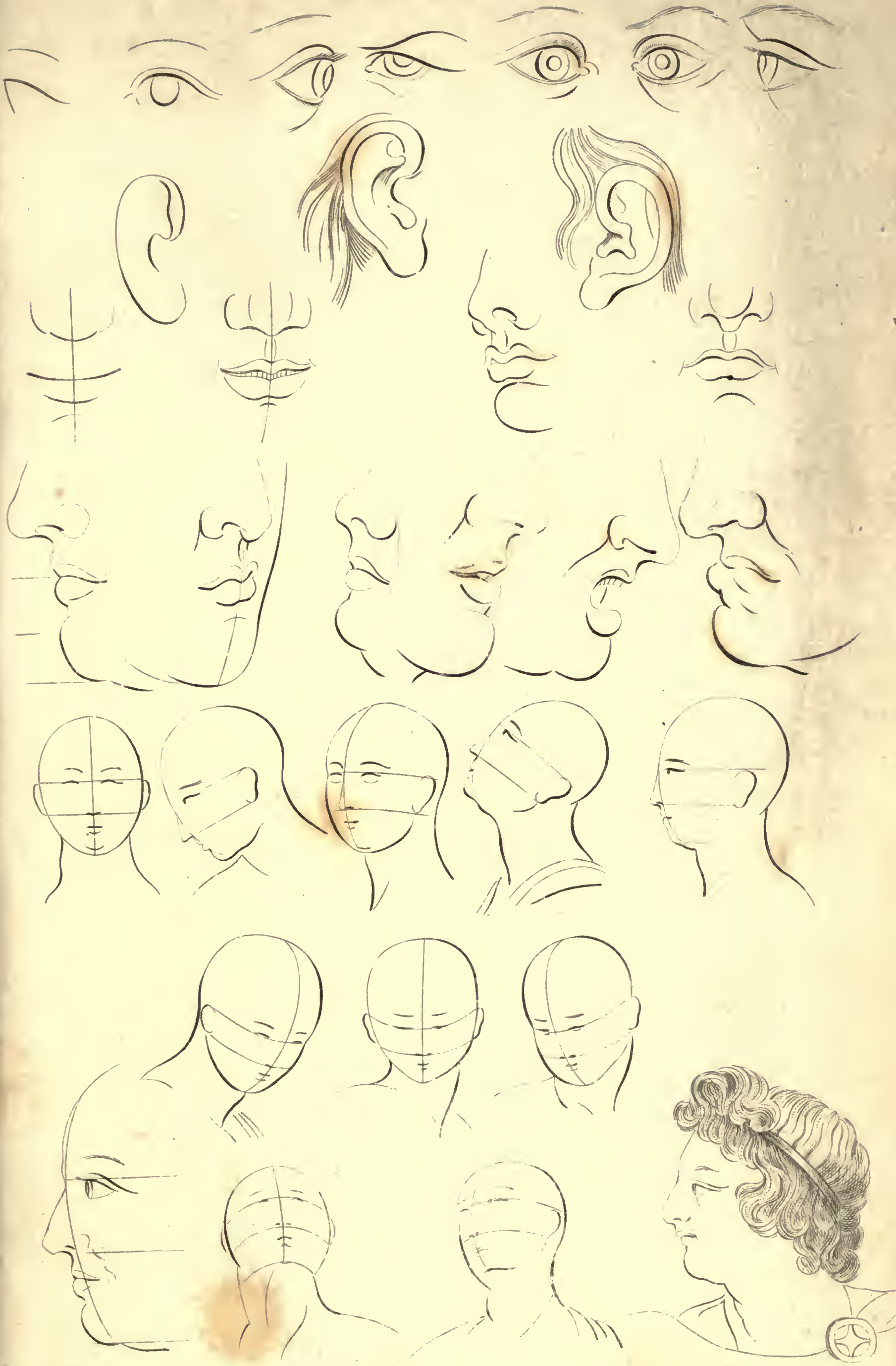


Fig. 4.



4



MISCELLANIES.

Plate III.