ENCYCLOPÆDIA BRITANNICA.

Microfcope.

MICROSCOPE, an optical inftrument, confifting of lenfes, or mirrors, by means of which fmall objects appear larger than they do to the naked eye. *Single* microfcopes confift of a fingle lens or mirror; or if more lenfes or mirrors be made ufe of, they only ferve to throw light upon the object, but do not contribute to enlarge the image of it. *Double* or *compound* microfcopes are thofe in which the image of an object is compofed by means of more lenfes or mirrors than one.

For the principles on which the conftruction of microfcopes depends, fee OPTICS. In the prefent article, it is intended to defcribe the finifhed inftrument, with all its varied apparatus, according to the lateft improvements; and to illuftrate by proper details its ufes and importance.

I. *Of SINGLE Microfcopes.*

THE famous microfcopes made ufe of by Mr Leeuwenhoeck, were all, as Mr Baker affures us, of the fingle kind, and the conftruction of them was the moft fimple poffible; each confifting only of a fingle lens fet between two plates of filver, perforated with a fmall hole, with a moveable pin before it to place the object on and adjuft it to the eye of the beholder. He informs us alfo, that *lenfes* only, and not *globules*, were ufed in every one of thefe microfcopes.

Plate CCCXXXVII. fig. 1.

1. The fingle microfcope now moft generally known and ufed is that called *Wilfon's Pocket Microfcope.* The body is made of brafs, ivory, or filver, and is reprefented by AA, BB. CC is a long fine-threaded male fcrew that turns into the body of the microfcope; D a convex glafs at the end of the fcrew. Two concave round pieces of thin brafs, with holes of different diameters in the middle of them, are placed to cover the above mentioned glafs, and thereby diminifh the aperture when the greateft magnifiers are employed. EE, three thin plates of brafs within the body of the microfcope; one of which is bent femicircularly in the middle, fo as to form an arched cavity for the reception of a tube of glafs, the ufe of the other two being to receive and hold the fliders between them. F, a piece of wood or ivory, arched in the manner of the femicircular plate, and cemented to it. G, the other end of the body of the microfcope, where a hollow female fcrew is adapted to receive the different magnifiers. H is a fpiral fpring of fteel, between

Microfcope.

the end G and the plates of brafs, intended to keep the plates in a right pofition and counteract the long fcrew CC. I is a fmall turned handle, for the better holding of the inftrument, to fcrew on or off at pleafure.

To this microfcope belong fix or feven magnifying glaffes: fix of them are fet in filver, brafs, or ivory, as in the figure K; and marked 1, 2, 3, 4, 5, 6, the loweft numbers being the greateft magnifiers. L is the feventh magnifier, fet in the manner of a little barrel, to be held in the hand for the viewing of any larger object. M is a flat flip of ivory, called a *flider*, with four round holes through it, wherein to place objects between two pieces of glafs or Mufcovy talc, as they appear at *dddd.* Six fuch fliders, and one of brafs, are ufually fold with this microfcope, fome with objects placed in them, and others empty for viewing any thing that may offer: but whoever pleafes to make a collection, may have as many as he defires. The brafs flider is to confine any fmall object, that it may be viewed without crufhing or deftroying it. N is a tube of glafs contrived to confine living objects, fuch as frogs, fifhes, &c. in order to difcover the circulation of the blood. All thefe are contained in a little neat box of fifh-fkin or mahogany, very convenient for carrying in the pocket.

When an object is to be viewed, thruft the ivory flider, in which the faid object is placed, between the two flat brafs plates EE: obferving always to put that fide of the flider where the brafs rings are fartheft from the eye. Then fcrew on the magnifying glafs you intend to ufe, at the end of the inftrument G; and looking through it againft the light, turn the long fcrew CC, till your object be brought to fuit your eye; which will be known by its appearing perfectly diftinct and clear. It is moft proper to look at it firft through a magnifier that can fhow the whole at once, and afterwards to infpect the feveral parts more particularly with one of the greateft magnifiers; for thus you will gain a true idea of the whole, and of all its parts. And though the greateft magnifiers can fhow but a minute portion of any object at once, fuch as the claw of a flea, the horn of a loufe, or the like; yet by gently moving the flider which contains the object, the eye may gradually examine it all over.

As objects muft be brought very near the glaffes when the greateft magnifiers are made ufe of, be careful not to fcratch them by rubbing the flider againft

Microscope. them as you move it in or out. A few turns of the screw CC will easily prevent this mischief, by giving them room enough. You may change the objects in your sliders for any others you think proper, by taking out the brass rings with the point of a penknife; the talcs will then fall out, if you but turn the sliders; and after putting what you please between them, by replacing the brass rings you will fasten them as they were before. It is proper to have some sliders furnished with talcs, but without any object between them, to be always in readiness for the examination of fluids, salts, sands, powders, the farina of flowers, or any other casual objects of such sort as need only be applied to the outside of the talc.

The circulation of the blood may be easiest seen in the tails or fins of fishes, in the fine membranes between a frog's toes, or best of all in the tail of a water-newt. If your object be a small fish, place it within the tube N, and spread its tail or fin along the side thereof: if a frog, choose such a one as can but just be got into your tube; and, with a pen, or small stick, expand the transparent membrane between the toes of the frog's hind foot as much as you can. When your object is so adjusted that no part of it can intercept the light from the place you intend to view, unscrew the long screw CC, and thrust your tube into the arched cavity, quite through the body of the microscope; then screw it to the true focal distance, and you will see the blood passing along its vessels with a rapid motion, and in a most surprising manner.

The third or fourth magnifiers may be used for frogs or fishes: but for the tails of water-newts, the fifth or sixth will do; because the globules of their blood are twice as large as those of frogs or fish. The first or second magnifier cannot well be employed for this purpose; because the thickness of the tube in which the object lies, will scarce admit its being brought so near as the focal distance of the magnifier.

An apparatus for the purpose of viewing opaque objects generally accompanies this microscope; and which consists of the following parts. A brass arm QR, which is screwed at Q, upon the body of the microscope at G. Into the round hole R, any of the magnifiers suitable to the object to be viewed are to be screwed; and under it, in the same ring, the concave polished silver speculum S. Through a small aperture in the body of the microscope under the brass plates EE, is to slide the long wire with the forceps T: This wire is pointed at one of its ends; and so, that either the points or forceps may be used for the objects as may be necessary. It is easy to conceive, therefore, that the arm at R, which turns by a twofold joint at *a* and *b*, may be brought with its magnifier over the object, the light reflected upon it by the application of the speculum, and the true focus obtained by turning of the male screw CC as before directed.—As objects are sometimes not well fixed for view, either by the forceps or point, the small piece shown at V is added, and in such cases answers better: it screws over the point of T; it contains a small round piece of ivory, blackened on one side, and left white upon the other as a contrast to coloured objects, and by a small piece of watch-spring fastens down the objects upon the ivory.

2. *Single Microscope by reflection.* In fig. 2. A is a scroll of brass fixed upright upon a round wooden base B, or mahogany drawer or case, so as to stand perfectly firm and steady. C is a brass screw, that passes through a hole in the upper limb of the scroll into the side of the microscope D, and screws it fast to the said scroll. E is a concave speculum set in a box of brass, which hangs in the arch G by two small screws *ff*, that screw into the opposite sides thereof. At the bottom of this arch is a pin of the same metal, exactly fitted to a hole *h* in the wooden pedestal, made for the reception of the pin. As the arch turns on this pin, and the speculum turns on the end of the arch, it may, by this twofold motion, be easily adjusted in such a manner as to reflect the light of the sun, of the sky, or of a candle, directly upwards through the microscope that is fixed perpendicularly over it; and by so doing may be made to answer many purposes of the large double reflecting microscope. The body of the microscope may also be fixed horizontally, and objects viewed in that position by any light you choose; which is an advantage the common double reflecting microscope has not. It may also be rendered further useful by means of a slip of glass; one end of which being thrust through between the plates where the sliders go, and the other extending to some distance, such objects may be placed thereon as cannot be applied in the sliders: and then, having a limb of brass that may fasten to the body of the microscope, and extend over the projecting glass a hollow ring wherein to screw the magnifiers, all sorts of subjects may be examined with great convenience, if a hole be made in the pedestal, to place the speculum exactly underneath, and thereby throw up the rays of light. The pocket-microscope, thus mounted, says Mr Baker, "is as easy and pleasant in its use; as fit for the most curious examination of the animalcules and salts in fluids, of the farinæ in vegetables, and of the circulation in small animals; in short, is as likely to make considerable discoveries in objects that have some degree of transparency, as any microscope I have ever seen or heard of."

The brass scroll A is now generally made to unscrew into three parts, and pack with the microscope and apparatus into the drawer of a mahogany pocket-case, upon the lid of which the scroll is made to fix when in use.

The opaque apparatus also, as above described, is applicable this way by reflection. It only consists in turning the arm R (fig. 1.), with the magnifier over the concave speculum below (fig. 2.), or to receive the light as reflected obliquely from it: the silver speculum screwed into R will then reflect the light, which it receives from the glass speculum, strongly upon the object that is applied upon the wire T underneath.

This microscope, however, is not upon the most convenient construction, in comparison with others now made: it has been esteemed for many years past from its popular name, and recommendation by its makers. Its portability is certainly a great advantage in its favour; but in most respects it is superseded by the microscopes hereafter described.

3. *Microscope for Opaque Objects, called the Single Opaque Microscope.* Fig. 3. This microscope remedies the inconvenience of having the dark side of an object next the

Microscope. the eye, which formerly was an insurmountable objection to the making observations on opaque objects with any considerable degree of exactness or satisfaction: for, in all other contrivances commonly known, the nearness of the instrument to the object (when glasses that magnify much are used) unavoidably overshadows it so much, that its appearance is rendered obscure and indistinct. And, notwithstanding ways have been tried to point light upon an object, from the sun or a candle, by a convex glass placed on the side thereof, the rays from either can be thrown upon it in such an acute angle only, that they serve to give a confused glare, but are insufficient to afford a clear and perfect view of the object. But this microscope, by means of a concave speculum of silver highly polished, in whose centre a magnifying lens is placed, such a strong and direct light is reflected upon the object, that it may be examined with all imaginable ease and pleasure. The several parts of this instrument, made either of brass or silver, are as follow.

Through the first side A, passes a fine screw B, the other end of which is fastened to the moveable side C. D is a nut applied to this screw, by the turning of which the two sides A and C are gradually brought together. E is a spring of steel that separates the two sides when the nut is unscrewed. F is a piece of brass, turning round in a socket, whence proceeds a small spring tube moving upon a rivet; through which tube there runs a steel wire, one end whereof terminates in a sharp point G, and the other with a pair of pliers H fastened to it. The point and pliers are to thrust into, or take up and hold, any insect or object; and either of them may be turned upwards, as best suits the purpose. I is a ring of brass, with a female screw within it, mounted on an upright piece of the same metal; which turns round on a rivet, that it may be set at a due distance when the least magnifiers are employed. This ring receives the screws of all the magnifiers. K is a concave speculum of silver, polished as bright as possible; in the centre of which is placed a double convex lens, with a proper aperture to look through it. On the back of this speculum a male screw L is made to fit the brass ring I, to screw into it at pleasure. There are four of these concave specula of different depths, adapted to four glasses of different magnifying powers, to be used as the objects to be examined may require. The greatest magnifiers have the least apertures. M is a round object-plate, one side of which is white and the other black: The intention of this is to render objects the more visible, by placing them, if black, on the white side, or, if white, on the black side. A steel spring N turns down on each side to make any object fast; and issuing from the object-plate is a hollow pipe to screw it on the needle's point G. O is a small box of brass, with a glass on each side, contrived to confine any living object, in order to examine it: this also has a pipe to screw upon the end of the needle G. P is a turned handle of wood, to screw into the instrument when it is made use of. Q, a pair of brass pliers to take up any object, or manage it with conveniency. R is a soft hair-brush for cleaning the glasses, &c. S is a small ivory box for talcs, to be placed, when wanted, in the small brass box O.

When you would view any object with this microscope, screw the speculum, with the magnifier you think proper to use, into the brass ring I. Place your object, either on the needle G in the pliers H, on the object-plate M, or in the hollow brass box O, as may be most convenient: then holding up your instrument by the handle P, look against the light through the magnifying lens; and by means of the nut D, together with the motion of the needle, by managing its lower end, the object may be turned about, raised, or depressed, brought nearer the glass, or removed farther from it, till you find the true focal distance, and the light be seen strongly reflected from the speculum upon the object, by which means it will be shown in a manner surprisingly distinct and clear; and for this purpose the light of the sky or of a candle will answer very well. Transparent objects may also be viewed by this microscope; only observing, that when such come under examination, it will not always be proper to throw on them the light reflected from the speculum; for the light transmitted through them, meeting the reflected light, may together produce too great a glare. A little practice, however, will show how to regulate both lights in a proper manner.

4. *Ellis's single and Aquatic Microscope.* Fig. 4. represents a very convenient and useful microscope, contrived by Mr John Ellis, author of An Essay upon Corallines, &c. To practical botanists, observers of animalcula, &c. it possesses many advantages above those just described. It is portable, simple in its construction, expeditious, and commodious in use. K represents the box containing the whole apparatus: it is generally made of fish-skin; and on the top there is a female screw, for receiving the screw that is at the bottom of the pillar A: this is a pillar of brass, and is screwed on the top of the box. D is a brass pin which fits into the pillar; on the top of this pin is a hollow socket to receive the arm which carries the magnifiers; the pin is to be moved up and down, in order to adjust the lenses to their focal or proper distance from the object. [*N. B.* In the representations of this microscope, the pin D is delineated as passing through a socket at one side of the pillar A; whereas it is usual at present to make it pass down a hole bored through the middle of the pillar.] E, the bar which carries the magnifying lens; it fits into the socket X, which is at the top of the pin or pillar D. This arm may be moved backwards and forwards in the socket X, and sideways by the pin D; so that the magnifier, which is screwed into the ring at the end E of this bar, may be easily made to traverse over any part of the object that lies on the stage or plate B. FF is a polished silver speculum, with a magnifying lens placed at the centre thereof, which is perforated for this purpose. The silver speculum screws into the arm E, as at F. G, another speculum, with its lens, which is of a different magnifying power from the former. H, the semicircle which supports the mirror I; the pin R, affixed to the semicircle H, passes through the hole which is towards the bottom of the pillar A. B, the stage, or the plane, on which the objects are to be placed; it fits into the small dove-tailed arm which is at the upper end of the pillar DA. C, a plane glass, with a small piece of black silk stuck on it; this glass is to lay in a groove made in the stage C. M, a hollow glass to be laid occasionally on the stage instead Fig. 4.

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stead of the plane glass C. L, a pair of nippers. These are fixed to the stage by the pin at bottom; the steel wire of these nippers slides backwards and forwards in the socket, and this socket is moveable upwards and downwards by means of the joint, so that the position of the object may be varied at pleasure. The object may be fixed in the nippers, stuck on the point, or affixed, by a little gum-water, &c. to the ivory cylinder N, which occasionally screws to the point of the nippers.

To *use* this microscope: Take all the parts of the apparatus out of the box; then begin by screwing the pillar A to the cover thereof; pass the pin R of the semicircle which carries the mirror through the hole that is near the bottom of the pillar A; push the stage into the dove-tail at B, slide the pin into the pillar (see the *N. B.* above); then pass the bar E through the socket which is at the top of the pin D, and screw one of the magnifying lenses into the ring at F. The microscope is now ready for use: and though the enumeration of the articles may lead the reader to imagine the instrument to be of a complex nature, we can safely affirm that he will find it otherwise. The instrument has this peculiar advantage, that it is difficult to put any of the pieces in a place which is appropriated to another. Let the object be now placed either on the stage or in the nippers L, and in such manner that it may be as nearly as possible over the centre of the stage: bring the speculum F over the part you mean to observe; then throw as much light on the speculum as you can, by means of the mirror I, and the double motion of which it is capable; the light received on the speculum is reflected by it on the object. The distance of the lens F from the object is regulated by moving the pin D up and down, until a distinct view of it is obtained. The best rule is, to place the lens beyond its focal distance from the object, and then gradually to slide it down till the object appears sharp and well defined. The adjustment of the lenses to their focus, and the distribution of the light on the object, are what require the most attention: on the first the distinctness of the vision depends; the pleasure arising from a clear view of the parts under observation is due to the modification of the light. No precise rule can be given for attaining accurately these points; it is from practice alone that ready habits of obtaining these necessary properties can be acquired, and with the assistance of this no difficulty will be found.

5. A very simple and convenient microscope for botanical and other purposes, though inferior in many respects to that of Mr Ellis, was contrived by the ingenious Mr Benjamin Martin, and is represented at

Fig. 5.

fig. 5. where AB represents a small arm supporting two or more magnifiers, one fixed to the upper part as at B, the other to the lower part of the arm at C; these may be used separately or combined together. The arm AB is supported by the square pillar IK, the lower end of which fits into the socket E of the foot FG; the stage DL is made to slide up and down the square pillar; H, a concave mirror for reflecting light on the object.—To *use* this microscope, place the object on the stage, reflect the light on it from the concave mirror, and regulate it to the focus, by moving the stage nearer to or farther from the lens at B. The ivory sliders pass through the stage; other objects may be fixed in the nippers MN, and then brought under the eye-glasses; or they may be laid on one of the glasses which fit the stage. The apparatus to this instrument consists of three ivory sliders; a pair of nippers; a pair of forceps; a flat glass and a concave ditto, both fitted to the stage.

The two last microscopes are frequently fitted up with a toothed rack and pinion, for the more ready adjustment of the glasses to their proper focus.

6. *Withering's portable Botanic Microscope.* Fig. 6. Fig. 6.
represents a small botanical microscope contrived by Dr Withering, and described by him in his *Botanical Arrangements.* It consists of three brass plates, ABC, which are parallel to each other; the wires D and E are rivetted into the upper and lower plates, which are by this means united to each other; the middle plate or stage is moveable on the aforesaid wires by two little sockets which are fixed to it. The two upper plates each contain a magnifying lens, but of different powers; one of these confines and keeps in their places the fine point F, the forceps G, and the small knife H.—To *use* this instrument, unscrew the upper lens, and take out the point, the knife, and the forceps; then screw the lens on again, place the object on the stage, and then move it up or down till you have gained a distinct view of the object, as one lens is made of a shorter focus than the other; and spare lenses of a still deeper focus may be had if required. This little microscope is the most portable of any. Its principal merit is its simplicity.

7. *Botanical Lenses or Magnifiers.* The haste with which botanists, &c. have frequently occasion to view objects, renders an extempore pocket-glass indispensably necessary. The most convenient of any yet constructed, appears to be that contrived, in regard to the form of the mounting, by Mr Benjamin Martin; and is what he called a *Hand Megalascope*, because it is well adapted for viewing all the larger sort of small objects universally, and by only three lenses it has seven different magnifying powers.

Fig. 7. represents the case with the three frames and Fig. 7.
lenses, which are usually of 1, $1\frac{1}{2}$, and 2 inches focus: they all turn over each other, and shut into the case, and are turned out at pleasure.

The three lenses singly, afford three magnifying powers; and by combining two and two, we make three more: for *d* with *e* makes one, *d* with *f* another, and *e* with *f* a third; which, with the three singly, make six; and lastly, all three combined together make another; so that upon the whole, there are seven powers of magnifying with these glasses only.

When the three lenses are combined, it is better to turn them in, and look through them by the small apertures in the sides of the case. The eye in this case is excluded from extra light; the aberration of the superfluous rays through the glasses is cut off; and the eye coincides more exactly with the common axes of the lenses.

A very useful and easy kind of microscope (described by Joblot, and which has been long in use), adapted chiefly for viewing, and confining at the same time, any living insects, small animals, &c. is shown at fig. 8. where A represents a glass tube, about $1\frac{1}{4}$ inches diameter, and 2 inches high. B, a case of brass or wood, containing a sliding tube, with two or three magnifying

Plate cccxxxviii.

Fig. 8.

Microscope. ing glasses that may be used either separately or combined. In the inside, at the bottom, is a piece of ivory, black and white on opposite sides, that is occasionally removed, and admits a point to be screwed into the centre. The cap unscrews at D, to admit the placing of the object: the proper distance of the glasses from the object is regulated by pulling up or down the brass tube E at top containing the eye-glasses.

This microscope is particularly useful for exhibiting the well-known curious *curculio imperialis*, vulgarly called the *diamond beetle*, to the greatest advantage; for which, as well as for other objects, a glass bottom, and a polished reflector at the top, are often applied, to condense the light upon the object. In this case, the stand and brass-bottom F, as shown in the figure, are taken away by unscrewing.

9. *Mr Lyonet's Single Anatomical Dissecting Microscope.*—Fig. 9. represents a curious and extremely useful microscope, invented by that gentleman for the purpose of minute dissections, and microscopic preparations. This instrument must be truly useful to amateurs of the minutiæ of insects, &c. being the best adapted of any for the purposes of dissection. With this instrument Mr Lyonet made his very curious microscopical dissection of the *chenille de saule*, as related in his *Traité Anatomique de la chenille qui ronge le bois de saule*, 4to. Fig. 9.

AB is the anatomical table, which is supported by a pillar NO; this is screwed on the foot CD. The table AB is prevented from turning round by means of two steady pins. In this table or board there is a hole G, which is exactly over the centre of the mirror EF, that is to reflect the light on the object; the hole G is designed to receive a flat or concave glass, on which the objects for examination are to be placed.

RXZ is an arm formed of several balls and sockets, by which means it may be moved in every possible situation; it is fixed to the board by means of the screw H. The last arm IZ has a female screw, into which a magnifier may be screwed as at Z. By means of the screw H, a small motion may be occasionally given to the arm IZ, for adjusting the lens with accuracy to its focal distance from the object.

Another chain of balls is sometimes used, carrying a lens to throw light upon the object; the mirror is likewise so mounted, as to be taken from its place at K, and fitted on a clamp, by which it may be fixed to any part of the table AB.

To use the Dissecting Table.—Let the operator sit with his left side near a light window; the instrument being placed on a firm table, the side DH towards the stomach, the observations should be made with the left eye. In dissecting, the two elbows are to be supported by the table on which the instrument rests, the hands resting against the board AB; and in order to give it greater stability (as a small shake, though imperceptible to the naked eye, is very visible in the microscope), the dissecting instruments are to be held one in each hand, between the thumb and two forefingers.

II. *Of* Double *Microscopes, commonly called* Compound *Microscopes.*

Double microscopes are so called, from being a combination of two or more lenses.

The particular and chief advantages which the compound microscopes have over the single, are, that the objects are represented under a larger field of view, and with a greater amplification of reflected light. Microscope.

1. *Culpeper's Microscope.*—The compound microscope, originally contrived by Mr Culpeper, is represented at fig. 10. It consists of a large external brass body A, B, C, D, supported upon three scrolls, which are fixed to the stage EF; the stage is supported by three larger scrolls, that are screwed to the mahogany pedestal GH. There is a drawer in the pedestal, which holds the apparatus. The concave mirror *I* is fitted to a socket in the centre of the pedestal. The lower part LMCD of the body forms an exterior tube, into which the upper part of the body ABLM slides, and may be moved up or down, so as to bring the magnifiers, which are screwed on at N, nearer to or farther from the object. Fig. 10.

To *use* this microscope: Screw one of the buttons, which contains a magnifying lens, to the end N of the body: place the slider, with the objects, between the plates of the slider-holder. Then, to attain distinct vision, and a pleasing view of the object, adjust the body to the focus of the lens you are using, by moving the upper part gently up and down, and regulate the light by the concave mirror.

For opaque objects, two additional pieces must be used. The first is a cylindrical tube of brass (represented at L, fig. 11.), which fits on the cylindrical part at N of the body. The second piece is the concave speculum *h*; this is to be screwed to the lower end of the aforesaid tube: the upper edge of this tube should be made to coincide with the line which has the same number affixed to it as to the magnifier you are using; *e. g.* if you are making use of the magnifier marked 5, slide the tube to the circular line on the tube N that is marked also with N° 5. The slider-holder should be removed when you are going to view opaque objects, and a plane glass should be placed on the stage in its stead to receive the object; or it may be placed in the nippers, the pin of which fits into the hole in the stage. Fig. 11.

The apparatus belonging to this microscope consists of the following particulars: viz. Five magnifiers, each fitted in a brass button; one of these is seen at N, fig. 10. Six ivory sliders, five of them with objects. A brass tube, to hold the concave speculum. The concave speculum in a brass box. A fish pan. A set of glass tubes. A flat glass fitted to the stage. A concave glass fitted to the stage. A pair of forceps. A steel wire, with a pair of nippers at one end and a point at the other. A small ivory cylinder, to fit on the pointed end of the aforesaid nippers. A convex lens, moveable in a brass semicircle; this is affixed to a long brass pin, which fits into a hole on the stage.

The construction of the foregoing microscope is very simple, and it is easy in use; but the advantages of the stage and mirror are too much confined for an extensive application and management of all kinds of objects. Its greatest recommendation is its cheapness; and to those who are desirous of having a compound microscope at a low price, it may be acceptable.

2. *Cuff's Microscope.* The improved microscope next in order is that of Mr Cuff. Besides remedying the disadvantages above mentioned, it contains the addition-

Microscope. addition of an adjusting screw, which is a considerable improvement, and highly necessary to the examination of objects under the best defined appearance from the glasses. It is represented at fig. 11. with the apparatus that usually accompanies it. AB, C, shows the body of this microscope; which contains an eye-glass at A, a broad lens at B, and a magnifier which is screwed on at C. The body is supported by the arm DE, from which it may be removed at pleasure. The arm DE is fixed on the sliding bar F, and may be raised or depressed to any height within its limits. The main pillar *a b* is fixed in the box *b e;* and by means of the brass foot *d* is screwed to the mahogany pedestal XY, in which is a drawer containing all the apparatus. O is a milled-headed screw, to tighten the bar F when the adjusting screw *c g* is used. *p q* Is the stage, or plate, which carries the objects; it has a hole at the centre *n*. G, a concave mirror, that may be turned in any direction, to reflect the light of a candle, or the sky, upon the object.

Fig. 11.

To *use* this microscope: Screw the magnifier you intend to use to the end C of the body; place the slider-holder P in the hole *n*, and the slider with the object between the plates of the slider-holder; set the upper edge of the bar DE to coincide with the divisions which correspond to the magnifier you have in use, and pinch it by the milled nut; now reflect a proper quantity of light upon the object, by means of the concave mirror G, and regulate the body exactly to the eye and the focus of the glasses by the adjusting screw *c g*.

To view *opaque* objects, take away the slider-holder P, and place the object on a flat glass under the centre of the body, or on one end of the jointed nippers *o p*. Then screw the silver concave speculum *h* to the end of the cylinder L, and slide this cylinder on the lower part of the body, so that the upper edge thereof may coincide with the line which has the same mark with the magnifier that is then used: reflect the light from the concave mirror G to the silver speculum, from which it will again be reflected on the object. The glasses are to be adjusted to their focal distance as before directed.

The *apparatus* consists of a convex lens H, to collect the rays of light from the sun or a candle, and condense them on the object. L a cylindrical tube, open at each side, with a concave speculum screwed to the lower end *h*. P the slider-holder: this consists of a cylindrical tube, in which an inner tube is forced upwards by a spiral spring; it is used to receive an ivory slider K, which is to be slid between the plates *h* and *i*. The cylinder P fits the hole *n* in the stage; and the hollow part at *k* is designed to receive a glass tube. R is a brass cone, to be put under the bottom of the cylinder P, to intercept occasionally some of the rays of light. S, a box containing a concave and a flat glass, between which a small living insect may be confined: it is to be placed over the hole *n*. T a flat glass, to lay any occasional object upon; there is also a concave one for fluids. O is a long steel wire, with a small pair of pliers at one end, and a point at the other, designed to stick or hold objects: it slips backwards and forwards in the short tube *o;* the pin *p* fits into the hole of the stage. W, a little round ivory box, to hold a supply of talc and rings for the sliders. V, a small ivory cylinder, that fits on the pointed end of the steel wire: it is designed for opaque objects. Light-coloured ones are to be stuck upon the dark side, and *vice versa*. M, a fish-pan, whereon to fasten a small fish, to view the circulation of the blood: the tail is to be spread across the oblong hole *k* at the small end, and tied fast, by means of a ribband fixed thereto; the knob *l* is to be shoved through the slit made in the stage, that the tail may be brought under the magnifier.

3. This microscope has received several material improvements from Mr Martin, Mr Adams, &c. By an alteration, or rather an enlargement, of the body of the tube which contains the eye-glasses, and also of the eye glasses themselves, the field of view is made much larger, the mirror below for reflecting light is made to move upon the same bar with the stage; by which means the distance of it from the stage may be very easily and suitably varied. A condensing glass is applied under the stage in the slider-holder, in order to modify and increase the light that is reflected by the mirrors below from the light of a candle or lamp. It is furnished also with two mirrors in one frame, one concave and the other plane, of glass silvered; and by simply unscrewing the body, the instrument, when desired, may be converted into a single microscope. Fig. 12. is a representation of the instrument thus improved; and the following is the description of it, as given by Mr Adams in his Essays.

Fig. 12.

AB represents the body of the microscope, containing a double eye glass and a body-glass: it is here shown as screwed to the arm CD, from whence it may be occasionally removed, either for the convenience of packing, or when the instrument is to be used as a single microscope.

The eye-glasses and the body-glasses are contained in a tube which fits into the exterior tube AB; by pulling out a little this tube when the microscope is in use, the magnifying power of each lens is increased.

The body AB of the microscope is supported by the arm CD; this arm is fixed to the main pillar CF, which is screwed firmly to the mahogany pedestal GH; there is a drawer to this pedestal, which holds the apparatus.

NIS, the plate or stage which carries the slider-holder KL: this stage is moved up or down the pillar CF, by turning the milled nut M; this nut is fixed to a pinion, that works in a toothed rack cut on one side of the pillar. By means of this pinion, the stage may be gradually raised or depressed, and the object adjusted to the focus of the different lenses.

KL is a slider-holder, which fits into a hole that is in the middle of the stage NIS; it is used to confine and guide either the motion of the sliders which contain the objects, or the glass tubes that are designed to confine small fishes for viewing the circulation of the blood. The sliders are to be passed between the two upper plates, the tubes through the bent plates.

L is a brass tube, to the upper part of which is fixed the condensing lens before spoken of; it fits into the under part of the slider-holder KL, and may be set at different distances from the object, according to its distance from the mirror or the candle.

O is the frame which holds the two reflecting mirrors, Microscope. rors, one of which is plane, the other concave. These mirrors may be moved in various directions, in order to reflect the light properly, by means of the pivots on which they move, in the semicircle QSR, and the motion of the semicircle itself on the pin S: the concave mirror generally answers best in the day-time; the plane mirror combines better with the condensing lens, and a lamp or candle. At D there is a socket for receiving the pin of the arm Q (fig. 31.), to which the concave speculum, for reflecting light on opaque objects, is fixed. At S is a hole and slit for receiving either the nippers L (fig. 31.) or the fish-pan I; when these are used, the slider-holder must be removed. T, a hole to receive the pin of the convex lens M.

Plate CCCXLI. fig. 31.

To *use* this microscope: Take it out of the box. Screw the body into the round end of the upper part of the arm CD. Place the brass sliders, which contain the magnifiers, into the dove-tailed slit which is on the under side of the aforesaid arm, as seen at E, and slide it forwards until the magnifier you mean to use is under the centre of the body: opposite to each magnifier in this slit there is a notch, and in the dove-tailed part of the arm CD there is a spring, which falls into the above-mentioned notch, and thus makes each magnifier coincide with the centre of the body. Pass the ivory slider you intend to use between the upper plates of the slider-holder KL, and then reflect as strong a light as you can on the subject by means of one of the mirrors; after this, adjust the object to the focus of the magnifier and your eye, by turning the milled screw M, the motion of which raises and depresses the stage NIS. The degree of light, necessary for each object, and the accuracy required in the adjustment of the lenses to their proper focal distance from the object will be easily attained by a little practice.

When *opaque* objects are to be examined, remove the slider-holder, and place the object on a flat glass, or fix it to the nippers L, the pin of these fit into the hole on the stage; screw the concave speculum R into the arm Q (fig. 31.), and then pass the pin of this arm through the socket D (fig. 12.); the light is now to be reflected from the concave mirror to the silver speculum, and from this down on the object. No exact rule can be given for reflecting the light on the object; we must therefore refer the reader to the mother of all aptness, practice. The speculum must be moved lower or higher, to suit the focus of the different magnifiers and the nature of the object.

The foregoing directions apply equally to the using of this instrument as a *single microscope;* with this difference only, that the body AB is then removed, and the eye is applied to the upper surface of the arm CD, exactly over the magnifiers.

This microscope is sometimes made with the following *alterations*, which are supposed to make it still more convenient and useful. The arm CD that carries the body and magnifiers is made both to turn on a pin, and to slide backwards and forwards in a socket at C; so that, instead of moving the objects below on the stage, and disturbing them, the magnifiers are more conveniently brought over any part of the objects as desired. The condensing glass is made larger, and slides upon the square bar CF quite distinct from the stage, like the mirrors below; and it is thereby made useful for any other objects that may be applied on Microscope. glasses fitted to the stage, as well as those put into the slider-holder K. It is thereby not confined to this stage alone as in the preceding. When the body AB is taken away, the arm CD may be slipt away from its bar, with the magnifiers, and the forceps, wire, and joint, applied to it; and it thereby serves the purpose of a small single or opaque hand microscope, for any object occasionally applied to this wire. The magnifiers in the slider E are mounted in a wheel case, which perhaps prevents its being in the way so much as the long slider E before described.—This contrivance is represented at X, fig. 12.

4. *Martin's New Universal Compound Microscope.*—This instrument was originally constructed by Mr B. Martin, and intended to comprise all the uses and advantages of the single, compound, opaque, and aquatic microscopes. The following is a description of it.

Plate CCCXXIX. fig. 13.

Fig. 13. is a representation of the instrument placed up for use. ABCD is the body of the microscope: which consists of four parts, viz. AB the eye-piece, or that containing the eye-glasses, and is screwed into C, which is a moveable or sliding tube on the top; this inner tube contains the body-glass screwed into its lower part. D is the exterior tube or case, in which the other slides up and down in an easy and steady manner. This motion of the tube C is useful to increase and decrease the magnifying power of the body-glass when thought necessary, as before mentioned. E is a pipe or snout screwed on to the body of the microscope D, and at its lower part, over the several magnifying lenses hereafter described. FGHI is the square stem of the microscope, upon which the stage R moves in an horizontal position, upwards or downward, by means of the fine rack-work of teeth and pinion. KL is a strong solid joint and pillar, by which the position of the instrument is readily altered from a vertical one to an oblique or to a perfectly horizontal one as may be required: it is thus well adapted to the ease of the observer either sitting or standing; and as it is very often convenient to view objects by direct unreflected light, when the square stem FI is placed in a horizontal position for this purpose, the mirror T is then to be taken off in order to prevent the obstruction of the rays. M is a circular piece of brass, serving as a base to the pillar. NOP, the tripod or foot by which the whole body of the microscope is steadily supported; it folds up when packed into the case. W is a brass frame, that contains the condensing lens, and acts in conjunction with the large concave and plane mirrors below at T; the reflected rays from which, either of the common light or of that of a candle or lamp, it agreeably modifies, and makes steady in the field of view.

The particulars of the apparatus to this microscope are as follow: Q is a circular brass box, containing six magnifiers or object lenses, numbered 1, 2, 3, 4, 5, 6; the digits of which appear severally through a small round hole in the upper plate of it. To the upper side is fixed a small circle of brass, by which it is connected with, and screwed into, the round end of the arm *abcd;* which is a long piece of brass, and moves through either by teeth or pinion, or not, as may be desired, in *ef;* which is a socket on the upper part of the pillar, and admits, with a motion both easy and steady, the brass

Microscope. brass arm. R is a fixed stage, upon which the objects to be viewed are to be placed: it is firmly fastened to the square pillar, which is moved by the rack-work. In the middle is a large circular hole, for receiving concave glasses, with fluids, &c. it has also a sliding spring frame to fasten down slips of glass or other things: at *abc* are three small sockets or holes, intended to receive several parts of the apparatus. S is the refractor, or illuminating lens, for converging the sun's rays upon opaque objects laid upon the stage R. To this purpose it moves on a semicircle upon a long shank *g*, in a spring socket *h*, in the arm *i*; this arm moving every way by a stout pin *k* in the socket *a* of the stage. In this manner it is easily adjusted to any position of the sun, candle, &c.—T, the reflecting-glass frame, containing a concave and plane speculum, which is moved upon the square pillar by the hand. The use of it is to illuminate all transparent objects that are applied to the stage above.

Fig. 14. Fig. 14. N° 1. is an auxiliary moveable stage; which by means of a pin *k* is placed in the hole *a* of the stage R, and can be moved in a horizontal direction over the whole field of the stage. In this stage, there are three circular holes with shouldered bottoms; a large one in the middle, and on each side a small one, for the reception of the three following necessary articles: N° 2. a watch-glass to be placed in the large hole, to hold fluids containing animalcules, &c.; a circular piece of ivory, N° 3. one side of which is black, the other white, to support opaque objects of different contrasted colours; and circular plane and concave glasses, N° 4. for extemporaneous transparent objects. —The same use is made of the other small hole as of the large one, only in a lesser degree, to receive small concave glasses, plates, &c.

N° 5. is the silvered speculum, called a *Liberkhun*, which makes the single opaque microscope, by being screwed to the slider *abcd* (fig. 13.) in room of the box of lenses Q, and the body AE above it. The chief use of this is to view very small objects strongly illuminated near the compounded focus of the mirror T (fig. 13.). N° 6. is the forceps or pliers, for holding such kind of objects, and by which they can be applied very readily to the focus of the lens in the liberkhun. They have a motion all ways by means of the spring socket *a*, the joint *b*, and the shank *c*: they are placed in the socket *c* of the fixed stage R (fig. 13.). N° 7. is a small piece of ivory, to be placed upon the pointed end of the pliers: it is black upon one side, and white upon the other, to receive opaque objects.

N° 8. is a liberkhun of a larger size than that first mentioned, with a hole in its centre: this is screwed into N° 9. the hole *a* of a brass ring, fastened to a long wire *b*; which moves up and down in the spring socket *b* of the stage R, in which it also moves sideways; and thus, with the body AE above, forms an *aquatic compound microscope* for showing all sorts of objects in water and other fluids placed under it in the watch-glass N° 2. on the stage.

N° 11. is a cone, with a proper aperture *a* to exclude superfluous light, that would disturb a critical observation of a curious object; it is placed on the under side of the fixed stage R.

N° 12. is what is usually called a bug-box, consisting of a concave glass with a plane one screwed over it; by means of which a bug, louse, flea, &c. may be secured and viewed alive. It is to be placed on either of the stages R (fig. 13.), or N° 1. (fig. 14.). Microscope.

N° 13. is the fish-pan. In the long concave body *ab*, a fish may be so confined by the ribband *c*, that the transparent tail may be in part over the slit or hole at *a*. In this state, it is placed on the stage R, with the pin *d* in the hole *c* of the stage, and moves freely and horizontally for viewing the circulation of the blood, &c.

N° 14. is the slider-holder that is placed on the stage R: it receives the sliders and tubes when filled with transparent objects, to be viewed either by the compound or single microscope.

N° 15. represents the ivory slider, to hold the objects between the talcs as usual.

N° 16. is a useful auxiliary slider framed in brass. In this slider small concave glasses are cemented; and a slip of plane glass slides over them; by which any small living object, as mites, &c. may be confined without injury, and deliberately viewed.

N° 17. represents a set of glass tubes, three in number, one within another; they are useful for small tadpoles, water newts, eels, &c. when the circulation of the blood is to be viewed. There is a small hole at one end of each tube, that serves to admit the air; for when they are filled with water, the other end is stopped with a cork.

N° 18. is a small ivory box, containing spare talcs and wires, to supply the sliders with occasionally.

N° 19. a brass cell or button, containing a very small lens, properly set between two small plates of brass, that it may be brought very near to the object when viewed therewith as a single microscope. This magnifier is screwed into the same hole as the wheel of six magnifiers Q are (fig. 13.).

N° 20. is a lens, adapted to view and examine objects, by magnifying them sufficiently, so as to be able to apply them to the microscope for inspection: on this account it is called the *explorator*.

The preceding are the chief articles of the apparatus: which, on account of their being somewhat different from what is applied to other microscopes, we have been thus particular in describing. In using the microscope, and while viewing objects by either the single or compound instrument, the focal distances of the magnifiers are made perfectly exact by turning of the pinion at the nut *w*, in one way or the other, very gently in the teeth of the rack-work at X (fig. 13.).

It is necessary that the centres of the object-lenses or magnifiers, the stage, and the mirrors at bottom, should all be in a right line in the axis of the microscope, when opaque objects are to be viewed, that are placed upon the ivory piece N° 7. or the forceps N° 6. and all other such sort of objects which are placed in the centre of the stage R, or slider-holder N° 14: But when aquatic or living objects, which require a great space to move in, are to be viewed, then the horizontal motion at *ef* (fig. 13.) is made use of, and the view may be extended laterally over the whole of the diameter of the object or field of view; and by putting the arm *abcd* forward or backward in its socket *ef*, the view is extended in the contrary direction

direction equally well; and in this manner the whole of the objects may be viewed without the leaſt diſturbance.

As the braſs arm *abcd* may be brought to the height of three or four inches above the ſtage R; ſo, by means of the rack-work motion of the ſtage, a lens of a greater focal diſtance than the greateſt in the wheel Q may be occaſionally applied in place of the wheel, and thereby the larger kind of objects be viewed; the inſtrument becoming, in this caſe, what is called a *megalaſcope*.

In viewing moving living objects, or even fixed ones, when nice motions are requiſite, a rack-work and pinion is often applied to the arm *abcd*: the arm is cut out with teeth; and the pinion, as ſhown at Y, is applied to work it. This acts but in one direction; and, in order to produce an equally neceſſary motion perpendicular to this, rack-work and pinion is applied tangent-wiſe to the ſtage, which is then jointed.

What has been related above reſpects the conſtruction of thoſe denominated *parlour* microſcopes, in contradiſtinction to thoſe which are portable: their dimenſions, however, have been conſiderably reduced by opticians, in order to render them fit for the pocket; and as they are for the moſt part conſtructed on nearly the ſame principles as thoſe which have been already deſcribed, what has been ſaid will ſufficiently inſtruct our readers in uſing any pocket microſcope whatever. Only it may be obſerved, that in thoſe reduced inſtruments, both the field of view and the magnifying power are proportionably diminiſhed.

We ſhall conclude the account of this ſort of microſcope with deſcriptions of a very portable pocket apparatus of microſcopic inſtruments, and of a new microſcopic pocket teleſcope, both invented by the late Mr B. Martin, and ſince made by moſt inſtrument-makers in London.

The former is repreſented at fig. 15. It conſiſts of two parts, viz. the body *ab*, and the pedeſtal *ik*, which is joined by a ſcrew at the part between *b* and . It conſiſts of three cylindric tubes, viz. (1.) the exterior tube, or caſe, *ab*; (2.) a middle tube *cb*; and (3.) the interior tube *fg*. The middle tube *cd* is the adjuſter; and is connected with the outer tube by the rack-work of teeth and pinion, as ſhown at *e*: by which means it is moved up and down at pleaſure through the ſmalleſt ſpace, and carries with it the internal tube *fg*. The interior tube *fg* receives on its lower part at *b* the ſeveral capſules or boxes 2, 3, 4, 5, (fig. 16.) which contain the object lenſes or magnifiers.

The method of *uſing* this compound microſcope in the perpendicular poſition, is as follows: The ſtage N° 1. is put within the exterior tube at *b*. Under the ſprings are applied the four ivory ſliders, which contain a variety of tranſparent objects; then move the interior tube *fg* up and down with the hand, till you diſcern the object in the ſlider, and there let it reſt. After this, turn the pinion at *e* very tenderly one way or the other, till you obtain a perfect view of the tranſparent objects properly illuminated, from a mirror contained in the pedeſtal or ſtand *ik*, ſuſpended upon, and moveable about, the points of two ſcrews (*ll*). N° 6. (fig. 16.) repreſents a moveable ſtage, which is placed in the ſpring ſocket *m*. It contains a concave glaſs, for the reception of animalcules in fluids; and has the advantage of bringing any part into view by moving the handle at *n*. If living and moving objects are required to be ſhown, they muſt be confined in the concave, by putting a glaſs cover, N° 7. upon the ſtage; and then a ſmall ſpider, a louſe, a flea, bug, &c. may be ſeen, and the motion or circulaton of the blood, &c. obſerved with ſurpriſing diſtinctneſs.

To view the circulation of the blood in the moſt eminent degree, it muſt be done by placing ſmall frogs, tadpoles, water-newts, fiſhes, &c. in a tube as repreſented N° 8. (fig. 17.); which tube is placed in the holes *o* in the oppoſite ſides of the caſe *ab*, fig. 15. in the lower part.—N° 9. (fig. 16.) is a pair of pincers or pliers *d*, for holding any object; the other end of the ſteel wire is pointed to receive a piece of ivory *b*, with one end black, and the other white, on which you ſtick objects of different hue: this alſo, when uſed, is placed in the ſpring ſocket *m*.

To uſe this inſtrument as a compound opaque, you ſcrew off the body part *ab*, and ſcrew to it the handle *r* (fig. 16.); by this means you may hold the microſcope in a horizontal poſition, as ſhown in the figure. The ſilver diſh or ſpeculum (which is contained in the bottom or baſe *k*, fig. 15.), is then ſcrewed on at *b*. N° 9. is placed in the ſpring ſocket *m*, and adjuſted backward and forward in *m*, till the reflected light from the ſpeculum falls in a proper manner on the opaque object. Either of the 4 magnifiers, 2, 3, 4, 5, may be uſed, and brought to a proper focus, as before deſcribed by the tooth and pinion *e* (fig. 15.). If you take off the opaque apparatus, and apply the ſtage N° 1. (fig. 16.) with an ivory ſlider, and at the end *b* ſcrew in either of the two lenſes, N° 10. (which are diſtinguiſhed by the name of illuminators), the microſcope being held up to the light (and properly adjuſted), the whole field of view will be ſtrongly illuminated, and preſent a moſt pleaſing appearance of any tranſparent object. Theſe two convex lenſes are of different focuſes, and are to be uſed ſingly or together; N° 2. being the greateſt magnifier, will require the object to be ſtrongly illuminated, and of courſe both the lenſes muſt be uſed together. By candle-light, this method of viewing tranſparent objects will prove very entertaining; by ſcrewing the handle *r* into the part *s* of N° 10. it becomes a delightful hand megalaſcope for viewing flowers, foſſils, ſhells, &c.; and each lens, as before mentioned, having a different focus, produces two magnifying powers uſed ſingly, and when combined a third.

The manner of uſing this inſtrument as a ſingle microſcope (like Wilſon's) is repreſented in fig. 17. where the button or magnifier at each is to be ſcrewed off, and the circular piece N° 11. is ſcrewed in its place. This piece has a ſpring ſocket made to receive the ſlider-holder N° 12. N° 13. is a circular piece of braſs, with a long ſhank and ſpring, and is introduced through the outſide tube *ab* at *t*. N° 2, 3, 4, 5, are ſcrewed occaſionally in the centre of this piece, and uſed as ſingle lenſes with ivory ſliders, &c. N° 14. contains a lens of a great magnifying power, for viewing very minute objects: to reder this inſtrument the moſt complete ſingle opaque microſcope, you have only to ſcrew into N° 13. the

Microscope. the filver fpeculum N° 15. which has a fmall lens fet in its centre. The flider-holder N° 12. is taken out of N° 11. and the pincers or nippers *db*, being detached from the other part of N° 9. are paffed through the long fpring focket N° 11. and ready to receive any opaque body in the pincers, or on the black and white piece of ivory. To the large fcrew of N° 13. are applied the two lenfes N° 10. which make it the completeft megalafcope that can be defired.

The handle *r* contains the four ivory fliders with objects.

The fhagreen cafe which contains this univerfal microfcope and its apparatus, is fix inches long, three inches wide, two inches deep; and weighs together 16 ounces. "Thus (fays Mr Martin) fo fmall, fo light, fo portable, and yet fo univerfally complete, is this pocket microfcopic apparatus, that you find nothing material in the large three-pillared microfcope, the opaque microfcope, Wilfon's fingle microfcope, and the aquatic microfcope, all together, which you have not in this; befides fome very confiderable advantages in regard to the field of view, &c. which they have not (A)."

This inventive artift having contrived a conftruction of the compound microfcope fo fmall as to admit of being packed in a common walking cane, thought next of introducing the fame inftrument into the infide of what he called his *Pocket Three-brafs drawer Achromatic Telefcope*. The fame eye glaffes that ferve the purpofe of a telefcope, anfwer as the compound magnifier, for viewing tranfparent and opaque objects in a microfcope.

Fig. 18, 19, 20, reprefent the telefcope feparated by unfcrewing it at *m*, in order that the whole of the neceffary parts in ufe may be exhibited. Fig. 19. reprefents the exterior tube, which is of mahogany, and its rims of brafs. It is detached from the reft of the telefcope, as not making any part of the microfcope. The brafs cover *k l*, that fhuts up the object-glafs of the telefcope, is alfo the box which contains the two-wheel object frames, and a fmall plain reflecting mirror.

In fig. 20. A is the cover taken off, by unfcrewing the top part: The mirror B is taken out; and alfo, by unfcrewing the bottom part, the two circular wheels, with the objects fhown in C and D.

Fig. 18. is a reprefentation of the three internal brafs fliding tubes of the telefcope, which form the microfcopic part. The tubes are to be drawn out as fhown in this figure; then, at the lower end of the large tube in the infide, is to be pulled out a fhort tube *b c*, that ferves as a kind of ftage to hold the wheels with objects, and fupport the reflecting mirror. This tube is to be partly drawn out, and turned fo that the circular hole that is pierced in it may coincide with a fimilar hole that is cut in the exterior tube. This tube is reprefented as drawn out in the figure; and the mirror B placed therein, and the wheel with Microfcope. tranfparent objects. C (fig. 20.) reprefents the wheel with tranfparent objects, and D the wheel with opaque objects. They are both made of ivory; and turn round upon a centre brafs pin flit upon the top, which fits upon the edge of the tube; which tube is then to be pufhed up into the telefcope tube, fo that its lower end may reft upon the upper edge of the wheel according to its view at *a* fig. 18.

In viewing the objects, the fecond brafs tube of the telefcope muft be pufhed down, till its milled edge at top falls upon that of the exterior tube; taking care that the circular hole is duly placed to the exterior one. Thefe circular holes are not feen in fig. 18. being fuppofed in the oppofite fide, where the wheel is fixed. The adjuftment for the focus is now only neceffary; which is obtained by pufhing downwards or upwards the proper tube, till the object appear quite diftinct. In viewing tranfparent objects, the inftrument may be ufed in two pofitions; one vertical, when the light is to be reflected upon the object by the mirror; the other, by looking up directly againft the light of a candle, common light, &c; in which cafe the mirror muft be taken away. In viewing opaque objects, the mirror is not ufed; but as much common light as poffible muft be admitted through the circular holes in the fides of the tubes.

There is a fpare hole in the tranfparent wheel, and alfo one in the opaque, to receive any occafional object that is to be viewed. Any fort of object whatfoever may be viewed, by only pufhing up the microfcope tube into its exterior, and bringing the firft eye-tube to its focal diftance from the object.

The brafs tubes are fo contrived, that they ftop when drawn out to the full length: fo that by applying one hand to the outfide tube, and the other to the end of the fmalleft tube, the telefcope at one pull may be drawn out; then any of the tubes (that next to the eye is beft) may be pufhed in gradually, till the moft diftinct view of the object be obtained.

The tubes all flide through fhort brafs fpring tubes, any of which may be unfcrewed from the ends of the fliding tubes by means of the milled edges which project above the tubes, taken from each other, and the fprings fet clear if required.

III. *Of Solar Microfcopes.*

This inftrument, in its principle, is compofed of a tube, a looking-glafs or mirror, a convex lens, and Wilfon's fingle microfcope before defcribed. The fun's rays being reflected through the tube by means of the mirror upon the object, the image or picture of the object is thrown diftinctly and beautifully upon a fcreen of white paper or a white linen fheet, placed at a proper diftance to receive the fame; and may be magnified Plate CCCXL

(A) Notwithftanding the properties that have been afcribed to the above inftrument, and the praifes beftowed upon it by fome, which induced us to admit fo minute a defcription; we muft apprife our readers, that it has been omitted in Mr Adams's enumeration: and upon inquiry we learn, that it has fallen into neglect among the moft judicious opticians, being found too imperfect to ferve the purpofes of fcience, and too complicated for the ufe of perfons who feek only entertainment.

Microſcope. magnified to a ſize not to be conceived by thoſe who have not ſeen it: for the farther the ſcreen is removed, the larger will the object appear; inſomuch, that a louſe may thus be magnified to the length of five or ſix feet, or even a great deal more; though it is more diſtinct when not enlarged to above half that ſize.

The different forms in which the Solar Microſcope is conſtructed, are as follow.

I. The old conſtruction is repreſented in fig. 21. A is a ſquare wooden frame, through which paſs two long ſcrews aſſiſted by a couple of nuts 1, 1. By theſe it is faſtened firmly to a window ſhutter, wherein a hole is made for its reception; the two nuts being let into the ſhutter, and made faſt thereto. A circular hole is made in the middle of this frame to receive the piece of wood B, of a circular figure; whoſe edge, that projects a little beyond the frame, compoſes a ſhallow groove 2, wherein runs a catgut 3; which, by twiſting round, and then croſſing over a braſs pulley 4, (the handle whereof 5, paſſes through the frame), affords an eaſy motion for turning round the circular piece of wood B, with all the parts affixed to it. C is a braſs tube, which, ſcrewing into the middle of the circular piece of wood, becomes a caſe for the uncovered braſs tube D to be drawn backwards or forwards in. E is a ſmaller tube, of about one inch in length, cemented to the end of the larger tube D. F is another braſs tube, made to ſlide over the above deſcribed tube E; and to the end of this the microſcope muſt be ſcrewed, when we come to uſe it. 5, A convex lens, whoſe focus is about 12 inches, deſigned to collect the ſun's rays, and throw them more ſtrongly upon the object. G is a looking-glaſs of an oblong figure, ſet in a wooden frame, faſtened by hinges in the circular piece of wood B, and turning about therewith by means of the above-mentioned catgut. H is a jointed wire, partly braſs and partly iron; the braſs part, whereof 6, which is flat, being faſtened to the mirror, and the iron part 7, which is round, paſſing through the wooden frame, enable the obſerver, by putting it backwards or forwards, to elevate or depreſs the mirror according to the ſun's altitude. There is a braſs ring at the end of the jointed wire 8, whereby to manage it with the greater eaſe. The extremities of the catgut are faſtened to a braſs pin, by turning of which it may be braced up, if at any time it becomes too ſlack.

When this microſcope is employed, the room muſt be rendered as dark as poſſible; for on the darkneſs of the room, and the brightneſs of the ſunſhine, depend the ſharpneſs and perfection of your image. Then putting the looking-glaſs G through the hole in your window ſhutter, faſten the ſquare frame A to the ſhutter by its two ſcrews and nuts 1, 1. This done, adjuſt your looking-glaſs to the elevation and ſituation of the ſun, by means of the jointed wire H, together with the catgut and pulley, 3, 4. For the firſt of theſe raiſing or lowering the glaſs, and the other inclining it to either ſide, there reſults a twofold motion, which may eaſily be ſo managed as to bring the glaſs to a right poſition, that is, to make it reflect the ſun's rays directly through the lens 5, upon the paper ſcreen, and form thereon a ſpot of light exactly round. But though the obtaining a perfect circular ſpot of light upon the ſcreen before you apply the microſcope, is a certain proof that your mirror is adjuſted right, that proof muſt not always be expected: for the ſun is ſo low in winter, that if it ſhine in a direct line againſt the window, it cannot then afford a ſpot of light exactly round; but if it be on either ſide, a round ſpot may be obtained, even in December. As ſoon as this appears, ſcrew the tube D into the braſs collar provided for it in the middle of your wood-work, taking care not to alter your looking-glaſs: then ſcrewing the magnifier you chooſe to employ to the end of your microſcope in the uſual manner, take away the lens at the other end thereof, and place a ſlider, containing the objects to be examined, between the thin braſs plates, as in the other ways of uſing the microſcope.

Things being thus prepared, ſcrew the body of the microſcope over the ſmall end E of the braſs tube F; which ſlip over the ſmall end E of the tube D, and pull out the ſaid tube D leſs or more as your object is capable of enduring the ſun's heat. Dead objects may be brought within about an inch of the focus of the convex lens 5; but the diſtance muſt be ſhortened for living creatures, or they will ſoon be killed.

If the light fall not exactly right, you may eaſily, by a gentle motion of the jointed wire and pulley, direct it through the axis of the microſcopic lens. The ſhort tube F, to which the microſcope is ſcrewed, renders it eaſy, by ſliding it backwards or forwards on the other tube E, to bring the objects to their focal diſtance; which will be known by the ſharpneſs and clearneſs of their appearance: they may alſo be turned round by the ſame means without being in the leaſt diſordered.

The magnifiers moſt uſeful in the ſolar microſcope are in general, the fourth, fifth, or ſixth. The ſcreen on which the repreſentations of the objects are thrown, is uſually compoſed of a ſheet of the largeſt elephant paper, ſtrained on a frame which ſlides up or down, or turns about at pleaſure on a round wooden pillar, after the manner of ſome fire ſcreens. Larger ſcreens may alſo be made of ſeveral ſheets of the ſame paper paſted together on cloth, and let down from the ceiling with a roller like a large map.

"This microſcope (ſays Mr Baker) is the moſt entertaining of any; and perhaps the moſt capable of making diſcoveries in objects that are not too opaque: as it ſhows them much larger than can be done any other way. There are alſo ſeveral conveniencies attending it, which no other microſcope can have: for the weakeſt eyes may uſe it without the leaſt ſtraining or fatigue: numbers of people together may view any object at the ſame time; and by pointing to the particular parts thereof, and diſcourſing on what lies before them, may be able better to underſtand one another, and more likely to find out the truth, than in other microſcopes, where they muſt peep one after another, and perhaps ſee the object neither in the ſame light nor in the ſame poſition. Thoſe alſo, who have no ſkill in drawing, may, by this contrivance, eaſily ſketch out the exact figure of any object they have a mind to preſerve a picture of; ſince they need only faſten a paper on the ſcreen, and trace it out thereon either with a pen or pencil, as it appears before them. It is worth

 the

Microscope. the while of those who are desirous of taking many draughts in this way, to get a frame, wherein a sheet of paper may be put in or taken out at pleasure; for if the paper be single, the image of an object will be seen almost as plainly on the back as on the fore side; and, by standing behind the screen, the shade of the hand will not obstruct the light in drawing, as it must in some degree when one stands before it." This construction, however, has now become rather obsolete, and is superseded by the following.

II. *The improved Solar Microscope, as used with the improved single Microscope, with teeth and pinion.* Fig. 22. represents the whole form of the *single microscope;* the parts of which are as follows: ABCD the external tube; GHIK the internal moveable one; QM part of another tube within the last, at one end of which is fixed a plate of brass hollowed in the middle, for receiving the glass tubes: there is also a moveable flat plate, between which, and the fixed end of the second tube, the ivory sliders are to be placed. L, a part of the microscope, containing a wire spiral spring, keeping the tube QM with its plates firm against the fixed part IK of the second tube.

EF is the small rack-work of teeth and pinion, by which the tube IG is moved gradually to or from the end AB, for adjusting the objects exactly to the focus of different lengths. NO is a brass slider, with six magnifiers; any one of which may easily be placed before the object. It is known when either of the glasses is in the centre of the eye-hole, by a small spring failing into a notch in the side of the slider, made against each of the glasses. Those parts of the apparatus, fig. 14. marked N° 15, 16, 17, 18, 19, 20, 21 and 22. are made use of here to this microscope. GH is a brass cell, which holds an illuminating glass for converging the sun's beams or the light of a candle strongly upon the objects. The aperture of the glass is made greater or less, by two circular pieces of brass, with holes of different sizes, that are screwed separately over the said lens. But at times, objects appear best when the microscope is held up to the common light only, without this glass. It is also taken away when the microscope is applied to the apparatus now to be described.

Plate CCCXXXIX.

Fig. 23. represents the apparatus, with the single microscope screwed to it, which constitutes the *Solar Microscope.* AB is the inner moveable tube, to which the single microscope is screwed. CD is the external tube, containing a condensing convex glass at the end D, and is screwed into the plate EF, which is cut with teeth at its circumference, and moved by the pinion I, that is fixed with the plate GH. This plate is screwed fast against the window-shutter, or board fitted to a convenient window of a darkened room, when the instrument is used. KL is a long frame, fixed to the circular plate EF; containing a looking-glass or mirror for reflecting the solar rays through the lens in the body of the tube D. O is a brass milled head, fastened to a worm or endless screw; which on the outside turns a small wheel, by which the reflecting mirror M is moved upwards and downwards.

In *using* this microscope, the square frame GH is first to be screwed to the window-shutter, and the room well darkened: which is best done by cutting a round hole of the size of the moveable plate EF, that carries the reflector, in the window-shutter or board; and, by means of two brass nuts *a a*, let into the shutter to receive the screws PP, when placed through the holes in the square frame GH, at the two holes QQ: which will firmly fasten the microscope to the shutter, and is easily taken away by only unscrewing the screws PP.

The white paper screen, or white cloth, to receive the images, is to be placed several feet distant from the window: which will make the representations the larger in proportion to the distance. The usual distances are from 6 to 16 feet.

The frame KL, with its mirror M, is to be moved by turning the pinion I, one way or the other, till the beams of the sun's light come through the hole into the room: then, by turning of the worm at O, the mirror must be raised or depressed till the rays become perfectly horizontal, and go straight across the room to the screen. The tube CD, with its lens at D, is now to be screwed into the hole of the circular plate EF: by this glass the rays will be converged to a focus; and from thence proceed diverging to the screen, and there make a large circle of light. The single microscope, fig. 22. is to be screwed on to the end AB (fig. 23.) of the inner tube; and the slider NO, with either of the lenses marked 1, 2, 3, 4, 5, or 6, in the centre of the hole at the end AB. This will occasion a circle of light upon the screen much larger than before. The slider or glass-tube, with the objects to be viewed, is to be placed between the plates at IK against the small magnifier, and moved at pleasure. By shifting the tube AB in or out, you may place the object in such a part of the condensed rays as shall be sufficient to illuminate it, and not scorch or burn it; which will generally require the glass to be about one inch distant from the focus. It now remains only to adjust the object, or to bring it so near to the magnifier that its image formed upon the screen shall be the most distinct or perfect: and it is effected by gently turning the pinion F, fig. 22, a small matter one way or the other. If the object be rather large in size, the least magnifiers are generally used, and *vice versa.*

N° 1. is the greatest magnifier, and N° 6. the least, in the brass slider NO. But, if desired, single lenses of greater magnifying powers are made: and they are applied, by being screwed to the end AB, fig. 22. and the brass slider NO is then taken away.

The same object may be variously magnified, by the lenses severally applied to it; and the degree of magnifying power is easily known by this rule: *As the distance of the object is to that of its image from the magnifier; so is the length or breadth of the object to that of the image.*

Instead of the brass sliders with the lenses NO, there is sometimes screwed a lens of a large size, and longer focal distance: the instrument is then converted into a *megalascope;* and is adapted for viewing the larger kind of objects contained in large sliders, such as is represented at R. And, in the same manner, small objects of entertainment, painted upon glass like the sliders of a magic lanthorn, are much magnified, and represented upon the same screen.

The solar microscopes just described are capable only of magnifying transparent objects; for which purpose

Microscope. pose the last instrument is extremely well adapted. But as opaque objects form the most considerable part of the curious collections in the works of art as well as nature, a solar microscope for this purpose was a long time wanted.—For several years previous to 1774, Mr Martin made several essays towards the construction of such an instrument; and at last completed one about the time just mentioned, which he named,

III. *The Opaque Solar Microscope.* With this instrument (to use his own words) "all *opaque* objects, whether of the animal, vegetable, or mineral kingdom, may be exhibited in great perfection, in all their native beauty; the lights and shades, the prominences and cavities, and all the varieties of different hues, tints, and colours; heightened by reflection of the solar rays condensed upon them.—*Transparent objects* are also shown with greater perfection than by the common solar microscope.

Fig. 24. represents the solar opaque microscope, mounted for exhibiting opaque objects.

Fig. 25. is the single tooth and pinion microscope, as before, which is used for showing transparent objects; the cylindrical tube Y thereof being made to fit into the tube FE of the solar microscope.

ABCDEF, (fig. 24.) represents the body of the solar microscope; one part thereof, ABCD, is conical; the other, CDEF, is cylindrical. The cylindrical part receives the tube G of the opaque box, or the tube Y of the single microscope. At the large end AB of the conical part, there is a lens to receive the rays from the mirror, and refract them towards the box HIKL. NOP is a brass frame; which is fixed to the moveable circular plate *a b c*: in this frame there is a plane mirror, to reflect the solar rays on the aforementioned lens. This mirror may be moved into the most convenient position for reflecting the light, by means of the nuts Q and R. By the nut Q it may be moved from east to west; and it may be elevated or depressed by the nut R. *d e*, Two screws to fasten the microscope to a window shutter. The box for opaque objects is represented at HIKL: it contains a plane mirror M, for reflecting the light which it receives from the large lens to the object, and thereby illuminating it; S is a screw to adjust this mirror, or place it at a proper angle for reflecting the light. VX, two tubes of brass, one sliding within the other, the exterior one in the box HIKL; these carry the magnifying lenses: the interior tube is sometimes taken out, and the exterior one is then used by itself. Part of this tube may be seen in the plate within the box HIKL. At H there is a brass plate, the back part of which is fixed to the hollow tube *h*, in which there is a spiral wire, which keeps the plate always bearing against the side H of the brass box HIKL. The sliders, with the opaque objects, pass between this plate and the side of the box; to put them there, the plate is to be drawn back by means of the nut *g*: *i k* is a door to one side of the opaque box. The foregoing pieces constitute the several parts necessary for viewing opaque objects. We shall now proceed to describe the single microscope, which is used for transparent objects: but in order to examine these, the box HIKL must be first removed, and in its place we must insert the tube Y of the single microscope that we are now going to describe.

Fig. 25. represents a large tooth and pinion microscope: at *m*, within the body of this microscope, are two thin plates, that are to be separated in order to let the ivory sliders pass between them; they are pressed together by a spiral spring, which bears up the under plate, and forces it against the upper one. Microscope.

The slider S (under fig. 24), which contains the magnifiers, fits into the hole *n*; and any of the magnifiers may be placed before the object, by moving the aforesaid slider: when the magnifier is at the centre of the hole P, a small spring falls into one of the notches which is on the side of the slider.

Under the plate *m* are placed two lenses, for enlarging the field of view on the screen: the smaller of the two is fixed in a piece of brass, and is nearest the plate *m*; this is to be taken out when the magnifiers, N° 4, 5, or 6, are used, or when the megalascope lens T (fig. 24.) is used; but is to be replaced for N° 1, 2, 3.

This microscope is adjusted to the focus by turning the milled nut O.

To *use* the solar microscope:—Make round hole in the window shutter, a little larger than the circle *a b c*; pass the mirror ONP through this hole, and apply the square plate to the shutter; then mark with a pencil the places which correspond to the two holes through which the screw is to pass; take away the microscope, and bore two holes at the marked places, sufficiently large to let the milled screws *d e* pass through them.

The screws are to pass from the outside of the shutter, to go through it; and being then screwed into their respective holes in the square plate, they will, when screwed home, hold it fast against the inside of the shutter, and thus support the microscope.

Screw the conical tube ABCD to the circle *a b c*, and then slide the tube G of the opaque box into the cylindrical part CD EF of the body, if opaque objects are to be examined; but if they be transparent objects you mean to show, then place the tube Y within the tube CDEF.

The room is to be darkened as much as possible, that no light may enter but what passes through the body of the microscope; for, on this circumstance, together with the brightness of the sunshine, the perfection and distinctness of the image in a great measure depend.

When the microscope is to be used for opaque objects, 1. Adjust the mirror NOP, so as to receive the solar rays, by means of the two finger screws or nuts, QR; the first, Q, turns the mirror to the right or left; the second, R, raises or depresses it: this you are to do till you have reflected the sun's light through the lens at AB strongly upon a screen of white paper placed at some distance from the window, and formed thereon a round spot of light. An unexperienced observer will find it more convenient to obtain the light by forming this spot before he puts on either the opaque box or the tooth and pinion microscope.

Now put in the *opaque* box, and place the object between the plates at H; open the door *i k*, and adjust the mirror M till you have illuminated the object strongly. If you cannot effect this by the screw S, you must move the screws Q, R, in order to get the light reflected strongly from the mirror NOP, or the mirror

Microfcope. mirror M, without which the latter cannot illuminate the object.

The object being ftrongly illuminated, fhut the door *i k*, and a diftinct view of the object will foon be obtained on your fcreen, by adjufting the tubes VX, which is effected by moving them backwards or forwards.

A round fpot of light cannot always be procured in northern latitudes, the altitude of the fun being often too low; neither can it be obtained when the fun is directly perpendicular to the front of the room.

As the fun is continually changing its place, it will be neceffary, in order to keep his rays full upon the object, to keep them continually directed through the axis of the inftrument, by the two fcrews Q and R.

To view *tranfparent* objects, remove the opaque box, and infert the tube Y, fig. 25. in its place; put the flider S into its place at *n*, and the flider with the objects between the plates at *m*; then adjuft the mirror NOP, as before directed by the fcrews Q, R, fo that the light may pafs through the object; regulate the focus of the magnifier by the fcrew O. The moft pleafing magnifiers in ufe are the fourth and fifth.

The fize of the object may be increafed or diminifhed, by altering the diftance of the fcreen from the microfcope: five or fix feet is a convenient diftance.

To examine tranfparent objects of a larger fize, or to render the inftrument what is ufually called a *megalafcope*, take out the flider S from its place at *n*, and fcrew the button T (fig. 24.) into the hole at P, fig. 25. and remove the glafs which is under the plate at *m*, and regulate the light and focus agreeable to the foregoing directions.

N. B. At the end of the tube G there is a lens for increafing the denfity of the rays, for the purpofe of burning or melting any combuftible or fufible fubftance: this lens muft be removed in moft cafes, left the objects fhould be burnt. The intenfity of the light is alfo varied by moving this tube backwards or forwards.

Apparatus of the Opaque Solar Microfcope.—The large fquare plate and mirror; the body of the microfcope; the opaque box and its tube; the tooth and pinion microfcope; the flider with the magnifiers; the megalafcope magnifier; the two fcrews *d* and *e*; fome ivory fliders; fome fliders with opaque objects; a brafs frame, with a bottom of foft deal to ftick any object on; a brafs cylinder K (fig. 31.), for confining opaque objects. Plate CCCXLI.

IV. *The Camera Obscura, or Lucernal, Microfcope.*

The great facility with which objects can be reprefented on paper or a rough glafs in the camera obfcura, and copies drawn from them by any perfon though unfkilled in drawing, evidently fuggefted the application of the microfcope to this inftrument. The greateft number of experiments that appear to have been made with this view, were by Mr Martin and Mr Adams; the former of whom frequently applied the microfcope to the portable camera, and with much effect and entertainment. But thefe inftruments being found to anfwer only with the affiftance of the fun, Mr Adams directed his experiments to the conftruction of an inftrument of more extended utility, which could be equally employed in the day-time and by night. He accordingly fucceeded fo far as to produce, by *candle-light*, the images of objects refracted from a fingle magnifier upon one or two large convex lenfes (of about five inches or upwards in diameter), at the end of a pyramidal fhaped box, in a very pleafing and magnified appearance, fo as to give opaque objects as well as tranfparent ones the utmoft diftinctnefs of reprefentation; but ftill the light of a candle or lamp was found generally infufficient to throw the requifite degree of illumination upon the objects. The invention of what is called *Argand's lamp*, within thefe few years offered a complete remedy for this defect, by the intenfity and fteadinefs of its light. This did not efcape Mr Adams (fon of the former), who immediately applied it; and who had likewife fo altered and improved his father's inftrument, both in conftruction and form, as to render it altogether a different one, and far more perfect and ufeful. Microfcope.

The advantages and properties of this excellently conceived inftrument are numerous and important. "As the far greater part of the objects which furround us are opaque (fays our author), and very few are fufficiently tranfparent to be examined by the common microfcopes, an inftrument that could be readily applied to the examination of opaque objects has always been a defideratum. Even in the examination of tranfparent objects, many of the fine and more curious portions are loft, and drowned, as it were, in the light which muft be tranfmitted through them; while different parts of the fame object appear only as dark lines or fpots, becaufe they are fo opaque as not to permit any light to pafs through them. Thefe difficulties, as well as many more, are obviated in the lucernal microfcope; by which opaque objects of various fizes may be feen with eafe and diftinctnefs: the beautiful colours with which moft of them are adorned, are rendered more brilliant, without changing in the leaft the real tint of the colour; and the concave and convex parts retain alfo their proper form.—The facility with which all opaque objects are applied to this inftrument, is another confiderable advantage, and almoft peculiar to itfelf; as the texture and configuration of the more tender parts are often hurt by previous preparation, every object may be examined by this inftrument, firft as opaque, and afterwards (if the texture will admit of it) as tranfparent.—The lucernal microfcope does not in the leaft fatigue the eye; the object appears like nature itfelf, giving eafe to the fight and pleafure to the mind: there is alfo, in the ufe of this inftrument, no occafion to fhut the eye which is not directed to the object. A further advantage peculiar to this microfcope is, that by it the outlines of every object may be taken, even by thofe who are not accuftomed to draw; while thofe who can draw well will receive great affiftance, and execute their work with more accuracy and in lefs time than they would otherwife have been able to have performed it. Tranfparent objects as well as opaque may be copied in the fame manner. The inftrument may be ufed at any time of the day, but the beft effect is by night; in which refpect it has a fuperiority over the folar microfcope, as that inftrument can only be ufed when the fun fhines.

Tranfparent objects may be examined with the lucernal microfcope in three or four different modes, from

Microſcope. from a blaze of light almoſt too great for the eye to bear, to that which is perfectly eaſy to it: And by the addition of a tin lanthorn to the apparatus, may be thrown on a ſcreen, and exhibited at one view to a large company, as by the ſolar microſcope.

We ſhall now proceed to the deſcription of the inſtrument and apparatus as given by Mr Adams.

Fig. 26. repreſents the improved *Lucernal Microſcope*, mounted to view opaque objects. ABCD is a large mahogany pyramidal box, which forms the body of the microſcope; it is ſupported firmly on the braſs pillar FG, by means of the ſocket H and the curved piece IK.

LMN is a guide for the eye, in order to direct it in the axis of the lenſes; it conſiſts of two braſs tubes, one ſliding within the other, and a vertical flat piece, at the top of which is the hole for the eye. The outer tube is ſeen at MN, the vertical piece is repreſented at LM. The inner tube may be pulled out, or puſhed in, to adjuſt it to the focus of the glaſſes. The vertical piece may be raiſed or depreſſed, that the hole, through which the object is to be viewed, may coincide with the centre of the field of view; it is fixed by a milled ſcrew at M, which could not be ſhown in this figure.

At N is a dove-tailed piece of braſs, made to receive the dove-tail at the end of the tubes MN, by which it is affixed to the wooden box ABCDE. The tubes MN may be removed from this box occaſionally, for the convenience of packing it up in a leſs compaſs.

OP, a ſmall tube which carries the magnifiers.

O, one of the magnifiers; it is ſcrewed into the end of a tube, which ſlides within the tube P; the tube P may be unſcrewed occaſionally from the wooden body.

QRSTVX, a long ſquare bar, which paſſes through the ſockets YZ, and carries the ſtage or frame that holds the objects; this bar may be moved backward or forward, in order to adjuſt it to the focus by means of the pinion which is at *a*.

b, A handle furniſhed with an univerſal joint, for more conveniently turning the pinion. When the handle is removed, the nut (fig. 27.) may be uſed in it ſtead.

de, A braſs bar, to ſupport the curved piece KI, and keep the body AB firm and ſteady.

fghi, The ſtage for opaque objects: it fits upon the bar QRST by means of the ſocket *hi*, and is brought nearer to or removed farther from the magnifying lens by turning the pinion *a*: the objects are placed in the front ſide of the ſtage (which cannot be ſeen in this figure) between four ſmall braſs plates; the edges of two of theſe are ſeen at *kl*. The two upper pieces of braſs are moveable; they are fixed to a plate, which is acted on by a ſpiral ſpring, that preſſes them down, and confines the ſlider with the objects: this plate, and the two upper pieces of braſs, are lifted up by the ſmall nut *m*.

At the lower part of the ſtage, there is a ſemicircular lump of glaſs *n*, which is deſigned to receive the light from the lamp, fig. 29. and to collect and throw it on the concave mirror *o*, whence it is to be reflected on the object.

The upper part *fghs* (fig. 26.) of the opaque ſtage takes out, that the ſtage for tranſparent objects may be inſerted in its place. Microſcope.

Fig. 28. repreſents the ſtage for tranſparent objects; the two legs 5 and 6 fit into the top of the under part *rshi* of the ſtage for opaque objects; 7 is the part which confines or holds the ſliders, and through which they are to be moved; 9 and 10 a braſs tube, which contains the lenſes for condenſing the light, and throwing it upon the object; there is a ſecond tube within that, marked 9 and 10, which may be placed at different diſtances from the object by the pin 11.

When this ſtage is uſed as a ſingle microſcope, without any reference to the lucernal, the magnifiers or object lenſes, are to be ſcrewed into the hole 12, and to be adjuſted to a proper focus by the nut 13.

N. B. At the end AB (fig. 26.) of the wooden body there is a ſlider, which is repreſented as partly drawn out at A: when quite taken out, three grooves will be perceived; one of which contains a board that forms the end of the box; the next contains a frame with a grayed glaſs; and the third, or that fartheſt from the end AB, two large convex lenſes.

Fig. 29. repreſents one of Argand's lamps, which are the moſt ſuitable for microſcopic purpoſes, on account of the clearneſs, the intenſity, and the ſteadineſs of the light. The following account of the method of managing them, with other obſervations, is copied from an account given by Mr Parker with thoſe he ſells.

The principle on which the lamp acts, conſiſts in diſpoſing the wick in thin parts, ſo that the air may come into contact with all the burning fuel; by which means, together with an increaſe of the current of air occaſioned by rarefaction in the glaſs tube, the whole of the fuel is converted into flame.

The wicks are circular; and, the more readily to regulate the quantity of light, are fixed on a braſs collar, with a wire handle, by means of which they are raiſed or depreſſed at pleaſure.

To fix the wick on, a wooden mandril is contrived, which is tapered at one end, and has a groove turned at the other.

The wick has a ſelvage at one end, which is to be put foremoſt on the mandril, and moved up to the groove; then putting the groove into the collar of the wick-holder, the wick is eaſily puſhed forward upon it.

The wick-holder and wick being put quite down in their place, the ſpare part of the wick ſhould, while dry, be ſet a-light, and ſuffered to burn to the edge of the tubes; this will leave it more even than by cutting, and, being black by burning, will be much eaſier lighted: for this reaſon, the black ſhould never be quite cut off.

The lamp ſhould be filled an hour or two before it is wanted, that the cotton may imbibe the oil and draw the better.

The lamps which have a reſervoir and valve, need no other direction for filling than to do it with a proper trimming pot, carefully obſerving when they are full; then pulling up the valve by the point, the reſervoir, being turned with the other hand, may be replaced without ſpilling a drop.

Thoſe lamps which fill in the front like a bird-fountain, muſt be reclined on the back to fill; and this ſhould

ſhould be done gently, that the oil in the burner may return into the body when ſo placed and filled: if, by being too full, any oil appears above the guard, only move the lamp a little, and the oil will diſappear; the lamp may then be placed erect, and the oil will flow to proper level.

The oil muſt be of the ſpermaceti kind, commonly called chamber oil, which may generally be diſtinguiſhed by its paleneſs, tranſparency, and inoffenſive ſcent: all thoſe oils which are of a red and brown colour, and of an offenſive ſcent, ſhould be carefully avoided, as their glutinous parts clog the lamp, and the impurities in ſuch oil, not being inflammable, will accumulate and remain in the form of a cruſt on the wick. Seal oil is nearly as pale and ſweet as chamber oil; but being of a heavy ſluggiſh quality, is not proper for lamps with fine wicks.

Whenever bad oil has been uſed, on changing it, the wick muſt alſo be changed; becauſe, after having imbibed the coarſe particles in its capillary tubes, it will not draw up the fine oil.

To obtain the greateſt degree of light, the wick ſhould be trimmed exactly even, the flame will then be completely equal.

There will be a great advantage in keeping the lamp clean, eſpecially the burner and air tubes; the neglect of cleanlineſs in lamps is too common: a candleſtick is generally cleaned every time it is uſed, ſo ſhould a lamp; and if a candleſtick is not to be objected to becauſe it does not give light after the candle is exhauſted, ſo a lamp ſhould not be thought ill of, if it does not give light when it wants oil or cotton: but this laſt has often happened, becauſe the deficiency is leſs viſible.

The glaſs tubes are beſt cleaned with a piece of waſh leather.

If a fountain lamp is left partly filled with oil, it may be liable to overflow: this happens by the contraction of the air when cold, and its expanſion by the warmth of a room, the rays of the ſun, or the heat of the lamp when re-lighted: this accident may be effectually prevented by keeping the reſervoir filled, the oil not being ſubject to expanſion like air. On this account, thoſe with a common reſervoir are beſt adapted for microſcopic purpoſes.

To examine Opaque Objects, with the Lucernal Microſcope. To render the uſe of this inſtrument eaſy, it is uſually packed with as many of the parts together as poſſible: it occupies on this account rather more room, but is much leſs embarraſſing to the obſerver, who has only three parts to put on after it is taken out of its box, namely, the guide for the eye, the ſtage, and the tube with its magnifier.

But to be more particular: Take out the wooden ſlider A (fig. 26), then lift out the cover and the gray glaſs, from their reſpective grooves under the ſlider A.

Put the end N of the guide for the eye LMN into its place, ſo that it may ſtand in the poſition which is repreſented in this figure.

Place the ſocket which is at the bottom of the opaque ſtage, on the bar QXT, ſo that the concave mirror *o* may be next the end DE of the wooden body.

Screw the tubes PO into the end DE. The magnifier you intend to uſe is to be ſcrewed on the end O of theſe tubes.

The handle G *b*, or the milled nut, fig. 27. muſt be placed on the ſquare end of the pinion *a*.

Place the lamp lighted before the glaſs lamp *n*, and the object you intend to examine between the ſpring plates of the ſtage; and the inſtrument is ready for uſe.

In all microſcopes there are two circumſtances which muſt be particularly attended to: firſt, the modification of the light, or the proper quantity to illuminate the object; ſecondly, the adjuſtment of the inſtrument to the focus of the glaſs and eye of the obſerver. In the uſe of the lucernal microſcope there is a third circumſtance, which is, the regulation of the guide for the eye.

1. To throw the light upon the object. The flame of the lamp is to be placed rather below the centre of the glaſs lump *n*, and as near it as poſſible; the concave mirror *o* muſt be ſo inclined and turned as to receive the light from the glaſs lump, and reflect it thence upon the object; the beſt ſituation of the concave mirror and the flame of the lamp depends on a combination of circumſtances, which a little practice will diſcover.

2. To regulate the guide for the eye, or to place the centre of the eye-piece L ſo that it may coincide with the focal point of the lenſes and the axis of viſion: Lengthen and ſhorten the tubes MN, by drawing out or puſhing in the inner tube, and raiſing or depreſſing the eye-piece ML, till you find the large lens (which is placed at the end AB of the wooden body) filled by an uniform field of light, without any priſmatic colours round the edge; for till this piece is properly fixed, the circle of light will be very ſmall, and only occupy a part of the lens; the eye muſt be kept at the centre of the eye-piece L, during the whole of the operation; which may be rendered ſomewhat eaſier to the obſerver, on the firſt uſe of the inſtrument, if he hold a piece of white paper parallel to the large lens, removing it from or bringing it nearer to them till he find the place where a lucid circle, which he will perceive on the paper, is brighteſt and moſt diſtinct; then he is to fix the cenre of the eye-piece to coincide with that ſpot; after which a very ſmall adjuſtment will ſet it perfectly right.

3. To adjuſt the lenſes to their focal diſtance. This is effected by turning the pinion *a*, the eye being at the ſame time at the eye-piece L. The gray glaſs is often placed before the large lenſes, while regulating the guide for the eye, and adjuſting for the focal diſtance.

If the obſerver, in the proceſs of his examination of an object, advance rapidly from a ſhallow to a deep magnifier, he will ſave himſelf ſome labour by pulling out the internal tube at O.

The upper part *f g r s* of the ſtage is to be raiſed or lowered occaſionally, in order to make the centre of the object coincide with the centre of the lens at O.

To delineate objects, the gray glaſs muſt be placed before the large lenſes; the picture of the object will be formed on this glaſs, and the outline may be accurately taken by going over the picture with a pencil.

The

Microſcope.

The opaque part may be uſed in the daytime without a lamp, provided the large lenſes at AB are ſcreened from the light.

To uſe the Lucernal Microſcope in the examination of Tranſparent Objects.—The inſtrument is to remain as before: the upper part *f g s* of the opaque ſtage muſt be removed, and the ſtage for tranſparent objects, repreſented at fig. 28. put in its place; the end 9 10 to be next the lamp.

Place the grayed glaſs in its groove at the end AB, and the objects in the ſlider-holder at the front of the ſtage; then tranſmit as ſtrong a light as you are able on the object, which you will eaſily do by raiſing or lowering the lamp.

The object will be beautifully depicted on the gray glaſs: it muſt be regulated to the focus of the magnifier, by turning the pinion *a*.

The object may be viewed either with or without the guide for the eye. A ſingle obſerver will ſee an object to the greateſt advantage by uſing this guide, which is to be adjuſted as we have deſcribed above. If two or three wiſh to examine the object at the ſame time, the guide for the eye muſt be laid aſide.

Take the large lens out of the groove, and receive the image on the gray glaſs; in this caſe, the guide for the eye is of no uſe: if the gray glaſs be taken away, the image of the object may be received on a paper ſcreen.

Take out the gray glaſs, replace the large lenſes, and uſe the guide for the eye; attend to the foregoing directions, and adjuſt the object to its proper focus. You will then ſee the object in a blaze of light almoſt too great for the eye, a circumſtance that will be found very uſeful in the examination of particular objects. The edges of the object in this mode will be ſomewhat coloured: but as it is only uſed in this full light for occaſional purpoſes, it has been thought better to leave this ſmall imperfection, than, by remedying it, to ſacrifice greater advantages; the more ſo, as this fault is eaſily corrected, a new and intereſting view of the object is obtained, by turning the inſtrument out of the direct rays of light, and permitting them to paſs through only in an oblique direction, by which the upper ſurface is in ſome degree illuminated, and the object is ſeen partly as opaque, partly as tranſparent. It has been already obſerved, that the tranſparent objects might be placed between the ſlider-holders of the ſtage for opaque objects, and then be examined as if opaque.

Some tranſparent objects appear to the greateſt advantage when the lens at 9 10 is taken away; as, by giving too great a quantity of light, it renders the edges leſs ſharp.

The variety of views which may be taken of every object by means of the improved lucernal microſcope, will be found to be of great uſe to an accurate obſerver: it will give him an opportunity of correcting or confirming his diſcoveries, and inveſtigating thoſe parts in one mode which are inviſible in another.

Microſcope.

To throw the image of tranſparent objects on a ſcreen as in the ſolar microſcope. It has been long a microſcopical deſideratum, to have an inſtrument by which the image of tranſparent objects might be thrown on a ſcreen, as in the common ſolar microſcope: and this not only becauſe the ſun is ſo uncertain in this climate, and the uſe of the ſolar microſcope requires confinement in the fineſt part of the day, when time ſeldom hangs heavy on the mind; but as it alſo affords an increaſe of pleaſure, by diſplaying its wonders to ſeveral perſons at the ſame inſtant, without the leaſt fatigue to the eye.

This purpoſe is now effectually anſwered, by affixing the tranſparent ſtage of the lucernal to a lanthorn, with one of Argand's lamps.—The lamp is placed within the lanthorn, and the end 9 10 of the tranſparent ſtage is ſcrewed into a female ſcrew, which is rivetted in the ſliding part of the front of the lanthorn; the magnifying lenſes are to be ſcrewed into the hole repreſented at 12, and they are adjuſted by turning the milled nut. The quantity of light is to be regulated by raiſing and lowering the ſliding-plate or the lamp.

Apparatus which uſually accompanies the improved Lucernal Microſcope.—The ſtage for opaque objects, with its ſemicircular lump of glaſs, and concave mirror. The ſtage for tranſparent objects, which fits on the upper part of the foregoing ſtage. The ſliding tube, to which the magnifiers are to be affixed: one end of theſe is to be ſcrewed on the end D of the wooden body; the magnifier in uſe is to be ſcrewed to the other end of the inner tube. Eight magnifying lenſes: theſe are ſo conſtructed that they may be combined together, and thus produce a very great variety of magnifying powers. A fiſh-pan, ſuch as is repreſented at I. A ſteel wire L, with a pair of nippers at one end, and a ſmall cylinder of ivory *l* at the other. A ſlider of braſs N, containing a flat glaſs ſlider, and a braſs ſlider into which are fitted ſome ſmall concave glaſſes. A pair of forceps. Six large and ſix ſmall ivory ſliders, with tranſparent objects. Fourteen wooden ſliders, with four opaque objects in each ſlider; and two ſpare ſliders. Some capillary tubes for viewing ſmall animalcula.

Ingenious men ſeldom content themſelves with an inſtrument under one form; hence ſuch a variety of microſcopes, hence many alterations in the Lucernal Microſcope. Mr Adams himſelf, we underſtand, has fitted up this laſt in a great many different ways; and it is reaſonable to think that no perſon is more likely to give it every improvement of which it is ſuſceptible. Of the alterations by other hands we ſhall only particularize one, made by Mr Jones of Holborn (B), whoſe deſcription is as follows:

A repreſents a portion of the top of the mahogany box

(B) We truſt the reader will never conſider any paragraph wherein the name of an inſtrument-maker or other artiſt is inſerted, as a recommendation of thoſe artiſts by the editors of this work. In the courſe of a pretty extenſive correſpondence, they have been favoured with very liberal communications from various artiſts, for which they are greatly indebted to them: the inſerting their names in this work is therefore to be conſidered as box in which it packs, to preſerve it ſteady; it ſlides in a dove-tail groove withinſide, a ſimilar groove to which is cut in the top of the box A; ſo that when the inſtrument is to be uſed, it is ſlipt out of the box withinſide, and then ſlipt into the groove at top ready for uſe, almoſt inſtantly, as ſhown in the figure. The adjuſtment of the objects is at the ſtage E; for the right focal diſtance is readily and conveniently made by turning the long ſcrew-rod BB, which goes through the two pillars ſupporting the box, and works in the baſe of the braſs ſtage E; which baſe is alſo dove-tailed, ſo as to have a regular and ſteady motion in another braſs baſis that ſupports it. In this inſtrument, therefore, the pyramidical box does not move; but the ſtage part only, which, from its ſmall weight, moves in the moſt agreeable and ſteady manner. While obſerving the image of the object upon the glaſs through the ſight-hole at G, the object may be moved or changed by only turning the rack-work and pinion applied to the ſtage by means of the handle D, for that purpoſe. By this contrivance you have no occaſion to change your poſition during the view of the objects upon one of the ſliders. This motion changes the objects horizontally only; and as they are generally placed exactly in one line, it anſwers all the purpoſes for which this motion is intended very well. But it may ſometimes happen that the obſerver would wiſh to alter the vertical poſition of the object; to perform which there is another plane rod at F, that acts ſimply as a lever for this purpoſe, and moves the ſliding part of the ſtage E vertically either upwards or downwards.

Thus, without altering his poſition, the obſerver may inveſtigate all parts of the objects in the moſt ſatisfactory manner. Rack-work and pinion might be applied to the ſtage for the vertical motion alſo; but as it would materially enhance the expence, it is ſeldom applied. The braſs work at the handle of D contains a Hooke's univerſal joint.

The brilliancy of the images of the objects ſhown upon the large lenſes at the end of the box, being very frequently ſo great as to dazzle the eyes, Mr Jones applies a ſlight tinge of blue, green, and other coloured glaſs, to the ſight-hole at G, which ſoftens this glare, and caſts an agreeable hue upon the objects.

Deſcription of thoſe Parts of a Microſcopical Apparatus, common to moſt Inſtruments, which are delineated at fig. 31.

A and B repreſent the braſs cells which contain the magnifiers belonging to the different kinds of compound microſcopes. The magnifiers are ſometimes contained in a ſlider like that which is delineated at S (fig. 24.) The lenſes of A and B are confined by a ſmall cap; on unſcrewing this, the ſmall lens may be taken out and cleaned. The magnifiers A of the lucernal microſcope are ſo contrived, that any two of them may be ſcrewed together, by which means a conſiderable variety of magnifying powers is obtained.

To get at the lenſes in the ſlider S (fig. 24.) take out the two ſcrews which hold on the cover.

C repreſents the general form of the ſlider-holder. It conſiſts of a cylindrical tube, in which an inner tube is forced up by a ſpring. It is uſed to receive the ivory or any other ſlider, in which the tranſparent objects are placed; theſe are to be ſlid between the two upper plates: the hollow part in one of the plates is deſigned for the glaſs tubes.

D, the condenſing lens and its tube, which fits into the ſlider-holder C, and may be moved up and down in it. When this piece is puſhed up as far as it will go, it condenſes the light of a candle, which is reflected on it by the plain mirror of the compound microſcope, and ſpreads it uniformly over the object; in this caſe it is beſt adapted to the ſhalloweſt magnifiers. If the deeper lenſes are uſed, it ſhould be drawn down, or rather removed further from the object, that it may concentrate the light in a ſmall compaſs, and thus render it more denſe. The condenſing lens is ſometimes fitted up differently; but the principle being the ſame, it will be eaſy to apply it to uſe notwithſtanding ſome variations in the mechaniſm.

E, a braſs cone. It fixes under the ſlider-holder, and is uſed to leſſen occaſionally the quantity of light which comes from the mirror to any object.

F, a box with two flat glaſſes, which may be placed at different diſtances from each other in order to confine a ſmall living inſect.

G, a ſmall braſs box to hold the ſilver ſpeculum H.

H, a ſmall ſilver concave ſpeculum, deſigned to reflect the light from the mirror on opaque objects; it ſhould only be uſed with the ſhallow magnifiers. It is applied in different ways to the compound microſcope; ſometimes to a tube ſimilar to that repreſented at X, which ſlides on the lower part of the body; ſometimes it is ſcrewed into the ring of the piece Q; the pin of this generally fits into one of the holes in the ſtage. When this ſpeculum is uſed, the ſlider-holder ſhould be removed.

I, a fiſh-pan, whereon a ſmall fiſh may be faſtened, in order to view the circulation of the blood: its tail is to be ſpread acroſs the oblong hole at the ſmalleſt end, and tied faſt by means of the ribbon fixed thereto, by ſhoving the knob which is on the back of it through the ſlit made in the ſtage; the tail of the fiſh may be brought under the lens which is in uſe.

K, a cylindrical piece, intended for the ſolar opaque microſcope; by pulling back the ſpiral ſpring, ſmaller or larger objects may be confined in it.

k, A pair of triangular nippers for taking hold of and confining a large object.

L, a long ſteel wire, with a ſmall pair of pliers at one end and a ſteel point at the other: the wire ſlips backwards or forwards in a ſpring tube, which is affixed to a joint, at the bottom of which is a pin to fit one

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as a grateful acknowledgement from the editors for favours conferred on them,—not as a teſtimonial of their opinion of the abilities of an individual, or as deſigned to inſinuate any preference over others in the ſame line, where ſuch preference has not been already beſtowed by the public.

Microscope. one of the holes in the stage; this piece is used to confine small objects.

l, A small ivory cylinder that fits on the pointed end of the steel wire L; it is designed to receive opaque objects. Light-coloured ones are to be stuck on the dark side, and *vice versa*.

M, a convex lens, which fits to the stage by means of the long pin adhering to it. This piece is designed to collect the light from the sun or a candle, and to throw them on any object placed on the stage; but it is very little used at present.

N, a brass slider, into which is fitted a flat piece of glass, and a brass slider containing four small glasses, one or two of them concave, the others flat; it is designed to confine small living objects, and when used is to be placed between the two upper plates of the slider-holder.

O, a glass tube to receive a small fish, &c.

P, represents one of the ivory sliders, wherein objects are placed between two pieces of talc, and confined by a brass ring.

Q, a piece to hold the speculum H: this piece is generally fitted to the microscope represented at fig. 12.

R, a pair of forceps, to take up any occasional object.

S, a camel's hair pencil to brush the dust off the glasses; the upper part of the quill is scooped out, to take up a drop of any fluid, and place it on either of the glasses for examination.

T, an instrument for cutting thin transverse sections of wood. It consists of a wooden base, which supports four brass pillars; on the top of the pillars is placed a flat piece of brass, near the middle of which there is a triangular hole.

A sharp knife, which moves in a diagonal direction, is fixed on the upper side of the afore-mentioned plate, and in such a manner that the edge always coincides with the surface thereof.

The knife is moved backwards and forwards by means of the handle *a*. The piece of wood is placed in the triangular trough which is under the brass plate, and is to be kept steady therein by a milled screw which is fitted to the trough; the wood is to be pressed forward for cutting by the micrometer screw *b*.

The pieces of wood should be applied to this instrument immediately on being taken out of the ground, or else they should be soaked for some time in water, to soften them so that they may not hurt the edge of the knife.

When the edge of the knife is brought in contact with the piece of wood, a small quantity of spirits of wine should be poured on the surface of the wood, to prevent its curling up; it will also make it adhere to the knife, from which it may be removed by pressing a piece of blotting paper on it.

y, An appendage to the cutting engine, which is to be used instead of the micrometer screw, being preferred to it by some. It is placed over the triangular hole, and kept flat down upon the surface of the brass plate, while the piece of wood is pressed against a circular piece of brass which is on the under side of it. This circular piece of brass is fixed to a screw, by which its distance from the flat plate on which the knife moves may be regulated.

z, An ivory box, containing at one end spare talc for the ivory sliders, and at the other spare rings for pressing the talcs together and confining them to the slider. Microscope.

Fluid microscopes have been also proposed; the first, it would appear, was suggested by Mr Grey. This was formed of water, and an account of it will be found in N° 221, 223, Phil. Transf. An improved microscope, on a similar principle, has been invented by Mr Brewster, of which the following is a description, taken from a note by the translator of Haüy's Natural Philosophy.

"A vertical bar" (says Mr Gregory), is fixed upon a horizontal pedestal; and from the top of this bar proceeds a horizontal arm, which supports a circular case containing the lenses; below this another horizontal arm slides up and down, capable of adjustment by means of a screw, and carrying the usual sliders to hold the object which it is proposed to examine; and upon the pedestal is fixed the frame of a mirror, which has both an inclined and a horizontal motion, in order to illuminate any object upon the slider. The upper circular case is hollow, and contains four or more plano-convex lenses, which are constituted each of a drop of very pure and viscid turpentine varnish, taken up by the point of a piece of wood, and dropped upon a piece of very thin and well polished glass. The lenses thus formed may be made of any focal length by taking up a greater or a less quantity of fluid. The lower surface of the glass having been first smoked with a candle, the black pigment immediately below the lenses is then to be removed, so that no light may pass but through the lenses. The piece of glass is then perforated at its centre, and surrounded by a toothed wheel, which, when the wheel is put in the upper circular case, may be turned by a common endless screw, so that the fluid lenses shall be brought severally under an eye-aperture properly disposed, and any object be successfully examined with a variety of magnifying powers." Note, p. 365. See also Ferguson's Lectures by Brewster, vol. ii.

After what has been related of microscopes, they cannot be said to be complete without the valuable addition of a *micrometer*; for the use and advantages of which, see the article Micrometer.

Having presented our readers with descriptions of the various microscopes generally used, we think it our duty to point out to them those which we conceive to be best calculated to answer the purposes of science. The first which presents itself to our mind is that of *Ellis*: It is better adapted than any other portable microscope, to the purpose of general observation; simple in its construction, and general in its application. To those who prefer a double microscope, we should recommend that figured in Plate CCCXXXVIII. fig. 12. If opaque objects, as insects, &c. be subjects of investigation, the *Lucernal Microscope* claims the preference: but if amusement alone guides the choice, the *Solar Microscope* must be fixed upon.

We shall now proceed to explain some necessary particulars respecting the method of using microscopes; after which, we shall subjoin an enumeration of the principal

cipal objects discovered or elucidated by their means. On this subject Mr Adams, in his *Essay on the Microscope*, has been very copious; with a view, as he informs us, to remove the common complaint made by Mr Baker, "that many of those who purchase microscopes are so little acquainted with their general and extensive usefulness, and so much at a loss for objects to examine by them, that after diverting their friends some few times with what they find in the sliders which generally accompany the instrument, or perhaps with two or three common objects, the microscope is laid aside as of little further value; whereas no instrument has yet appeared in the world capable of affording so constant, various, and satisfactory an entertainment to the mind.

I. In using the microscope, there are three things necessary to be considered. (1.) The preparation and adjustment of the instrument itself. (2.) The proper quantity of light, and the best method of directing it to the object. (3.) The method of preparing the objects, so that their texture may be properly understood.

1. With regard to the microscope itself, the first thing necessary to be examined is, whether the glasses be clean or not: if they are not so, they must be wiped with a piece of soft leather, taking care not to soil them afterwards with the fingers; and, in replacing them, care must be taken not to place them in an oblique situation. We must likewise be careful not to let the breath fall upon the glasses, nor to hold that part of the body of the instrument where the glasses are placed with a warm hand; because thus the moisture expelled by the heat from the metal will condense upon the glass, and prevent the object from being distinctly seen. The object should be brought as near the centre of the field of view as possible; for there only it will be exhibited in the greatest perfection. The eye should be moved up and down from the eye-glass, of a compound microscope, till the situation is found where the largest field and most distinct view of the object are to be had: but every person ought to adjust the microscope to his own eye, and not to depend upon the situation it was placed in by another. A small magnifying power should always be begun with; by which means the observer will best obtain an exact idea of the situation and connexion of the whole; and will of consequence be less liable to form any erroneous opinion when the parts are viewed separately by a lens of greater power. Objects should also be examined first in their most natural position: for if this be not attended to, we shall be apt to form very inadequate ideas of the structure of the whole, as well as of the connexion and use of the parts. A living animal ought to be as little hurt or discomposed as possible.

From viewing an object properly, we may acquire a knowledge of its nature: but this cannot be done without an extensive knowledge of the subject, much patience, and many experiments; as in a great number of cases the images will resemble each other, though derived from very different substances. Mr Baker therefore advises us not to form an opinion too suddenly after viewing a microscopical object; nor to draw our inferences till after repeated experiments and examinations of the object in many different lights and positions; to pass no judgement upon things extended by force, or contracted by dryness, or in any manner out of a natural state, without making suitable allowances. The true colour of objects cannot be properly determined by very great magnifiers; for as the pores and interstices of an object are enlarged according to the magnifying power of the glasses made use of, the component particles of its substance will appear separated many thousand times farther asunder than they do to the naked eye: hence the reflection of the light from these particles will be very different, and exhibit different colours. It is likewise somewhat difficult to observe opaque objects; and as the apertures of the larger magnifiers are but small, they are not proper for the purpose. If an object be so very opaque, that no light will pass through it, as much as possible must be thrown upon the upper surface of it. Some consideration is likewise necessary in forming a judgement of the motion of living creatures, or even of fluids, when seen through the microscope; for as the moving body, and the space wherein it moves, are magnified, the motion will also be increased.

2. On the management of the light depends in a great measure the distinctness of the vision: and as, in order to have this in the greatest perfection, we must adapt the quantity of light to the nature of the object and the focus of the magnifier, it is therefore necessary to view it in various degrees of light. In some objects, it is difficult to distinguish between a prominence and a depression, a shadow or a black stain: or between a reflection of light and whiteness, which is particularly observable in the eye of the libellula and other flies: all of these appearing very different in one position from what they do in another. The brightness of an object likewise depends on the quantity of light, the distinctness of vision, and on regulating the quantity to the object; for some will be in a manner lost in a quantity of light scarcely sufficient to render another visible.

There are various ways in which a strong light may be thrown upon objects; as by means of the sun and a convex lens. For this purpose, the microscope is to be placed about three feet from a southern window; then take a deep convex lens, mounted on a semicircle and stand, so that its position may easily be varied: place this lens between the object and the window, so that it may collect a considerable number of solar rays, and refract them on the object or the mirror of the microscope. If the light thus collected from the sun be too powerful, it may be lessened by placing a piece of oiled paper, or a piece of glass lightly grayed, between the object and lens. Thus a proper degree of light may be obtained, and diffused equally all over the surface of an object: a circumstance which ought to be particularly attended to; for if the light be thrown irregularly upon it, no distinct view can be obtained. If we mean to make use of the solar light, it will be found convenient to darken the room, and to reflect the rays of the sun on the above-mentioned lens by means of the mirror of a solar microscope fixed to the window-shutter: for thus the observer will be enabled to preserve the light on his subject, notwithstanding the motion of the sun. But by reason of this motion, and the variable state of the atmosphere, solar observations are rendered both tedious and inconvenient; whence it will be proper for the observer to be

Microscope. be furnished with a large tin lanthorn, formed something like the common magic lanthorn, capable of containing one of Argand's lamps. This, however, ought not to be of the fountain kind, lest the rarefaction of the air in the lanthorn should force the oil over. There ought to be an aperture in the front of the lanthorn, which may be moved up and down, and be capable of holding a lens; by which means a pleasant and uniform as well as strong light may easily be procured. The lamp should likewise move on a rod, so that it may be easily raised or depressed. This lanthorn may likewise be used for many other purposes; as viewing of pictures, exhibiting microscopic objects on a screen, &c. A weak light, however, is best for viewing many transparent objects: among which we may reckon the prepared eyes of flies, as well as the animalcules in fluids. The quantity of light from a lamp or candle may be lessened by removing the microscope to a greater distance from them, or by diminishing the strength of the light which falls upon the objects. This may very conveniently be done by pieces of black paper with circular apertures of different sizes, and placing a larger or smaller one upon the reflecting mirror, as occasion may require. There is an oblique situation of the mirrors, which makes likewise an oblique reflection of the light easily discovered by practice, (but for which no general rule can be given in theory); and which will exhibit an object more distinctly than any other position, showing the surface, as well as those parts through which the light is transmitted. The light of a lamp or candle is generally better for viewing microscopic objects than day light; it being more easy to modify the former than the latter, and to throw it upon the objects with different degrees of density.

3. Swammerdam has excelled in the preparation of objects almost all other investigators. Neither difficulty nor disappointment could make him abandon the pursuit of any object until he had obtained a satisfactory idea of it. But unhappily the methods he used in preparing his objects for the microscope are now entirely unknown. Boerhaave examined with the strictest attention all the letters and manuscripts of Swammerdam which he could find; but his researches were far from being successful. The following are all the particulars, which have thus come to the knowledge of the public.

For dissecting *small insects*, Swammerdam had a brass table made by S. Muschenbroek, to which were affixed two brass arms moveable at pleasure to any part of it. The upper part of these vertical arms was constructed in such a manner as to have a slow vertical motion; by which means the operator could readily alter their height as he saw convenient. One of these arms was to hold the minute objects, and the other to apply the microscope.

The lenses of Swammerdam's microscopes were of various sizes as well as foci: but all of them the best that could be procured, both for the transparency of the glass and the fineness of the workmanship. His observations were always begun with the smallest magnifiers, from which he proceeded to the greatest; but in the use of them, he was so exceedingly dexterous, that he made every observation subservient to that which succeeded it, and all of them to the confirmation of each other, and to the completing of the description. His chief art seems to have been in constructing scissars of an exquisite fineness, and making them very sharp. Thus he was enabled to cut very minute objects to much more advantage than could be done by knives and lancets; for these, though ever so sharp and fine, are apt to disorder delicate substances by displacing some of the filaments, and drawing them after them as they pass through the bodies; but the scissars cut them all equally. The knives, lancets, and styles he made use of in his dissections, were so fine that he could not see to sharpen them without the assistance of a magnifying glass; but with these he could dissect the intestines of bees with the same accuracy that the best anatomists can do those of large animals. He made use also of very small glass tubes no thicker than a bristle, and drawn to a very fine point at one end, but thicker at the other. These were for the purpose of blowing up, and thus rendering visible the smallest vessels which could be discovered by the microscope; to trace their courses and communications, or sometimes to inject them with coloured liquors.

Swammerdam sometimes made use of spirit of wine, water, or oil of turpentine, for suffocating the insects he wished to examine; and would preserve them for a time in these liquids. Thus he kept the parts from putrefying, and gave them besides such additional strength and firmness, as rendered the dissections much more easy than they would otherwise have been. Having then divided the body transversely with the scissars, and made what observations he could without farther dissection, he proceeded to extract the intestines carefully with very fine instruments, to wash away the fat in the like careful manner; and thus to put the parts into such a state as would best expose them to view; but these operations are best performed while the insects are in their nympha state.

Sometimes the delicate viscera of the insects, after having been suffocated as above mentioned, were put into water: after which, having shaken them gently, he procured an opportunity of examining them, especially the air vessels, which last he could thus separate entire from all the other parts, to the admiration of all who beheld them: as these vessels cannot be distinctly seen in any other manner, or indeed in any way whatever, without injuring them. Frequently also he injected water with a syringe to cleanse the parts thoroughly, after which he blew them up with air and dried them; thus rendering them durable, and fit for examination at a proper opportunity. Sometimes he made very important discoveries, by examining insects which he had preserved for several years in balsam. Other insects he punctured with a very fine needle; and after squeezing out all their moisture through the holes made in this manner, he filled them with air, by means of very slender glass tubes; then dried them in the shade; and lastly, anointed them with oil of spike in which a little rosin had been dissolved; and by which means they for a long time retained their proper forms. He was likewise in possession of a singular secret, by which he could preserve the limbs of insects as limber and perspicuous as ever they had been. He used to make a small puncture or incision in the tails of worms;

Microscope worms; and after having with great caution squeezed out all the humours, as well as great part of the viscera, he injected them with wax in such a manner as to give them the appearance of living creatures in perfect health. He found that the fat of all insects was entirely dissolvable in oil of turpentine; by which means he was enabled plainly to discern the viscera; though, after this dissolution, it was necessary to cleanse and wash them frequently in clean water. In this manner he would frequently have spent whole days in the preparation of a single caterpillar, and cleaning it from its fat, in order to discover the true situation of the insect's heart. He had a singular dexterity in stripping off the skins of caterpillars that were on the point of spinning their cones. This was done by letting them drop by their threads into scalding water, and then suddenly withdrawing them. Thus the epidermis peeled off very easily; and, when this was done, he put them into distilled vinegar and spirit of wine mixed together in equal proportions; which, by giving a due degree of firmness to the parts, gave him an opportunity of separating them with very little trouble from the exuviæ, without any danger to the internal parts. Thus the nympha could be shown to be wrapped up in the caterpillar and the butterfly in the nympha; and there is little doubt that those who look into the works of Swammerdam, will be amply recompensed, whether they consider the unexampled labour or the piety of the author.

M. Lyonet, an eminent naturalist, usually drowned the insects he designed to examine; by which means he was enabled to preserve both the softness and transparency of the parts. According to him, the insect, if very small, viz. one tenth of an inch, or little more, in length, should be dissected on a glass somewhat concave. If it should be suspected that the insect will putrefy by keeping for a few days, spirit of wine diluted with water must be substituted instead of pure water. The insect must be suffered to dry; after which it may be fastened by a piece of soft wax, and again covered with water.—Larger objects should be placed in a trough of thin wood; and for this purpose the bottom of a common chip box will answer very well; only surrounding the edge of it with soft wax, to keep in the water or other fluid employed in preserving the insect. The body is then to be opened; and if the parts are soft like those of a caterpillar, they should be turned back, and fixed to the trough by small pins, which ought to be set by a small pair of nippers. At the same time, the skin being stretched by another pair of finer forceps, the insect must be put into water, and dissected therein, occasionally covering it with spirit of wine. Thus the subject will be preserved in perfection, so that its parts may be gradually unfolded, no other change being perceived than that the soft elastic parts become stiff and opaque, while some others lose their colour.

The following instruments were made use of by M. Lyonet in his dissection of the *Chenille de Saule*. A pair of scissars as small as could be made, with long and fine arms: A pair of forceps, with their ends so nicely adjusted, that they could easily lay hold of a spider's thread, or a grain of sand: Two fine steel needles fixed in wooden handles, about two inches and three quarters in length; which were the most generally useful instruments he employed. Microscope.

Dr Hooke, who likewise made many microscopic observations, takes notice, that the common ant or pismire is much more troublesome to draw than other insects, as it is extremely difficult to get the body in a quiet natural posture. If its feet be fettered with wax or glue, while the animal remains alive, it so twists its body, that there is no possibility of gaining a proper view of it; and if it be killed before any observation is made, the shape is often spoiled before it can be examined. The bodies of many minute insects, when their life is destroyed, instantly shrivel up; and this is observable even in plants as well as insects, the surface of these small bodies being affected by the least change of air; which is particularly the case with the ant. If this creature, however, be dropped into rectified spirit of wine, it will instantly be killed; and when it is taken out, the spirit of wine evaporates, leaving the animal dry, and in its natural posture, or at least in such a state, that it may easily be placed in whatever posture we please.

Parts of Insects. The *wings*, in many insects, are so transparent, that they require no previous preparation: but some of those that are folded up under *elytra* or cases, require a considerable share of dexterity to unfold them; for these wings are naturally endowed with such a spring, that they immediately fold themselves again, unless care be taken to prevent them. The wing of the earwig, when expanded, is of a tolerable size, yet is folded up under a case not one eighth part of its bulk; and the texture of this wing renders it difficult to be unfolded. This is done with the least trouble immediately after the insect is killed. Holding then the creature by the thorax, between the finger and the thumb, with a blunt-pointed pin endeavour gently to open it, by spreading it over the forefinger, and at the same time gradually sliding the thumb over it. When the wing is sufficiently expanded, separate it from the insect by a sharp knife or a pair of scissars. The wing should be pressed for some time between the thumb and finger before it be removed; it should then be placed between two pieces of paper, and again pressed for at least an hour; after which time, as there will be no danger of its folding up any more, it may be put between the talcs, and applied to the microscope. Similar care is requisite in displaying the wings of the notonecta and other water insects, as well as most kinds of grylli.

The minute *scales* or *feathers*, which cover the wings of moths or butterflies, afford very beautiful objects for the microscope. Those from one part of the wing frequently differ in shape from such as are taken from other parts; and near the thorax, shoulder, and on the fringes of the wings, we generally meet with hair instead of scales. The whole may be brushed off the wing, upon a piece of paper, by means of a camels hair pencil; after which the hairs can be separated with the assistance of a common magnifying glass.

It is likewise a matter of considerable difficulty to dissect properly the *proboscis* of insects, such as the gnat, tabanus, &c. and the experiment must be repeated a great number of times before the structure and situation

Microscope.

tuation of the parts can be thoroughly investigated, as the observer will frequently discover in one what he could not in another. The *collector of the bee*, which forms a very curious object, ought to be first carefully washed in spirit of turpentine; by which means it will be freed from the unctuous matter adhering to it: when dry, it is again to be washed with a camel's hair pencil to disengage and bring forward the small hairs which form part of this microscopic beauty. The best method of managing the *stings* of insects, which are in danger of being broken by reason of their hardness, is to soak the case and the rest of the apparatus for some time in spirit of wine or turpentine; then lay them on a piece of paper, and with a blunt knife draw out the sting, holding the sheath with the nail of the finger or any blunt instrument; but great care is necessary to preserve the *feelers*, which when cleaned add much to the beauty of the object. The *beard* of the lepas anatifera is to be soaked in clean soft water, frequently brushing it while wet with a camel's hair pencil: after it is dried, the brushing must be repeated with a dry pencil to disengage and separate the hairs, which are apt to adhere together.

To view to advantage the *fat*, *brains*, and other similar substances, Dr Hooke advises to render the surface smooth, by pressing it between two plates of thin glass, by which means the matter will be rendered much thinner and more transparent: without this precaution, it appears confused, by reason of the parts lying too thick upon one another. For *muscular fibres*, take a piece of the flesh, thin and dry; moisten it with warm water, and after this is evaporated the vessels will appear more plain and distinct; and by repeated macerations they appear still more so. The *exuviæ* of insects afford a pleasing object, and require but little preparation. If bent or curled up, they will become so relaxed by being kept a few hours in a moist atmosphere, that you may easily extend them to their natural positions; or the steam of warm water will answer the purpose very well.

The *eyes* of insects in general form very curious and beautiful objects. Those of the libellula and other flies, as well as of the lobster, &c. must first be cleaned from the blood, &c. after which they should be soaked in water for some days: one or two skins are then to be separated from the eye, which would be otherwise too opaque and confused; but some care is requisite in this operation; for if the skin be rendered too thin, it is impossible to form a proper idea of the organization of the part. In some substances, however, the organization is such, that by altering the texture of the part, we destroy the objects which we wish to observe. Of this sort are the nerves, tendons, muscular fibres, many of which are viewed to most advantage when floating in some transparent fluid. Thus very few of the muscular fibres can be discovered when we attempt to view them in the open air, though great numbers may be seen if they be placed in water or oil. By viewing the thread of a ligament in this manner, we find it composed of a vast number of smooth round threads lying close together. Elastic objects should be pulled or stretched out while they are under the microscope, that the texture and nature of those parts, the figure of which is altered by being thus pulled out, may be more fully discovered.

Other objects. To examine *bones* by the microscope, they should first be viewed as opaque objects; but afterwards, by procuring thin slices of them, they may be viewed as transparent. The sections should be cut in all directions, and be well washed and cleaned; and in some cases maceration will be useful, or the bones may be heated red hot in a clear fire, and then taken out; by which means the bony cells will appear more conspicuous. The *pores of the skin* may be examined by cutting off a thin slice off the upper skin with a razor, and then a second from the same place; applying the latter to the microscope. The lizard, guana, &c. have two skins, one very transparent, the other thicker and more opaque; and, separating these two, you obtain very beautiful objects.

To view the *scales of fish* to advantage, they ought to be soaked in water for a few days, and then carefully rubbed to clean them from the skin and dirt which may adhere to them. The scales of the eel are a great curiosity; and the more so, as this creature was not known to have any scales till they were discovered by the microscope. The method of discovering them is this. Take a piece of the skin of an eel from off its side, and spread it while moist on a piece of glass, that it may dry very smooth: when thus dried, the surface will appear all over dimpled or pitted by the scales, which lie under a sort of cuticle or thin skin; which may be raised with the sharp point of a penknife, together with the scales, which will then easily slip out; and thus we may procure as many as we please.

The *leaves* of many *trees*, as well as of some plants, when dissected, form a very agreeable object. In order to dissect them, take a few of the most perfect leaves you can find, and place them in a pan with clean water. Let them remain there three weeks, or a month, without changing the water: then take them up; and if they feel very soft, and almost rotten, they are sufficiently soaked. They must then be laid on a flat board, and holding them by the stalk, draw the edge of a knife over the upper side of the leaf, which will take off most of the skin. Then turn the leaf, and do the same with the under side; and when the skin is taken off on both sides, wash out the pulpy matter, and the fibres will be exhibited in a very beautiful manner. The leaf may be slit into two parts, by splitting the stalk; and the skins peeled from the fibres will also make a good object. This operation is best performed in the autumn; the fibres of the leaves are much stronger at that season, and less liable to be broken.—The internal structure of shells may be observed by grinding them down on a hone: and all ores and minerals should be carefully washed and brushed with a small brush, to remove any sordes that may adhere to them.

To view the *circulation of the blood*, we must observe living animals of the most transparent kind.—A small eel is sometimes used for this purpose; in which case it must be cleansed from the slime naturally adhering to it; after which it may be put into a tube filled with water, where it can be viewed in a satisfactory manner. The tail of any other small fish may be viewed in the same manner, or put upon a slip of flat glass, and thus laid before the microscope. By filling the tube with water when an eel is made use of, we

Microfcope. we prevent in a great meafure the fliminefs of the animal from foiling the glafs.

The particles of the blood form a very curious object, and have been carefully viewed by different philofophers; who, neverthelefs, differ from one another very much in their accounts of them. The beft method of viewing thefe is to take a fmall drop of blood when warm, and fpread it as thin as poffible upon a flat piece of glafs. By diluting it a little with warm water, fome of the large globules will be feparated from the fmaller, and many of them fubdivided; or a fmall drop of blood may be put into a capillary glafs tube, and then placed before the microfcope. Mr Baker advifes warm milk as proper to be mixed with the blood; but Mr Hewfon, diluted the blood with its own ferum: and by this method he could preferve the fmall particles entire, and view them diftinctly; and thus he found that they were not globular, as had been imagined by other anatomifts, but flat. Having fhaken a piece of the craffamentum of the blood in ferum till the latter became a little coloured, he fpread it with a foft hair pencil on a piece of thin glafs, which he placed under the microfcope, in fuch a manner as not be quite horizontal, but rather higher at one end than the other. Thus the ferum flows from the higher to the lower part; and, as it flows, fome of the particles will be found to fwim on their flat fides, and will appear to have a dark fpot in the middle; while others will turn over from one fide to the other as they roll down the glafs. Many cruel experiments have been tried in order to obferve the circulation of the blood in living creatures, and an apparatus has been invented for viewing the circulation in the mefentery of a frog; but as this can anfwer no ufeful purpofe, and will never be put in practice by perfons of humanity, we forbear to mention it.

II. Befides the objects for the microfcope already mentioned, there are innumerable others, fome hardly vifible, and others totally invifible, to the naked eye; and which therefore, in a more peculiar fenfe, are denominated

Microfcopic Animals. They are the animalcules or moving bodies in water, in which certain fubftances have been infufed; and of which there are a great many different kinds. Thefe animalcula are fometimes found in water which we would call *pure*, did not the microfcope difcover its minute inhabitants; but not equally in all kinds of water, or even in all parts of the fame kind of it. The furfaces of infufions are generally covered with a fcum which is eafily broken, but acquires thicknefs by ftanding. In this fcum the greateft number of animalcules are ufually found. Sometimes it is neceffary to dilute the infufions; but this ought always to be done with water, not only diftilled, but viewed through a microfcope, left it fhould alfo have animalcules in it, and thus prove a fource of deception. It is, however, moft proper to obferve thofe minute objects after the water is a little evaporated; the attention being lefs diverted by a few objects than when they appear in great number. One or two of the animalcules may be feparated from the reft by placing a fmall drop of water on the glafs near that of the infufion; join them together by making a fmall connexion between them with a pin; and as foon as you perceive that an animalcule has entered the clear drop, cut off the connexion again. Microfcope.

Eels in pafte are obtained by boiling a little flour and water into the confiftence of bookbinders pafte; then expofing it to the air in an open veffel, and beating it frequently together to keep the furface from growing mouldy or hard. In a few days it will be found peopled with myriads of little animals vifible to the naked eye, which are the eels in queftion. They may be preferved for a whole year by keeping the pafte moiftened with water; and while this is done, the motion of the animals will keep the furface from growing mouldy. Mr Baker directs a drop or two of vinegar to be put into the pafte now and then. When they are applied to the microfcrope, the pafte muft be diluted in a piece of water for them to fwim in

Numberlefs animalcules are obferved by the microfcope in infufions of pepper. To make an infufion for this purpofe, bruife as much common black pepper as will cover the bottom of an open jar, and lay it thereon about half an inch thick: pour as much foft water into the veffel as will rife about an inch above the pepper. Shake the whole well together: after which they muft not be ftirred, but be left expofed to the air for a few days; in which time a thin pellicle will be formed on the furface, in which innumerable animals are to be obferved by the microfcope.

The microfcopic animals are fo different from thofe of the larger kinds, that fcarce any fort of analogy feems to exift between them; and one would almoft be tempted to think that they lived in confequence of laws directly oppofite to thofe which preferve ourfelves and other vifible animals in exiftence. They have been fyftematically arranged by O. F. Muller; though it is by no means probable that all the different claffes have yet been difcovered. Such as have been obferved, however, are by this author divided in the following manner:

I. *Such as have no external organs.*

1. Monas: Punctiforme. A mere point.
2. Proteus: Mutabilis. Mutable.
3. Volvox: Sphæricum. Spherical.
4. Enchelis: Cylindracea. Cylindrical.
5. Vibrio: Elongatum. Long.

* Membranaceous.

6. Cyclidium: Ovale. Oval.
7. Paramecium: Oblongum. Oblong.
8. Kolpoda: Sinuatum. Sinuous.
9. Gonium: Angulatum. With angles.
10. Burfaria. Hollow like a purfe.

II. *Thofe that have external organs.*

* Naked, or not enclofed in a fhell.

1. Cercaria: Caudatum. With a tail.
2. Trichoda: Crinitum. Hairy.
3. Kerona: Corniculatum. With horns.
4. Himantopus: Cirratum. Cirrated.
5. Leucophra: Ciliatum undique. Every part ciliated.
6. Vorticella: Ciliatum apice. The apex ciliated.

* Covered with a fhell.

7. Brachionus; Ciliatum apice. The apex ciliated.

In

Microscope.

In the treatise on HELMINTHOLOGY under the fifth order of the class vermes, viz. *Infusoria*, the genera here enumerated have already been noticed according to an arrangement somewhat different, and a few of the species have been described. For the sake of those who wish to prosecute microscopical inquiries we shall introduce descriptions of a few more, and particularly those whose habitats are known.

I. *Monas.*

This is by our author defined to be "an invisible (to the naked eye), pellucid, simple, punctiform worm;" but of which, small as it is, there are several species.

The *monas termo* or *gelatinosa*, is a small jelly-like point, which can be but imperfectly seen by the single microscope, and not at all by the compound one. In a full light they totally disappear, by reason of their transparency. Some infusions are so full of them that scarce the least empty space can be perceived; the water itself appearing composed of innumerable globular points, in which a motion may be perceived somewhat similar to that which is observed when the sun's rays shine on the water; the whole multitude of animals appearing in commotion like a hive of bees. This animal is very common in ditch-water, and in almost all infusions either of animal or vegetable substances.

Monas atomus or *albida;* white monas with a variable point. This appears like a white point, which through a high magnifier appears somewhat egg-shaped. The smaller end is generally marked with a black point, the situation of which is variable; sometimes it appears on the large end, and sometimes there are two black spots in the middle. This species was found in sea water, which had been kept through the whole winter, but was not very fetid. No other kind of animalcule was found in it.

II. *The Proteus.*

An invisible, very simple, pellucid worm, of a variable form.

The *tenax*, running out into a fine point. This is a pellucid gelatinous body, stored with black molecules, and likewise changing its figure, but in a more regular order than the former. It first extends itself in a straight line, the lower part terminating in a bright acute point. It appears to have no intestines; and when the globules are all collected in the upper part, it next draws the pointed end up toward the middle of the body, which assumes a round form. It goes through a number of different shapes, part of which are described under the article ANIMALCULE. It is found in some kinds of river water, and appears confined almost entirely to one place, only bending sidewise.

III. *Volvox.*

An invisible, very simple, pellucid, spherical worm.

The *punctum;* of a black colour, with a lucid point. This is a small globule, with one hemisphere opaque and black, the other having a crystalline appearance; and a vehement motion is observed in the black part. It moves as on an axis, frequently passing through the drop in this manner. Many are often seen joined together in their passage through the water; sometimes moving as in a little whirlpool, and then separating. They are found in great numbers on the surface of fetid sea water.

The *globulus*, with the hinder part somewhat obscure, sometimes verges a little towards the oval in its shape, having a slow fluttering kind of motion, but more quick when disturbed. The intestines are but just visible. It is found in most vegetable infusions, and is ten times larger than the monas lens.

The *lunula*, with lunular molecules, is a small roundish transparent body, consisting of an innumerable multitude of homogeneous molecules of the shape of a crescent, without any common margin. It moves continually in a twofold manner, viz. of the molecules among one another, and the whole mass turning slowly round. It is found in marshy places in the beginning of spring.

IV. *Enchelis.*

A simple, invisible, cylindric worm.

The *viridis*, or green enchelis, has an obtuse tail, the fore part terminating in an acute truncated angle; the intestines are obscure and indistinct. It continually varies its motion, turning from right to left.

The *punctifera*, having the fore part obtuse, the hinder part pointed. It is opaque, and of a green colour, with a small pellucid spot in the fore part, in which two black points may be seen; and a kind of double band crosses the middle of the body. The hinder part is pellucid and pointed, with an incision supposed to be the mouth, at the apex of the fore part. It is found in marshes.

The *pupula*, with the fore part papillary, is found in dunghill water in November and December: it has a rotatory motion on a longitudinal axis, and moves in an oblique direction through the water. Both ends are obtuse; and the hinder part is marked with a transparent circle, or circular aperture.

V. *Vibrio.*

A very simple, invisible, round, and rather long worm.

The *lineola* is found in most vegetable infusions in such numbers, that it seems to fill up almost the whole of their substance. It is so small, that with the best magnifiers we can discern little more than an obscure tremulous motion among them. It is more slender than the monas terma.

The *serpens*, with obtuse windings or flexures, is found in river water, but seldom. It is slender and gelatinous, resembling a serpentine line, with an intestine down the middle.

The *spirillum* is exceedingly minute, and twisted in a spiral form, which seems to be its natural shape as it never untwists itself, but moves forward in a straight line, vibrating the hind and fore parts. It was found in 1782 in an infusion of the sonchus arvensis.

The *vermiculus* has a milky appearance, with an obtuse apex, and a languid undulatory motion, like that of the common worm. It is found in marshy water in November

Microscope. November, but feldom. It is thought to be the animal mentioned by Leeuwenhoeck as found in the dung of the frog and fpawn of the male libellula.

The *fagitta*, with a fetaceous tail, has a long and flexible body; broadeft about the middle, and filled there alfo with gray molecules; the fore part being drawn out into a thin and tranfparent neck, and the upper end thick and black. It is found in falt water, and feems to move by contracting and extending its neck.

VI. *Cyclidium.*

A fimple, invifible, flat, pellucid, orbicular or oval worm.

The *bulla*, or orbicular bright cyclidium. This is found occafionally in an infufion of hay. It is very pellucid and white, but the edges fomewhat darker than the reft. It moves flowly, and in a femicircular direction.

The *millium* is very pellucid, and fplendid like cryftal; and of an elliptical figure, with a line through the whole length of it. The motion is fwift, interrupted, and fluttering.

VII. *Paramæcium.*

An invifible, membranaceous, flat, and pellucid worm.

The *chryfalis* is found in falt water, and differs very little from the former, only the ends are more obtufe, and the margins are filled with black globules.

The *verfutum* is found in ditches, and has an oblong, green, and gelatinous body, filled with molecules; the lower part thicker than the other; and both ends obtufe. It propagates by divifion.

VIII. *Kolpoda.*

An invifible, pellucid, flat, and crooked worm.

The *lamella* is very feldom met with. It refembles a long, narrow, and pellucid membrane, with the hind part obtufe, narrower, and curved towards the top. It has a vacillatory and very fingular motion; going upon the fharp edge, not on the flat fide as is ufual with microfcopic animals.

The *gallinula* is found in fetid falt water; and has the apex fomewhat bent, the belly oval, convex, and ftriated.

The *roftrum* is found, though feldom, in water where the lemna grows; and has a flow and horizontal motion. The fore part is bent into a kind of hook; the hind part obtufe, and quite filled with black molecules.

The *triquetra* was found in falt water, and appears to confift of two membranes; the upper fide flattened, the lower convex, with the apex bent into a kind of fhoulder.

The *affimilis* is found on the fea-coaft, and has an elliptic mafs in the middle, but is not folded like the former. The margin of the fore part is notched from the top to the middle; the lower part fwells out, and contracts again into a fmall point.

The *cucullulus* is found in an infufion of the fonchus arvenfis. It is very pellucid and cryftalline, with feveral globules, and has an oblique incifion a little below Microfcope. the apex.

The *ren*, or *craffa*, is found in an infufion of hay, commonly about 13 hours after the infufion is made, and has a quick and vacillatory motion. Its body is yellow, thick, and fomewhat opaque; curved a little in the middle, fo that it refembles a kidney; and full of molecules. When the water in which it fwims is about to fail, it takes an oval form, is compreffed, and at laft burfts.

IX. *Gonium.*

An invifible, fimple, fmooth, and angular worm.

The *pulvinatum* is found in dunghills; and appears like a little quadrangular membrane, plain on both fides; but with a large magnifier it appears like a bolfter formed of three or four cylindric pillows funk here and there.

The *corrugatum* is found in various kinds of infufions; and is fomewhat of a fquare fhape, very fmall, and in fome pofitions appears as ftreaked.

The *truncatum* is found chiefly in pure water, and then but feldom. It has a languid motion, and is much larger than the foregoing. The fore part is a ftraight line, with which the fides form obtufe angles, the end of the fides being united by a curved line. The internal molecules are of a dark green, and there are two little bright veficles in the middle.

X. *Burfaria.*

A very fimple, hollow, membranaceous worm.

The *truncatella* is vifible to the naked eye; white, oval, and truncated at the top, where there is a large aperture defcending towards the bafe. Moft of them have four or five yellow eggs, at the bottom. They move from left to right, and from right to left; afcending to the furface in a ftraight line, and fometimes rolling about while they defcend.

The *bullina* is pellucid and cryftalline, having fplendid globules of different fizes fwimming about with it. The under fide is convex, the upper hollow, with the fore part forming a kind of lip.

The *hirundinella* has two fmall projecting wings, which give it fomewhat of the appearance of a bird: and it moves fomething like a fwallow. It is invifible to the naked eye; but by the microfcope appears a pellucid hollow membrane.

The *duplella* was found among duckweed, and appears like a cryftalline membrane folded up, without any vifible inteftines except a fmall congeries of points under one of the folds.

XI. *Cercaria.*

An invifible tranfparent worm with a tail.

The *gyrinus* greatly refembles the fpermatic animalcules. It has a white gelatinous body; the fore part fomewhat globular; the hind part round, long, and pointed. Sometimes it appears a little compreffed on each fide. When fwimming it keeps its tail in continual vibration like a tadpole.

The *gibba* is found in the infufions of hay and other vegetables;

Microscope. vegetables; and is ſmall, opaque, gelatinous, white, and without any viſible inteſtines.

The *inquieta* is found in ſalt water, and is remarkable for changing the ſhape of its body: ſometimes it appears ſpherical, ſometimes like a long cylinder, and ſometimes oval. It is white and gelatinous, the tail filiform and flexible, the upper part vibrating violently. A pellucid globule may be obſerved at the baſe, and two very ſmall black points near the top.

The *turbo*, with a tail like a briſtle, is found among duckweed. It is of a talcy appearance, partly oval and partly ſpherical; and ſeems to be compoſed of two globular bodies, the lowermoſt of which is the ſmalleſt, and it has two little black points like eyes on the upper part. The tail is ſometimes ſtraight, ſometimes turned back on the body.

The *poduria* is found in November and December, in marſhy places covered with lemna. It is pellucid; and ſeems to conſiſt of a head, trunk, and tail: the head reſembles that of a herring; the trunk is ventricoſe and full of inteſtines, of a ſpiral form and black colour. The tail moſt commonly appears to be divided into two briſtles. The inteſtines are in a continual motion when the body moves, and by reaſon of their various ſhades make it appear very rough. There are likewiſe ſome hairs to be perceived. It turns round as upon an axis when it moves.

The *viridis* is found in the ſpring in ditches of ſtanding water; and in ſome of its ſtates has a conſiderable reſemblance to the laſt, but has a much greater power of changing its ſhape. It is naturally cylindrical, the lower end ſharp, and divided into two parts; but ſometimes contracts the head and tail ſo as to aſſume a ſpherical figure.

The *ſetifera* is found in ſalt water, but ſeldom. It is ſmall, the body rather opaque, and of a round figure. The upper part is bright, and ſmaller than the reſt: the trunk is more opaque; the tail ſharp, and near it a little row of ſhort hairs. It has a ſlow rotatory motion.

The *hirta* was likewiſe found in ſalt water. It is opaque and cylindrical; and when in motion, the body appears to be ſurrounded with rows of ſmall hairs ſeparated from each other.

The *pleuronectes* is found in water which has been kept for ſeveral months. It is membranaceous, roundiſh, and white, with two blackiſh points in the fore part, the hinder part being furniſhed with a ſlender ſharp tail. It has orbicular inteſtines of different ſizes in the middle; the larger of them bright. The motion is vacillatory; and in ſwimming it keeps one edge of the lateral membrane upwards, the other folded down.

The *tripos* is flat, pellucid, triangular, having each angle of the baſe or fore part bent down into two linear arms, the apex of the triangle prolonged into a tail. It is found in ſalt water.

XII. *Leucophra*.

An inviſible, pellucid, and ciliated worm.

The *mamilla* is of a dark colour, and filled with globular molecules; ſhort hairs are curved inwards; and it occaſionally projects and draws in a little white protuberance. It is pretty common in marſhy water.

The *vireſcens* is a large, pear-ſhaped, greeniſh-coloured animalcule, filled with opaque molecules, and covered with ſhort hairs; generally moving in a ſtraight line. It is found in ſalt water. Microſcope.

The *burſata* is found in ſalt water, and is ſimilar in many reſpects to the former. It is of a long oval ſhape, bulging in the middle, and filled with green molecules, everywhere ciliated except at the apex, which is truncated and ſhaped ſomewhat like a purſe; the hairs are ſometimes collected into little faſcicles.

The *poſthuma* is globular, and covered as it were with a pellucid net; is found in fetid ſalt water.

The *ſignata* is common in ſalt water in the months of November and December. It is oblong and ſubdepreſſed, with a black margin filled with little molecules, but more particularly diſtinguiſhed by a curved line in the middle ſomewhat in the ſhape of the letter S; one end of which is ſometimes bent into the form of a ſmall ſpiral.

XIII. *Trichoda*.

An inviſible, pellucid, hairy worm.

The *gyrinus* is one of the ſmalleſt of this genus, and is found in ſalt water. It is ſmooth and free from hairs, except at the fore part, where there are a few.

The *nigra* was found in ſalt water, and has an opaque body; but when at reſt one ſide appears pellucid. When in violent motion, it ſeems entirely black.

The *pubes* is found in water where duckweed grows, chiefly in the month of December. It has a bunch above the hind part marked with black ſpots, depreſſed towards the top, a little folded, and ſomewhat convex on the under part. The apex is furniſhed with hairs, but they are ſeldom viſible till the creature is in the agonies of death, when it extends and moves them vehemently, and attempting as it were to draw in the very laſt drop of water.

The *patens* is found in ſalt water; and is of a long cylindrical ſhape, filled with molecules, the fore part bright and clear, with a long opening near the top which tapers to a point, and is beſet with hairs.

The *ſtriata* is found in the month of December in river water. It is a beautiful animalcule, of a fox colour. It is of an oblong ſhape, the lower end ſomewhat larger than the other. It has a ſet of ſtreaks running from one end to the other, and at the abdomen a double row of little eggs lying in a tranſverſe direction.

The *uvula* is found in the infuſion of hay and other vegetables. It is ſix times longer than broad, round, flexuous, of an equal ſize, the greater part filled with obſcure molecules; the fore part rather empty, with an alimentary canal and lucid globules near the middle. The margin of the fore part is covered with ſhort hairs.

The *linter* is found in an infuſion of old graſs. It is egg-ſhaped, oblong, with both extremities raiſed ſo that the bottom becomes convex, and the upper part depreſſed like a boat: it is of different ſhapes at different ages, and ſometimes has a rotatory motion.

The *paxillus* is found in ſalt water; and is long, full of gray molecules; the fore part truncated and hairy, and rather ſmaller than the other.

The *vermicularis* is found in river water; and is pellucid

lucid in the fore part, with the hind part full of molecules.

The *melitæa* is found in falt water, but very rarely. It is oblong, ciliated, with a globular apex, a dilatable neck, and a kind of periftaltic motion perceivable within it.

The *perillum* is frequently found in marfhes. It is cylindrical, pellucid, mufcular, and capable of being folded up. It appears double; the interior part full of molecules, with an orbicular mufcular appendage, which it can open and fhut, and which forms the mouth. The external part is membranaceous, pellucid, dilated, and marked with tranfverfe ftreaks; and it can protrude or draw in the orbicular membrane at pleafure. Some have four articulations in the tail, others five; and it has two pairs of briftles, one placed at the fecond joint, the other at the laft.

The *delphis* is found in river water. It is fmooth, pellucid, having the fore part dilated into a femicircle, gradually decreafing in breadth towards the tail. The front is hairy, the hairs ftanding as rays from the femicircular edge: one of the edges is fometimes contracted.

The *delphinus* is found in hay that has been infufed for fome months. It is pellucid, fmooth, and egg-fhaped; the hinder part terminating in a tail about half the length of the body, dilated at the upper end, truncated, and always bent upwards. It moves fometimes on its belly and fometimes on its fide.

The *roftrata* is found in water where duckweed has been kept. It is depreffed, capable of changing its fhape, yellow, with long ciliated hairs; it has four feet tapering to a point, one of them longer than the reft. Both feet and hairs are within the margin. The fhape of the body is generally triangular; the apex formed into an obtufe beak, which the creature fometimes draws in fo that it appears quite round.

The *charon* was found in falt water. It is oval, and refembles a boat as well in its motion as fhape; the upper part is hollowed, the under part furrowed and convex; the ftern round, with feveral hairs proceeding from it.

XIV. *Kerona.*

An invifible worm with horns.

The *raftellum* is found in river water. It has three rows of horns on the back, which occupy almoft the whole of it.

The *cypris* is found in water covered with lemna. It is fomewhat of a pear fhape, compreffed, with a broad and blunt fore part; the front furnifhed with hairs, or little vibrating points inferted under the edge, fhorter in the hind part, partly extended ftraight, and partly bent down, having a retrograde motion.

The *calvitium* is found in the infufion of vegetables. The body is broad and flat, both fides obtufe, filled with black molecules, and there is a black fpot near the hinder part, where there are likewife a few fhort briftles.

The *puftulata* is found in falt water. It is oval, convex; one edge of the hinder part finuated, both ends fet with hairs, and fome horns on the fore part.

XV. *Himantopus.*

A pellucid, invifible, and cirrated worm.

The *acarus* is lively, conical, ventricofe, full of black molecules, with a bright and tranfparent fore part. The lower part of the apex has rows of long hairs on the under part fet like rays. Four locks of long crooked hair or feet proceed from the belly, and it is continually moving thefe and other hairs in various directions.

The *ludio* is a lively diverting animalcule, fmooth, pellucid, full of fmall points, the fore part clubbed and a little bent, the hinder part narrow; the bafe obliquely truncated, and terminating in a tail ftretched out tranfverfely. The top of the head and middle of the back are furnifhed with long and vibrating hairs; three moveable and flexible curls hang down from the fide of the head at a diftance from each other. When the creature is at reft, its tail is curled; but when in motion, it is drawn tight and extended upwards.

The *fannio* is found, though feldom, in water where the lemna grows. The cilia are longer than the hairs, and are continually vibrating: it has two moveable curls hanging on the fide of the head.

The *charon* is found in fea water, but rarely. It is oval, pellucid, and membranous, with longitudinal furrows and feveral bent diverging rows of hair below the middle, but none on the hinder part.

XVI. *Vorticella.*

A naked worm with rotatory cilia, capable of contracting and extending itfelf.

The *lunifera* is found in falt water; has the fore part obtufe, the bafe broad, and hollowed away like a crefcent, with a fhort protuberance in the middle of the concave part: the fore part is ciliated.

The *burfata* is found in falt water, and is ventricofe, crammed with molecules; the fore part truncated, and both fides of it pellucid: there is a prominent papilla in the middle, which when the animalcule is at reft appears notched, the edge of the aperture being ciliated; the hairs are capable of moving in various directions.

The *fputarium* is found in October, with the leffer lemna, and is one of the moft fingular of the microfcopic animalcules. When viewed fidewife, it is fometimes nearly cylindrical, only tapering a little towards the hinder part, and having a broad pellucid edge. Viewed from the top, it has fometimes a broad face or difk, furnifhed with radiating hairs, the under part contracted into a globular fhape, of a dark green colour, and filled with fmall grains.

The *multiformis* is found in falt water, and very much refembles the former.

The *nigra* is found in Auguft in meadows covered with water. It may be feen with the naked eye, appearing like a black point fwimming on the furface. Through the microfcope it appears as a fmall conical body, obtufe and ventricofe at one end, and acute at the other. When the extremities are extended, two fmall white hooks become vifible, by the affiftance of which

which it moves in the water, and it probably has a rotatory organ: it moves continually in a vacillating manner on the top of the water.

The *ocreata* is met with in rivers, though very ſeldom, and in ſhape ſomewhat reſembles the lower part of a boot. The apex of the upper part is truncated and ciliated, the heel pointed, and the foot round.

The *valga* is as broad as long, and the apex truncated and ciliated; both angles of the baſe projecting outwards, one ſomewhat like a wart, the other like a finger. It is found in marſhy waters.

The *papillaris* is likewiſe found in marſhes where the conferva nitida grows. It is ventricoſe; the fore part truncated, with a papillary tail, and a beautiful papillary excreſcence on the ſide.

The *cratægaria* is found in the month of April, both in the mud and on the tail of the monoculus quadricornis. They are generally heaped together in a ſpherical form, and united to one common ſtalk. They are likewiſe often to be found without a pedicle, the body rather contracted, the aperture circular, and ſurrounded with a marked margin. It has two ſmall arms; and with a powerful magnifier a violent rotatory motion may be obſerved. Sometimes an individual will ſeparate from the community, and move in a kind of ſpiral line for a little time, and then go back to the reſt.

The *rotatoria* is the *wheel animal* deſcribed by Mr Baker; and of which an account is given under the article ANIMALCULE.

The *furcata* is commonly found in water, and has a cylindric body with a rotatory organ, conſiſting of a row of hairs at the apex: the tail is divided into two parts, turning a little inwards. When at reſt it joins the ſegments of the tail, but opens them when in motion.

The *citrina* is found in ſtagnant water; the head full of molecules, round, everywhere of an equal ſize, and very tranſparent. Both ſides of the orifice are ciliated, and each has a rotatory motion appearing ſometimes without and ſometimes within the edge of the mouth.

The *convallaria* is the ſame with the *bell-animal* mentioned by Mr Baker. See the article ANIMALCULE.

The *acinoſa* inhabits that whitiſh ſubſtance which often entirely covers plants, wood, ſhells, &c. When this ſubſtance is examined by a microſcope, it appears to be wholly compoſed of living animals of the polype kind. See POLYPE.

The *pyraria*.
The *anaſtatica*. } See the article POLYPE.
The *digitalis*.

XVII. *Brachionus*.

A contractile worm, covered with a ſhell, and furniſhed with rotatory cilia.

The *patella* is found in marſhy water in the wintertime. It is univalve, the ſhell oval, plain, cryſtalline, with the anterior part terminating in two acute points on both ſides, though the intervening ſpace is commonly filled up with the head of the animal. By theſe points it faſtens itſelf, and whirls about the body erect. The rotatory cilia are perceived with great difficulty.

To what has been already ſaid on this ſubject, under the article ANIMALCULE, we ſhall here add the following obſervations from Mr Adams.—"How many kinds of theſe inviſibles there may be (ſays he), is yet unknown; as they are diſcerned of all ſizes, from thoſe which are barely inviſible to the naked eye, to ſuch as reſiſt the force of the microſcope as the fixed ſtars do that of the teleſcope, and with the greateſt powers hitherto invented appear only as ſo many moving points. The ſmalleſt living creatures our inſtruments can ſhow, are thoſe which inhabit the waters; for though animalcula equally minute may fly in the air, or creep upon the earth, it is ſcarcely poſſible to get a view of them; but as water is tranſparent, by confining the creatures within it we can eaſily obſerve them by applying a drop of it to the glaſſes.

"Animalcules in general are obſerved to move in all directions with equal eaſe and rapidity, ſometimes obliquely, ſometimes ſtraight forward; ſometimes moving in a circular direction, or rolling upon one another, running backwards and forwards through the whole extent of the drop, as if diverting themſelves; at other times greedily attacking the little parcels of matter they meet with. Notwithſtanding their extreme minuteneſs, they know how to avoid obſtacles, or to prevent any interference with one another in their motions: ſometimes they will ſuddenly change the direction in which they move, and take an oppoſite one; and, by inclining the glaſs on which the drop of water is, as it can be made to move in any direction, ſo the animalcules appear to move as eaſily againſt the ſtream as with it. When the water begins to evaporate, they flock towards the place where the fluid is, and ſhow a great anxiety and uncommon agitation of the organs with which they draw in the water. Theſe motions grow languid as the water fails, and at laſt ceaſe altogether, without a poſſibility of renewal if they be left dry for a ſhort time. They ſuſtain a great degree of cold as well as inſects, and will periſh in much the ſame degree of heat that deſtroys inſects. Some animalcules are produced in water at the freezing point, and ſome inſects live in ſnow. —By mixing the leaſt drop of urine with the water in which they ſwim, they inſtantly fall into convulſions and die.

"The ſame rule ſeems to hold good in thoſe minute creatures, which is obſervable in the larger animals, viz. that the larger kinds are leſs numerous than ſuch as are ſmaller, while the ſmalleſt of all are found in ſuch multitudes, that there ſeem to be myriads for one of the others. They increaſe in ſize, like other animals, from their birth until they have attained their full growth; and when deprived of proper nouriſhment, they in like manner grow thin and periſh."

The modes of propagation among theſe animalcules are various, and the obſervation of them is extremely curious. Some multiply by a tranſverſe diviſion, as is obſerved under the article ANIMALCULE: and it is remarkable, that though in general they avoid one another, it is not uncommon, when one is nearly divided, to ſee another puſh itſelf upon the ſmall neck which joins the two bodies in order to accelerate the ſeparation.—Others, when about to multiply, fix themſelves to the bottom of the water; then becoming firſt oblong, and afterwards round, turn rapidly as on a centre, but perpetually varying the direction of their rotatory motion.

Microfcope. motion. In a little time, two lines forming a crofs are perceived; after which the fpherule divides into four, which grow, and are again divided as before. A third kind multiply by a longitudinal divifion, which in fome begins in the fore part, in others in the hind part; and from others a fmall fragment detaches itfelf, which in a fhort time affumes the fhape of the parent animalcule. Laftly, others propagate in the fame manner as the more perfect animals.

In our obfervations under the article ANIMALCULE, we fuggefted fome doubts whether all thofe minute bodies which go under the name of *animalcules* really do enjoy animal life; or whether they are not in many cafes to be accounted only inanimate and exceedingly minute points of matter actuated by the internal motion of the fluid. This has alfo been the opinion of others: but to all hypothefes of this kind Mr Adams makes the following reply: "From what has been faid, it clearly appears, that their motions are not purely mechanical, but are produced by an internal fpontaneous principle; and that they muft therefore be placed among the clafs of living animals, for they poffefs the ftrongeft marks and the moft decided characters of animation; and, confequently, that there is no foundation for the fuppofition of a chaotic and neutral kingdom, which can only have derived its origin from a very tranfient and fuperficial view of thefe animalcules.—It may alfo be further obferved, that as we fee that the motions of the limbs, &c. of the larger animals, are produced by the mechanical conftruction of the body, and the action of the foul thereon, and are forced by the ocular demonftration which arifes from anatomical diffection to acknowledge this mechanifm which is adapted to produce the various motions neceffary to the animal; and as, when we have recourfe to the microfcope, we find thofe pieces which had appeared to the naked eye as the primary mechanical caufes of particular motions, to confift themfelves of leffer parts, which are the caufes of motion, extenfion, &c. in the larger; when the ftructure therefore can be traced no farther by the eye, or by the glaffes, we have no right to conclude that the parts which are invifible are not equally the fubject of mechanifm: for this would be only to affert, in other words, that a thing may exift becaufe we fee and feel it, and have no exiftence when it is not the object of our fenfes.—The fame train of reafoning may be applied to microfcopic infects and animalcula: we fee them move; but becaufe the mufcles and members which occafion thefe motions are invifible, fhall we infer that they have not mufcles, with organs appropriated to the motion of the whole and its parts? To fay that they exift not becaufe we cannot perceive them, would not be a rational conclufion. Our fenfes are indeed given us that we may comprehend fome effects; but then we have alfo a mind, with reafon, beftowed upon us, that, from the things which we do perceive with our fenfes, we may deduce the nature of thofe caufes and effects which are imperceptible to the corporeal eye."

Leaving thefe fpeculations, however, we fhall now proceed to give a particular

Explanation of the figures of the various animals, with their parts, ova, &c. reprefented in the plates.

Plate CCCXLII. Fig. 32. 33. reprefent the eggs of the phalæna neuftria, as they are taken from the tree to which they adhere, and magnified by the microfcope. The Microfcope. ftrong ground-work vifible in many places fhows the gum by which they are faftened together; and this connexion is ftrengthened by a very tenacious fubftance interpofed between the eggs, and filling up the vacant fpaces. Fig. 34. fhows a vertical fection of the eggs, exhibiting their oval fhape.—Fig. 35. is an horizontal fection through the middle of the egg. Thefe eggs make a beautiful appearance through the microfcope. The fmall figures *a*, *b*, *c*, reprefent the objects in their natural ftate, without being magnified.

Fig. 36. fhows the larva of the *mufca chameleon*, an aquatic infect. When viewed by the naked eye, it appears (as here reprefented) to be compofed of twelve annular divifions, feparating it into an head, thorax, and abdomen; but it is not eafy to diftinguifh the two laft parts from each other, as the inteftines lie equally both in the thorax and abdomen. The tail is furnifhed with a fine crown or circle of hair *b*, difpofed in the form of a ring, and by this means it is fupported on the furface of the water, the head and body hanging down towards the bottom, in which pofture it will fometimes remain for a confiderable time without any motion.—When it has a mind to fink to the bottom, it clofes the hairs of the ring, as in fig. 37. Thus an hollow fpace is formed, including a fmall bubble of air; by enlarging or diminifhing which, it can rife or fink in the water at pleafure. When the bubble efcapes, the infect can replace it from the pulmonary tubes, and fometimes confiderable quantities of air may be feen to efcape from the tail of the worm into the common atmofphere; which operation may eafily be obferved when the worm is placed in a glafs of water, and affords an entertaining fpectacle. The fnout of this infect is divided into three parts, of which that in the middle is immoveable; the other two, which grow from the fides of the middle one, are moveable, and vibrate like the tongues of lizards or ferpents. In thefe lateral parts lies moft of the creature's ftrength; for it walks upon them when out of the water, appearing to walk on its mouth, and to ufe it as the parrot does its beak to affift it in climbing.

The larva is fhown, fig. 38. as it appears through a microfcope. It grows narrower towards the head, is largeft about that part which we may call the thorax, converges all along the abdomen, and terminates at length in a fharp tail furrounded with hairs, as has already been mentioned. The twelve annular divifions are now extremely vifible, and are marked by numbers in the plate. The fkin appears fomewhat hard, and refembling fhagreen, being thick fet with grains pretty equally diftributed. It has nine holes, or fpiracula, probably for the purpofe of breathing, on each fide; but it has none of thefe on the tail divifion *a*, nor any eafily vifible on the third from the head. In the latter, indeed, it has fome very fmall holes concealed under the fkin, near the place where the embryo wings of the future fly are hid. "It is remarkable (fays Mr Adams) that caterpillars, in general, have two rings without thefe fpiracula, perhaps becaufe they change into flies with four wings, whereas this worm produces a fly with only two." The fkin of the larva is adorned with oblong black furrows, fpots of a light colour, and orbicular rings, from which there generally fprings a

Microscope. a hair; but only thoſe hairs which grow on the inſect's ſides are repreſented in the figure. There are alſo ſome larger hairs here and there, as at *c c*. The difference of colour, however, in this worm ariſes only from the quantity of grains in the ſame ſpace; for where they are in very great numbers, the furrows are darker, and paler where they are leſs plentiful.

The head *d* is divided into three parts, and covered with a ſkin which has hardly any diſcernible grains.—The eyes are rather protuberant, and lie near the ſnout; on which laſt are two ſmall horns at *i i*. It is crooked, and ends in a ſharp point as at *f*. The legs are placed near the ſnout between the ſinuſes in which the eyes are fixed. Each of theſe legs conſiſts of three joints, the outermoſt of which is covered with ſtiff hairs like briſtles *g g*. From the next joint there ſprings a horny bone *h h*, uſed by the inſect as a kind of thumb: the joint is alſo compoſed of a black ſubſtance of an intermediate hardneſs between bone and horn; and the third joint is of the ſame nature. In order to diſtinguiſh theſe parts, thoſe that form the upper ſides of the mouth and eyes muſt be ſeparated by means of a ſmall knife; after which, by the aſſiſtance of the microſcope, we may perceive that the leg is articulated by ſome particular ligaments, with the portion of the inſect's mouth which anſwers to the lower jaw in the human frame. We may then alſo diſcern the muſcles which ſerve to move the legs, and draw them up into a cavity that lies between the ſnout and thoſe parts of the mouth which are near the horns *i i*. The inſect walks upon theſe legs, not only in the water, but on the land alſo. It likewiſe makes uſe of them in ſwimming, keeping its tail on the ſurface contiguous to the air, and hanging downward with the reſt of the body in the water. In this ſituation, the only perceptible motion it has is in its legs, which it moves in a moſt elegant manner, from whence it is reaſonable to conclude, that the moſt of this creature's ſtrength lies in its legs, as we have already obſerved.

The ſnout of this larva is black and hard; the back part quite ſolid, and ſomewhat of a globular form; the front *f* ſharp and hollow. Three membranaceous diviſions may be perceived on the back part; by means of which, and the muſcles contained in the ſnout, the creature can contract or expand it at pleaſure.

The extremity of the tail is ſurrounded with thirty hairs, and the ſides adorned with others that are ſmaller; and here and there the large hairs branch out into ſmaller ones, which may be reckoned ſingle hairs. All theſe have their roots in the outer ſkin, which in this place is covered with rough grains, as may be obſerved by cutting it off and holding it againſt the light upon a ſlip of glaſs. Thus alſo we find, that at the extremities of the hairs there are grains like thoſe on the ſkin; and in the middle of the tail there is a ſmall opening, within which are minute holes, by which the inſect takes in and lets out the air it breathes. Theſe hairs, however, are ſeldom diſpoſed in ſuch a regular order as is repreſented in fig. 38. unleſs when the inſect floats with the body in the water, and the tail with its hairs a little lower than the ſurface, in which caſe they are diſpoſed exactly in the order delineated in the plate. The leaſt motion of the tail downward produces a concavity in the water; and it then aſſumes the figure of a wine glaſs, wide at the top and narrow at the bottom. The tail anſwers the double purpoſe of ſwimming and breathing, and through it the inſect receives what is the principle of life and motion to all animals. By means of theſe hairs alſo it can ſtop its motion when ſwimming, and remain ſuſpended quietly without motion for any length of time. Its motions in ſwimming are very beautiful, eſpecially when it advances with its whole body floating on the ſurface of the water after filling itſelf with air by the tail.—To ſet out, it firſt bends the body to the right or left, and then contracts it in the form of the letter S, and again ſtretches it out in a ſtraight line: by thus contracting and then extending the body alternately, it moves on the ſurface of the water. It is very quiet, and is not diſturbed by handling.

Theſe creatures are commonly found in ſhallow ſtanding waters in the beginning of June: but ſome years much more plentifully than others. They crawl on the graſs and other plants which grow in ſuch waters, and are often met with in ditches floating on the ſurface of the water by means of their tail, the head and thorax at the ſame time hanging down; and in this poſture they turn over the clay and dirt with their ſnout and feet in ſearch of food, which is commonly a viſcous matter met with in ſmall ponds and ditches. It is very harmleſs, though its appearance would ſeem to indicate the contrary. It is moſt eaſily killed for diſſection by ſpirit of turpentine.

Fig. 39. ſhows in its natural ſize a beautiful inſect, deſcribed by Linnæus under the name of *Leucopſis dorſigera*, and which appears to be a kind of intermediate genus between a ſphex and a waſp. The antennæ are black and cylindrical, increaſing in thickneſs towards the extremity; the joint neareſt the head is yellow; the head and thorax are black, encompaſſed with a yellow line, and furniſhed with a croſs line of the ſame colour near the head. The ſcutellum is yellow, the abdomen black, with two yellow bands, and a deep ſpot of the ſame colour on each ſide between the bands. A deep poliſhed groove extends down the back from the thorax to the anus, into which the ſting turns and is depoſited, leaving the anus very circular; a yellow line runs on each ſide of the ſting.—The anus and whole body, when viewed with a ſmall magnifier, appear punctuated; but when theſe points are ſeen through a large magnifier, they appear hexagonal. Fig. 40. ſhows the inſect very much magnified. Fig. 41. gives a ſide view of it magnified in a ſmaller degree.

Fig. 42. ſhows an inſect lately diſcovered by Mr John Adams of Edmonton, as he happened to be at an inn. It was firſt ſeen by ſome labouring people who were there at the time, by whom it was conjectured to be a louſe with unuſually long horns, a mite, &c. Mr Adams hearing the debate, procured the inſect; and having viewed it through a microſcope, it preſented the appearance exhibited in fig. 42. The inſect ſeems to be quite diſtinct from the phalangium cancroides of Linnæus. The latter has been deſcribed by ſeveral authors, but none of their deſcriptions agree with this. The abdomen of this inſect is more extended, the claws larger, and much more obtuſe; the body of the other being nearly orbicular, the claws ſlender, and almoſt terminating in a point, more tranſparent, and of a paler colour. Mr Marſham has one in Plate CCCXLIII.

Microſcope

in his poſſeſſion not to be diſtinguiſhed from that repreſented in fig. 42. excepting only that it wants the break or dent in the claws, which is ſo conſpicuous in this. He found that inſect firmly fixed by its claws to the thigh of a large fly, which he caught on a flower in Eſſex in the firſt week of Auguſt, and from which he could not diſengage it without great difficulty, and tearing off the leg of the fly. This was done upon a piece of writing paper; and he was ſurpriſed to ſee the little creature ſpring forward a quarter of an inch, and again ſeize the thigh with its claws, ſo that he had great difficulty in diſengaging it. The natural ſize of this creature, which Mr Adams calls the *lobſter-inſect*, is exhibited at *a*.

Fig. 43. ſhows the inſect named by M. de Geer *Phyſapus*, on account of the bladders at its feet, (*Thrips phyſapus*, Lin.) This inſect is to be found in great plenty upon the flowers of dandelion, &c. in the ſpring and ſummer. It has four wings, two upper and two under ones (repreſented fig. 44.) but the two undermoſt are not to be perceived without great difficulty. They are very long; and fixed to the upper part of the breaſt, lying horizontally. Both of them are rather pointed towards the edges, and have a ſtrong nerve running round them, which is ſet with a hair fringe tufted at the extremity. The colour of theſe wings is whitiſh: the body of the inſect is black; the head ſmall, with two large reticular eyes. The antennæ are of an equal ſize throughout, and divided into ſix oval pieces, which are articulated together.—The extremities of the feet are furniſhed with a membranaceous and flexible bladder, which it can throw out or draw in at pleaſure. It preſſes this bladder againſt the ſubſtances on which it walks, and thus ſeems to fix itſelf to them; the bladder ſometimes appears concave towards the bottom, the concavity diminiſhing as it is leſs preſſed. The inſect is repreſented of its natural ſize at *b*.

Fig. 45. repreſents the *Cimex ſtriatus* of Linnæus, remarkable for very bright and elegantly diſpoſed colours, though few in number. The head, proboſcis, and thorax, are black: the thorax ornamented with yellow ſpots; the middle one large, and occupying almoſt one third of the poſterior part; the other two are on each ſide, and triangular. The ſcutellum has two yellow oblong ſpots, pointed at each end. The ground of the elytra is a bright yellow; ſpotted and ſtriped with black. The nerves are yellow; and there is a brilliant triangular ſpot of orange, which unites the cruſtaceous and membranaceous parts; the latter are brown, and clouded. It is found in the elm tree in June. It is repreſented of its natural ſize at *c*.

Fig. 46. ſhows the *chryſomela aſparagi* of Linnæus, ſo called from the larva of the inſect feeding upon that plant. It is a common inſect, and very beautiful. It is of an oblong figure, with black antennæ, compoſed of many joints, nearly oval. The head is a deep and bright blue; the thorax red and cylindrical: the elytra are blue, with a yellow margin, and having three ſpots of the ſame colour on each; one at the baſe, of an oblong form, and two united with the margin: the legs are black; but the under ſide of the belly is of the ſame blue colour with the elytra and head. This little animal, when viewed by the naked eye, ſcarcely appears to deſerve any notice; but when examined by the microſcope, is one of the moſt pleaſing opaque objects we have. It is found in June on the aſparagus after it has run to ſeed; and it is ſhown of its natural ſize at *d*. De Geer ſays that it is very ſcarce in Sweden.

Fig. 47. ſhows an inſect of a ſhape ſo remarkable, that naturaliſts have been at a loſs to determine the genus to which it belongs. In the Fauna Suecica, Linnæus makes it an *attelabus*: but in the laſt edition of the Syſtema Naturæ, it is ranged as a meloe, under the title of the *Meloe monoceros*; though of this alſo there ſeems to be ſome doubt. The true figure of it can only be diſcovered by a very good microſcope. The head is black, and appears to be hid or buried under the thorax, which projects forward like a horn: the antennæ are compoſed of many joints, and are of a dirty yellow colour, as well as the feet: the hinder part of the thorax is reddiſh, the fore part black.—The elytra are yellow, with a black longitudinal line down the future; there is a band of the ſame colour near the apex, and alſo a black point near the baſe, the whole animal being curiouſly covered with hair. The natural ſize of it is ſhown at *e*. It was found in May. Geoffroy ſays that it lives upon umbelliferous plants.

Fig. 43—57. exhibit the anatomy of the coſſus caterpillar, which lives on the willow. The egg from which it proceeds is attached to the trunk of the tree by a kind of viſcous juice, which ſoon becomes ſo hard that the rain cannot diſſolve it. The egg itſelf is very ſmall and ſpheroidical, and, when examined by the microſcope, appears to have broad waving furrows running through the whole length of it, which are again croſſed by cloſe ſtreaks, giving it the appearance of a wicker baſket. It is not exactly known what time they are hatched; but as the ſmall caterpillars appear in September, it is probable that the eggs are hatched ſome time in Auguſt. When ſmall, they are generally met with under the bark of the tree to which the eggs were affixed; and an aqueous moiſture, oozing from the hole through which they got under the bark, is frequently, though not always, a direction for finding them. Theſe caterpillars change their colour but very little, being nearly the ſame when young as when old. Like many others, they are capable of ſpinning as ſoon as they come from the egg. They alſo change their ſkin ſeveral times; but as it is almoſt impoſſible to rear them under a glaſs, ſo it is very difficult to know exactly how often this moulting takes place.—Mr Adams conjectures that it is more frequently than the generality of caterpillars do, ſome having been obſerved to change more than nine times.

The coſſus generally faſts for ſome days previous to the moulting; during which time the fleſhy and other interior parts of the head are detached from the old ſkull, and retire as it were within the neck. The new coverings ſoon grow on, but are at firſt very ſoft.—When the new ſkin and the other parts are formed, the old ſkin is to be opened, and all the members withdrawn from it; an operation naturally difficult, but which muſt be rendered more ſo from the ſoft and weak ſtate of the creature at that time. It is always much larger after each change.

From Mr Lyonet's experiments, it appears, that the coſſus

Microscope. cossus generally passes at least two winters, if not three, before it assumes the pupa state. At the approach of winter, it forms a little case, the inside of which is lined with silk, and the outside covered with wood ground like very fine saw-dust. During the whole season it neither moves nor eats.

This caterpillar, at its first appearance, is not above one-twelfth of an inch long; but at last attains the length of two, and sometimes of three inches. In the month of May it prepares for the pupa state; the first care being to find a hole in the tree sufficient to allow the moth to issue forth; and if this cannot be found, it makes one equal in size to the future pupa. It then begins to form of wood a case or cone; uniting the bits, which are very thin, together by silk, into the form of an ellipsoid, the outside being formed of small bits of wood joined together in all directions; taking care, however, that the pointed end of the case may always be opposite to the mouth of the hole: having finished the outside of the case, it lines the inside with a silken tapestry of a close texture in all its parts, except the pointed end, where the texture is looser, in order to facilitate its escape at the proper time. The caterpillar then places itself in such a posture, that the head may always lie towards the opening of the hole in the tree or pointed end of its case. Thus it remains at rest for some time: the colour of the skin first becomes pale, and afterwards brown; the interior parts of the head are detached from the skull; the legs withdraw themselves from the exterior case; the body shortens; the posterior part grows small, while the anterior part swells so much, that the skin at last bursts; and, by a variety of motions, is pushed down to the tail; and thus the pupa is exhibited, in which the parts of the future moth may be easily traced.—The covering of the pupa, though at first soft, humid, and white, soon dries and hardens, and becomes of a dark purple colour; the posterior part is moveable; but not the fore part, which contains the rudiments of the head, legs, and wings. The fore-part of the pupa is furnished with two horns, one above and the other under the eyes. It has also several rows of points on its back. It remains for some weeks in the case; after which the moth begins to agitate itself, and the points are then of essential service, by acting as a fulcrum, upon which it may rest in its endeavours to proceed forward, and not slip back by its efforts for that purpose.

The moth generally continues its endeavours to open the case for a quarter of an hour; after which, by redoubled efforts, it enlarges the hole, and presses forward until it arrives at the edge, where it makes a full stop, lest by advancing further it should fall to the ground. After having in this manner reposed itself for some time, it begins to disengage itself entirely; and having rested for some hours with its head upwards, it becomes fit for action. Mr Marsham says, that it generally pushes one third of the case out of the hole before it halts.

The body of the caterpillar is divided into twelve rings, marked 1, 2, 3, &c. as represented in fig. 48, 49, 50, 51. each of which is distinguished from that which precedes, and that which follows, by a kind of neck or hollow; and, by forming boundaries to the rings, we make twelve other divisions, likewise expressed in the figures; but to the first of these the word *ring* is affixed, and to the second, *division*. To facilitate the description of this animal, M. Lyonet supposed a line to pass down through the middle of the back, which he called the superior line, because it marked the most elevated part of the back of the caterpillar; and another, passing from the head down the belly to the tail, he called the inferior line.

All caterpillars have a small organ, resembling an elliptic spot, on the right and left of each ring, excepting the second, third, and last; and by these we are furnished with a further subdivision of this caterpillar, viz. by lines passing through the spiracula, the one on the right side, the other on the left of the caterpillar. These four lines, which divide the caterpillar longitudinally into four equal parts, mark each the place under the skin which is occupied by a considerable viscus. Under the superior line lies the heart, or rather thread of hearts; over the inferior line, the spinal marrow; and the two tracheal arteries follow the course of the lateral lines. At equal distances from the superior and two lateral lines, we may suppose four intermediate lines. The two between the superior and lateral lines are called the intermediate superior; the two others opposite to them, and between the lateral and inferior lines, are called the intermediate inferior.

Fig. 48, 49. show the muscles of the caterpillar, arranged with the most wonderful symmetry and order, especially when taken off by equal strata on both sides, which exhibits an astonishing and exact form and correspondence in them. The figures show the muscles of two different caterpillars opened at the belly, and supposed to be joined together at the superior lines. The muscles of the back are marked by capitals; the gastric muscles by Roman letters; the lateral ones by Greek characters. Those marked θ are called, by M. Lyonet, dividing muscles, on account of their situation.

The caterpillar was prepared for dissection by being emptied, and the muscles, nerves, &c. freed from the fat in the manner formerly directed: after which the following observations were made.

The muscle A in the first ring is double; the anterior one being thick at top, and being apparently divided into different muscles on the upper side, but without any appearance of this kind on the under side. One insertion is at the skin of the neck towards the head; the other is a little above; and that of the second muscle A is a little below the first spiraculum, near which they are fixed to the skin.

The muscle marked α is long and slender, fixed by its anterior extremity under the gastric muscles *a* and *b* of the first ring, to the circumflex scale of the base of the lower lip. It communicates with the muscle *c* of the second ring, after having passed under some of the arteries, and introduced itself below the muscle θ.

The muscle β is so tender, that it is scarcely possible to open the belly of the caterpillar without breaking it. It is sometimes double, and sometimes triple.—Anteriorly it is fixed to the posterior edge of the side of the parietal scale, the lower fixture being at the middle of the ring near the inferior line.

There are three muscles marked ξ; the first affixed at at one extremity near the lower edge of the upper part of the parietal fcale; the other end divides itfelf into three or four tails, fixed to the fkin of the caterpillar under the mufcle ∂. The anterior part of the fecond is fixed near the firft; the anterior part of the third a little under the firft and fecond, at the fkin of the neck under the mufcle A. Thefe two laft paffing over the cavity of the firft pair of limbs, are fixed by feveral tails to the edge oppofite to this cavity. In this fubject there are two mufcles marked ∂, but fometimes there is only one anteriorly; they are fixed to the lower edge of the parietal fcale, the other ends being inferted in the firft fold of the fkin of the neck on the belly-fide. Fig. 50. beft reprefents the mufcles β and ∂; as in that figure they do not appear injured by any unnatural connexion.

In the fecond and four following rings we difcern two large dorfal mufcles A and B. In the 7th, 9th, and 10th rings are three, A, B, and C; in the 11th are four A, B, C, and D; and in the anterior part of the 12th ring are five, A, B, C, D, and E. All thefe ranges of mufcles, however, as well as the gaftric mufcles *a*, *b*, *c*, *d*, appear at firft fight only as a fingle mufcle, running nearly the whole length of the caterpillar; but when this is detached from the animal, it is found to confift of fo many diftinct mufcles, each confifting only of the length of one of the rings, their extremities being fixed to the divifion of each ring, excepting the middle mufcle *a*, which, at the 6th, 7th, 8th, and 9th rings, has its infertions rather beyond the divifion. Each row of mufcles appears as one, becaufe they are clofely connected at top by fome of the fibres which pafs from one ring to the other.

The mufcles A, which are 12 in number, gradually diminifh in breadth to the lower part of the laft ring: at the 8th and three following divifions they communicate with the mufcles B, and at the 11th with D. In the lower part of the laft ring, A is much broader than it was in the preceding ring; one extremity of it is contracted, and communicates with B; the lower infertion being at the membrane I, which is the exterior fkin of the fecal bag. The mufcles A and B, on the lower part of the laft ring, cannot be feen until a large mufcle is removed, which on one fide is fixed to the fubdivifion of the ring and on the other to the fecal bag.

The right mufcles B, which are alfo 12 in number, begin at the fecond ring, and grow larger from thence to the feventh. They are ufually narrower from thence to the 12th; the deficiency in width being fupplied by the fix mufcles C, which accompany it from the 7th to the fubdivifion of the 12th ring. The mufcles B and C communicate laterally with the 8th, 11th, and 12th divifions. C is wanting at the fubdivifion of the 12th; its place being here fupplied by B, which becomes broader at this part.

The firft of the three floating mufcles V originates at the firft ring, from whence it introduces itfelf under N, where it is fixed, and then fubdivides, and hides itfelf under other parts. The fecond begins at the fecond divifion, being fixed to the anterior extremity B of the fecond ring; from thence directing itfelf towards the ftomach; and, after communicating with the cafe of the *corpus craffum*, it divides, and fpreads into eight mufcles which run along the belly. The third begins at the third divifion, originating partly at the fkin, and partly at the junction of the mufcles B of the fecond and third ring. It directs itfelf obliquely towards the belly, meeting it near the third fpiraculum; and branching from thence, it forms the oblique mufcles of fome of the vifcera.

The thin long mufcle θ, which is at the fubdivifion of the laft ring, and covers the anterior infertion of the mufcle (*a*) where the ring terminates, is fingle. It begins at one extremity of the mufcle (*c*); at the fore part of the ring runs along the fubdivifion round the belly of the caterpillar, and finifhes, on the other fide, at the extremity of a fimilar mufcle C.

Fig. 49. fhows the dorfal mufcles of the coffus. To view which in an advantageous manner, we muft ufe the following mode of preparation.

1. All the dorfal mufcles, 35 in number, muft be taken out, as well as the feven lateral ones already defcribed.

2. All the ftraight mufcles of the belly muft be taken away, as well as the mufcular roots (*c*), and the ends of the gaftric mufcles (*c*), which are at the third and fourth divifions.

3. At the fecond divifion the mufcle θ muft be removed; only the extremities being left to fhow where it was inferted.

The parts being thus prepared, we begin at the third ring; where there are found four dorfal mufcles C, D, E, and F. The firft one C, is inferted at the third divifion, under the mufcles θ and α, where it communicates by means of fome fibres with the mufcle *f* of the fecond ring; proceeding from thence obliquely towards the intermediate fuperior line, and is fixed at the fourth divifion. As foon as C is retrenched, the mufcle D is feen; which grows wider from the anterior extremity: it lies in a contrary direction to the mufcle C, and is inferted into the third and fourth divifions. The mufcle E lies in the fame direction as the middle C, but not fo obliquely: the lower infertion is at the fourth divifion; the other at the third, immediately under C. The mufcle F is nearly parallel to D which joins it; the firft infertion is vifible, but the other is hid under the mufcles E and G at the fourth divifion.

In the eight following rings, there are only two dorfal mufcles; and of thefe D is the only one that is completely feen. It is very large, and diminifhes gradually in breadth from one ring to the other, till it comes to the laft, fending off branches in fome places.—E is one of the ftrait mufcles of the back; and is inferted under the dividing mufcles θ, at the divifions of its own ring.

On the anterior part of the 12th ring there are three dorfal mufcles, D, E, and F. D is fimilar to that of the preceding ring, marked alfo D, only that it is no more than half the length; terminating at the fubdivifion of its own ring. E is of the fame length, and differs from the mufcle E of the preceding ring only in its direction. F is parallel to E, and fhorter than it; its anterior end does not reach the twelfth divifion.

On the pofterior part there is only one dorfal mufcle, faftened by fome fhort ones to the fubdivifion of the laft ring, traverfing the mufcles α; and being fixed there as if defigned to ftrengthen them, and to to vary their direction.—α Is a single muscle, of which the anterior insertion is visible, the other end being fixed to the bottom of the foot of the last leg; its use is to move the foot. The anterior part of the muscle β branches into three or four heads, which cross the superior line obliquely, and are fixed to the skin a little above it. The other end is fastened to the membrane T.

Fig. 50. and 51. show the muscles of the caterpillar when it is opened at the back. The preparation for this view is to disengage the fat and other extraneous matter, as before directed.

The first ring has only two gastric muscles (*c*) and (*d*): the former is broad, and has three or four little tails: the first fixture is at the base of the lower lip, from whence it descends obliquely, and is fixed between the inferior and lateral line. The small muscle (*d*) is fastened on one side to the first spiraculum; on the other, a little lower, to the intermediate inferior and lateral line; and seems to be an antagonist to the muscle P, which opens the spiracula. The posterior fixture of δ is under the muscle C, near the skin of the neck; β is fixed a little on the other side of C, at the middle of the ring.

In the second ring there are three gastric muscles, *g*, *h*, and *i*: *g* and *h* are fixed at the folds which terminate the ring; but only the anterior part of *i* is fixed there. The muscle *h* is triple, and in one of the divisions separated into two parts; that marked *i* comes nearer the inferior line, and is fixed a little beyond the middle of the ring, where the corresponding muscle of the opposite side is forked to receive it.

In the third ring, the muscle *h*, which was triple in the foregoing ring, is only double here, that part which is nearest the inferior line being broadest: it has three tails, of which only two are visible in the figure. It is exactly similar to that of the preceding ring; and is crossed in the same manner by the muscle from the opposite side of the ring.

Throughout the eight following rings, the muscle *f* which runs through them all is very broad and strong. The anterior part of it is fixed at the intermediate inferior line, on the fold of the first division of the ring: the other part is fixed beyond the lower division; with this difference, that at the 10th and 11th rings it is fixed at the last fold of its ring; whereas, in the others it passes over that ring, and is inserted into the skin of the following one. In all these, the first extremity of the muscle *g* is fastened to the fold which separates the ring from the preceding one, and is parallel to *f*, and placed at the side of it. The first six muscles marked *g*, are forked; that of the fourth ring being more so than the rest, nor does it unite till near its anterior insertion. The longest tail lays hold of the following, and is inserted near the inferior line; the other inserts itself near the same line, at about the middle of its own ring; the two last do not branch out; but terminate at the divisions, without reaching the following ring. The muscle *h*, placed at the side of *f*, has nearly the same direction, and finishes at the folds of the ring.

The anterior part of the 12th ring has only one gastric muscle, marked *e*: it is placed on the intermediate inferior line; and is inserted at the folds of the upper division, and at the subdivision of this ring. The lower part has a larger muscle marked *c*, with several divisions; one placed under *b*, with one extremity fixed near the lateral line, at the subdivision of its ring; the other to the fecal bag, a little lower than the muscle *b*.

In fig. 51. all the gastric muscles described in fig. 50. disappear, as well as those lateral and dorsal ones of which the letters are not to be found in this figure.

In the first ring are the gastric muscles, *e*, *f*, *g*, which are best seen here: the first is narrow and long, passing under and crossing *f*: one of its insertions is at the lower line, the other at the lateral, between the spiraculum and neck: *f* is short, broad, and nearly straight, placed along the intermediate line; but between it and the lateral it passes under *e*, and is fixed to the fold of the skin which goes from the one bag to the other; the lower insertion is near the second division. There are sometimes three muscles of those marked *g*, and sometimes four: the lower parts of them are fixed about the middle of the ring, and the anterior parts at the fold of the skin near the neck. The muscles *i* and *h* are fixed to the same fold; the other end of *h* being fixed under the muscle Π, near the spiraculum. Above the upper end of *f*, a muscular body, *g*, may be seen. It is formed by the separation of two floating muscles.

The second ring has six gastric muscles, *k*, *l*, *m*, *n*, *o*, *p*. The first is a large oblique muscle, with three or four divisions placed at the anterior part of the ring: the head is fixed between the inferior line and its intermediate one, at the fold of the second division; from whence it crosses the inferior line and its corresponding muscle, terminating to the right and left of the line. I is a narrow muscle, whose head is fixed to the fold of the second division; the tail of it lying under *n*, and fastened to the edge of the skin that forms the cavity for the leg. The two muscles marked *m* have the same obliquity, and are placed the one on the other; the head is inserted in the skin under the muscle β, and communicates by a number of fibres with the tail of the muscle γ; the other end is fixed to the intermediate inferior line at the fold of the third division. The large and broad muscle *n*, covers the lower edge of the cavity of the limb, and the extremity of the tail of *l*. It is fixed first at the skin, near the intermediate line, from whence it goes in a perpendicular direction towards *m*, and introduces itself under *o* and *m*, where it is fixed. The muscle *o* is narrow and bent, and covers the edge of the cavity of the leg for a little way; one end terminating there, and the other finishing at the third division near *m*. That marked *p* is also bent: it runs near the anterior edge of the cavity of the leg; one end meets the head of *o*, the other end terminates at a raised fold near the inferior line. There is a triangular muscle on the side of the lateral muscle *o*, similar to that marked *g* in the following ring; in this figure it is entirely concealed by the muscle *m*.

The third ring has no muscle similar to *m*; that marked *k* differs only from that of the second ring in being crossed by the opposite muscle. Those marked *l*, *n*, *o*, *p*, are similar to those of the preceding one. The muscle *q* is triangular; the base is fastened to the last fold of the ring; on the lower side it is fixed to the muscle *o*, the top to the skin at the edge of the cavity for the leg.

The eight following rings have the gaftric mufcles, *i*, *k*, *l*, and *m*. The mufcle *i* is quite ftraight, and placed at fome diftance from the inferior line: it is broad at the fourth ring, but diminifhes gradually in breadth to the 11th. In the fourth it is united; but divides into two heads, which divaricate in the following rings. In the fix next rings thefe heads are fixed nearly at the fame place with *a* and *f*; and in the other two it terminates at the fold of the ring. The anterior infertion of the firft and laft is at the fold where the ring begins; that of the fix others is fomewhat lower under the place where the mufcle *i* terminates. The lower part of the oblique mufcle *k* is inferted in the fkin near *i*; the upper part at the intermediate inferior mufcle upon the fold which feparates the following ring, but is wanting in the 11th. The mufcle *l* is large, and co-operates with M: in the opening and fhutting the fpiraculum, one of its fixtures is near the intermediate inferior line, at about the fame height as *i*. The tail terminates a little below the fpiraculum.

The twelfth ring has only the fingle gaftric mufcle *d*, which is a bundle of fix, feven, or eight mufcles: the firft fixture of thefe is at the fubdivifion of the ring near the inferior line: one or two crofs this, and at the fame time the fimilar mufcles of the oppofite fide. Their fixture is at the bottom of the foot; and their office is to affift the mufcle *a* in bringing back the foot, and to loofen the claw from what it lays hold of. One of the infertions of this mufcle *a* is obferved in this figure near *d*, the other near the fubdivifion of the ring.

Fig. 52. and 53. fhow the organization of the head of the coffus, though in a very imperfect manner, as M. Lyonet found it neceffary to employ *twenty* figures to explain it fully. The head is reprefented as it appears when feparated from the fat, and difengaged from the neck. HH are the two palpi. The truncated mufcles D belong to the lower lip, and affift moving it. K fhows the two ganglions of the neck united. II are the two veffels which affift in fpinning the filk. L, the œfophagus. M, the two diffolving veffels. The Hebrew characters דבבא fhow the continuation of the four cephalic arteries. In fig. 52. the ten abductor mufcles of the jaw are reprefented by SS, TT, VV, and Z. Four occipital mufcles are feen in fig. 53. under *ee* and *ff*. At *ak* is reprefented a nerve of the firft pair belonging to the ganglion of the neck; *b* is a branch of this nerve.

Fig. 54. exhibits the nerves as feen from the under part; but excepting in two or three nerves, which may be eafily diftinguifhed, only one of each pair is drawn, in order to avoid confufion. The nerves of the firft ganglion of the neck are marked by capital letters, thofe of the ganglion (a) of the head by Roman letters; the nerves of the fmall ganglion by Greek characters. Thofe of the frontal ganglion, except one, by numbers.

The mufcles of the coffus have neither the colour nor form of thofe of larger animals. In their natural ftate they are foft, and of the confiftence of a jelly. Their colour is a grayifh blue, which, with the filver-coloured appearance of the pulmonary veffels, form a glorious fpectacle. After the caterpillar has been foaked for fome time in fpirit of wine, they lofe their elafticity and tranfparency, becoming firm, opaque, and white, and the air-veffels totally difappear. The number of mufcles in a caterpillar is very great. The greateft part of the head is compofed of them, and there is a vaft number about the œfophagus, inteftines, &c.; the fkin is, as it were, lined by different beds of them, placed the one under the other, and ranged with great fymmetry. M. Lyonet has been able to diftinguifh 228 in the head, 1647 in the body, and 2066 in the inteftinal tube, making in all 4041.

At firft fight the mufcles might be taken for tendons, as being of the fame colour, and having nearly the fame luftre. They are generally flat, and of an equal fize throughout; the middle feldom differing either in colour or fize from either of the extremities. If they are feparated, however, by means of very fine needles, in a drop of fome fluid, we find them compofed not only of fibres, membranes, and air-veffels, but likewife of nerves; and, from the drops of oil that may be feen floating on the fluid, they appear alfo to be furnifhed with many unctuous particles. Their ends are fixed to the fkin, but the reft of the mufcle is generally free and floating. Several of them branch out confiderably; and the branches fometimes extend fo far, that it is not eafy to difcover whether they are diftinct and feparate mufcles or parts of another. They are moderately ftrong; and thofe which have been foaked in fpirit of wine, when examined by the microfcope, are found to be covered with a membrane which may be feparated from them; and they appear then to confift of feveral parallel bands lying longitudinally along the mufcle, which, when divided by means of fine needles, appear to be compofed of ftill fmaller bundles of fibres lying in the fame direction; which, when examined by a powerful magnifier, and in a favourable light, appear twifted like a fmall cord. The mufcular fibres of the fpider, which are much larger than thofe of the caterpillar, confift of two different fubftances, one foft and the other hard; the latter being twifted round the former fpirally, and thus giving it the twifted appearance juft mentioned.

There is nothing in the caterpillar fimilar to the brain in man. We find indeed in the head of this infect a part from which all the nerves feem to proceed; but this part is entirely unprotected, and fo fmall, that it does not occupy one fifth part of the head; the furface is fmooth, and has neither lobes nor any anfractuofity like the human brain. But if we call this a brain in the caterpillar, we muft fay that it has *thirteen*: for there are twelve other fuch parts following each other in a ftraight line, all of them of the fame fubftance with that in the head, and nearly of the fame fize; and from them, as well as from that in the head, the nerves are diftributed through the body.

The fpinal marrow in the coffus goes along the belly; is very fmall, forking out at intervals, nearly of the fame thicknefs throughout, except at the ganglions, and is not enclofed in any cafe. It is by no means fo tender as in man; but has a great degree of tenacity, and does not break without a confiderable degree of tenfion. The fubftance of the ganglions differs from that of the fpinal marrow, as no veffels can be difcovered in the latter; but the former

mer are full of very delicate ones. There are 94 principal nerves, which divide into innumerable ramifications.

The coffus has two large tracheal arteries, creeping under the fkin clofe to the fpiracula: one at the right and the other at the left fide of the infect, each of them communicating with the air by means of nine fpiracula. They are nearly as long as the whole caterpillar; beginning at the firft fpiraculum, and extending fomewhat farther than the laft; fome branches alfo extending quite to the extremity of the body. Round each fpiraculum the trachea pufhes forth a great number of branches, which are again divided into fmaller ones, and thefe further fubdivide and fpread through the whole body of the caterpillar. The tracheal artery, with all its numerous ramifications, are open elaftic veffels, which may be preffed clofe together, or drawn out confiderably, but return immediately to their ufual fize when the tenfion ceafes. They are naturally of a filver colour, and make a beautiful appearance. This veffel, with its principal branches, is compofed of three coats, which may be feparated from one another. The outmoft is a thick membrane furnifhed with a great variety of fibres, which defcribe a vaft number of circles round it, communicating with each other by numerous fhoots. The fecond is very thin and tranfparent, without any particular veffel being diftinguifhable in it. The third is compofed of fcaly threads, generally of a fpiral form; and fo near each other as fcarcely to leave any interval. They are curioufly united with the membrane which occupies the intervals; and form a tube which is always open, notwithftanding the flexure of the veffel. There are alfo many other peculiarities in its ftructure. The principal tracheal veffels divide into 1326 different branches.

The heart of the coffus is very different from that of larger animals, being almoft as long as the animal itfelf. It lies immediately under the fkin at the top of the back, entering the head, and terminating near the mouth. Towards the laft rings of the body it is large and capacious, diminifhing very much as it approaches the head, from the fourth to the twelfth divifion. On both fides, at each divifion, it has an appendage, which partly covers the mufcles of the back, but which, growing narrower as it approaches the lateral line, it forms a number of irregular lozenge-fhaped bodies.—This tube, however, feems to perform none of the functions of the heart in larger animals, as we find no veffel opening into it which anfwers either to the aorta or vena cava. It is called the heart, becaufe it is generally filled with a kind of lymph, which naturalifts have fuppofed to be the blood of the caterpillar; and becaufe in all caterpillars which have a tranfparent fkin, we may perceive alternate regular contractions and dilatations along the fuperior line, beginning at the eleventh ring, and proceeding from ring to ring, from the fourth; whence this veffel is thought to be a ftring or row of hearts. There are two white oblong bodies which join the heart near the eighth divifion; and thefe have been called *reniform* bodies, from their having fomewhat of the fhape of a kidney.

The moft confiderable part of the whole caterpillar with regard to bulk is the corpus craffum. It is the firft and only fubftance that is feen on opening it. It forms a kind of fheath which envelopes and covers all the entrails, and, introducing itfelf into the head, enters all the mufcles of the body, filling the greateft part of the empty fpaces in the caterpillar. It very much refembles the configuration of the human brain, and is of a milk-white colour.

The œfophagus defcends from the bottom of the mouth to about the fourth divifion. The fore part, which is in the head, is flefhy, narrow, and fixed by different mufcles to the cruftaceous parts of it; the lower part, which paffes into the body, is wider, and forms a kind of membranaceous bag, covered with very fmall mufcles; near the ftomach it is narrower, and, as it were, confined by a ftrong nerve fixed to it at diftant intervals. The ventricle begins a little above the fourth divifion, where the œfophagus ends, and finifhes at the tenth. It is about feven times as long as broad; and the anterior part, which is broadeft, is generally folded. Thefe folds diminifh with the bulk as it approaches the inteftines; the furface is covered with a great number of aërial veffels, and opens into a tube, which M. Lyonet calls the large inteftine.—There are three of thefe large tubes, each of which differs fo much from the reft, as to require a particular name to diftinguifh it from them.

The two veffels from which the coffus fpins its filk are often above three inches long, and are diftinguifhed into three parts; the anterior, intermediate, and pofterior. It has likewife two other veffels, which are fuppofed to prepare and contain the liquor for diffolving the wood on which it feeds.

Fig. 55. fhows the wing of an earwig magnified; *a* reprefents it of the natural fize. The wings of this infect are fo artificially folded up under fhort cafes, that few people imagine they have any. Indeed, they very rarely make ufe of their wings. The cafes under which they are concealed are not more than a fixth part of the fize of one wing, though a fmall part of the wing may be difcovered, on a careful infpection, projecting from under them. The upper part of the wing is cruftaceous and opaque, but the under part is beautifully tranfparent. In putting up their wings, they firft fold back the parts AB, and then fhut up the ribs like a fan; the ftrong mufcles ufed for this purpofe being feen at the upper part of the figure. Some of the ribs are extended from the centre to the outer edge; others only from the edge about half way: but they are all united by a kind of band, at a fmall but equal diftance from the edge; the whole evidently contrived to ftrengthen the wing, and facilitate its various motions. The infect itfelf differs very little in appearance in its three different ftates. De Geer afferts, that the female hatches eggs like a hen, and broods over her young ones as a hen does. Plate CCCXLIV.

Fig. 56. reprefents a wing of the *hemerobius perla* magnified. It is an infect which feldom lives more than two or three days.—The wings are nearly of a length, and exactly fimilar to one another. They are compofed of fine delicate nerves, regularly and elegantly difpofed as in the figure, beautifully adorned with hairs, and lightly tinged with green. The body is of a fine green colour; and its eyes appear like two burnifhed beads of gold, whence it has obtained the name of *golden eye*. This infect lays its eggs on the leaves of the plum or the rofe tree; the eggs are of a white colour,

Microfcope colour, and each of them fixed to a little pedicle or foot-ftalk, by which means they ftand off a little from the leaf, appearing like the fructification of fome of the moffes. The larva proceeding from thefe eggs refembles that of the coccinella or lady-cow, but is much more handfome. Like that, it feeds upon aphides or pucerons, fucking their blood, and forming itfelf a cafe with their dried bodies; in which it changes into the pupa ftate, from whence they afterwards emerge in the form of a fly.

Fig. E, F, I, reprefent the duft of a moth's wing magnified. This is of different figures in different moths. The natural fize of thefe fmall plumes is reprefented at H.

Fig. 57. fhows a part of the cornea of the libellula magnified. In fome pofitions of the light, the fides of the hexagons appear of a fine gold colour, and divided by three parallel lines. The natural fize of the part magnified is fhown at *b*.

Fig. 58. fhows the part *c* of a lobfter's cornea magnified.

Fig. 59. fhows one of the arms or horns of the lepas anatifera, or barnacle, magnified; its natural fize being reprefented at *d*. Each horn confifts of feveral joints, and each joint is furnifhed on the concave fide of the arm with long hairs. When viewed in the microfcope, the arms appear rather opaque; but they may be rendered tranfparent, and become a moft beautiful object, by extracting out of the interior cavity a bundle of longitudinal fibres, which runs the whole length of the arm. Mr Needham thinks that the motion and ufe of thefe arms may illuftrate the nature of the rotatory motion in the wheel-animal. In the midft of the arms is an hollow trunk, confifting of a jointed hairy tube, which enclofes a long round tongue that can be pufhed occafionally out of the tube or fheath, and retracted occafionally. The mouth of the animal confifts of fix laminæ, which go off with a bend, indented like a faw on the convex edge, and by their circular difpofition are fo ranged, that the teeth, in the alternate elevation and depreffion of each plate, act againft whatever comes between them. The plates are placed together in fuch a manner, that to the naked eye they form an aperture not much unlike the mouth of a contracted purfe.

Plate CCCXLV. Fig. 60. fhows the apparatus of the *tabanus* or gadfly, by which it pierces the fkin of horfes and oxen, in order to fuck the blood. The whole is contained in a flefhy cafe, not expreffed in the figure. The feelers *a a* are of a fpongy texture and gray coloured, covered with fhort hairs. They are united to the head by a fmall joint of the fame fubftance. They defend the other parts of the apparatus, being laid upon it fide by fide whenever the animal ftings, and thus preferve it from external injury. The wound is made by the two lancets *b b* and B, which are of a delicate ftructure, but very fharp, formed like the diffecting knife of an anatomift, growing gradually thicker to the back.—The two inftruments *c c* and C, appear as if intended to enlarge the wound, by irritating the parts round it; for which they are jagged or toothed. They may alfo ferve, from their hard and horny texture, to defend the tube *e* E, which is of a fofter nature, and tubular to admit the blood, and convey it to the ftomach. This part is totally enclofed in a line *d* D, which entirely covers it. Thefe parts are drawn feparately at B, C, D, E. De Geer obferves, that only the females fuck the blood of animals; and Reaumur informs us, that having made one, that had fucked its fill, difgorge itfelf, the blood it threw up appeared to him to be more than the whole body of the infect could have contained. The natural fize of this apparatus is fhown at *f*.

Microfcope, Midas.

Fig. 61. fhows a bit of the fkin of a lump-fifh (*cyclopterus*) magnified. When a good fpecimen of this can be procured, it forms a moft beautiful object. The tubercles exhibited in the figure probably fecrete an unctuous juice.

Fig. 62. fhows the fcale of a fea perch found on the Englifh coaft; the natural fize is exhibited at *h*.

Fig. 63. the fcale of an haddock magnified; its natural fize as within the circle.

Fig. 64. the fcale of a parrot fifh from the Weft Indies magnified; *l* the natural fize of it.

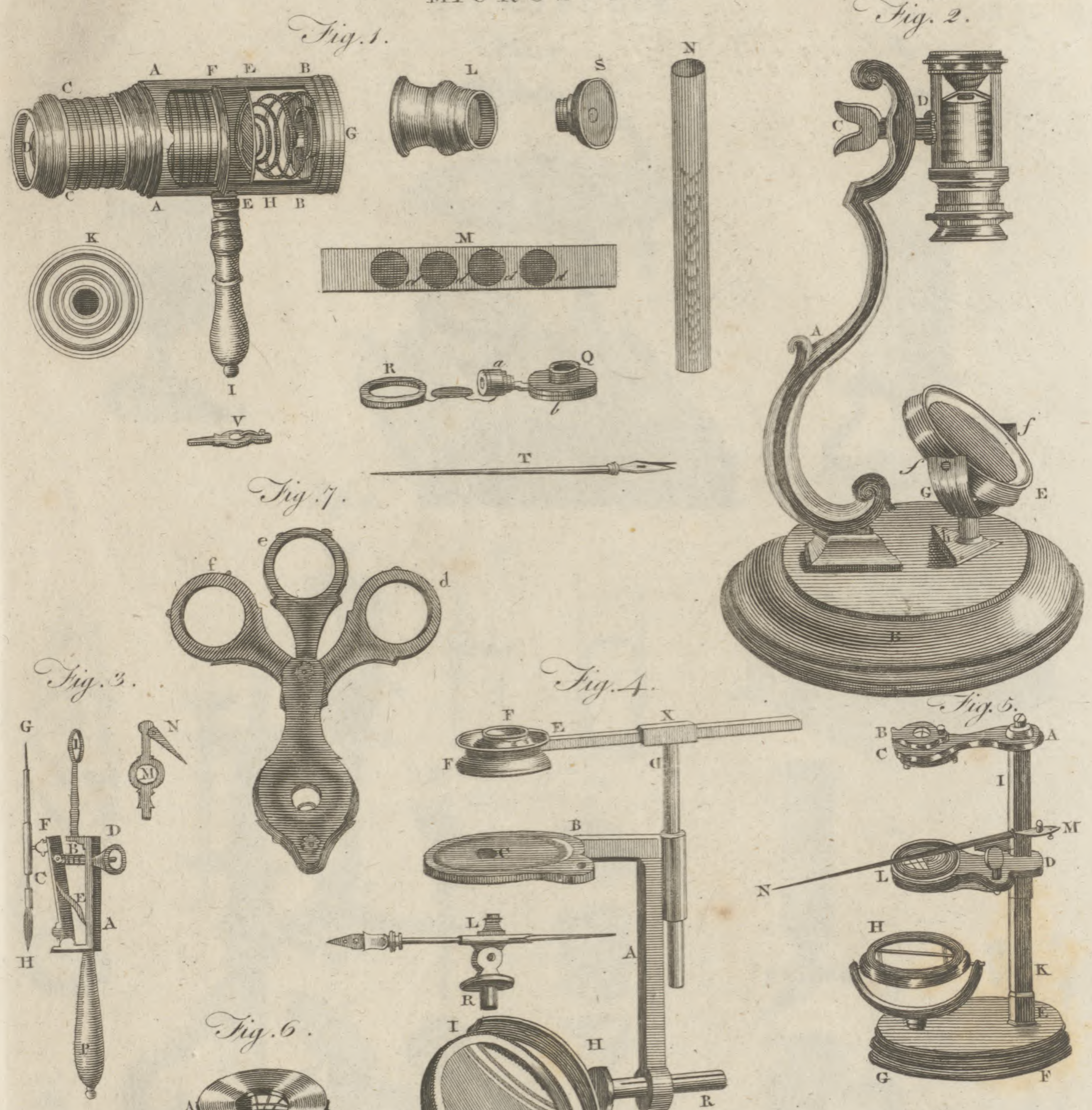
Fig. 65. the fcale of a kind of perch in the Weft Indies magnified; *k* the natural fize of the fcale.

Fig. 66. part of the fkin of a fole fifh, as viewed through an opaque microfcope; the magnified part, in its real fize, fhown at *l*.

The fcales of fifhes afford a great variety of beautiful objects for the microfcope. Some are long; others round, fquare, &c. varying confiderably not only in different fifhes, but even in different parts of the fame fifh. Leeuwenhoeck fuppofed them to confift of an infinite number of fmall fcales or ftrata, of which thofe next to the body of the fifh are the largeft. When viewed by the microfcope, we find fome of them ornamented with a prodigious number of concentric flutings, too near each other, and too fine, to be eafily enumerated. Thefe flutings are frequently traverfed by others diverging from the centre of the fcale, and generally proceeding from thence in a ftraight line to the circumference.

For more full information concerning thefe and other microfcopcial objects, the reader may confult Mr Adams's *Effays on the Microfcope*, who has made the moft valuable collection that has yet appeared on the fubject. See alfo the articles ANIMALCULE, CRYSTALLIZATION, POLYPE, PLANTS, and WOOD, in the prefent work.

MIDAS, in *Fabulous Hiftory*, a famous king of Phrygia, who having received Bacchus with great magnificence, that god, out of gratitude, offered to grant him whatever he fhould afk. Midas defired that every thing he touched fhould be changed into gold. Bacchus confented; and Midas, with extreme pleafure, everywhere found the effects of his touch. But he had foon reafon to repent of his folly; for wanting to eat and drink, the aliments no fooner entered his mouth than they were changed in gold. This obliged him to have recourfe to Bacchus again, to befeech him to reftore him to his former ftate; on which the god ordered him to bathe in the river Pactolus, which from thence forward had golden fands. Some time after, being chofen judge between Pan and Apollo, he gave another inftance of his folly and bad tafte, in preferring Pan's mufic to Apollo's; on which the latter being enraged, gave him a pair of affes ears. This Midas attempted to conceal from the knowledge of his fubjects: but one of his fervants faw the length of his ears, and being unable to keep the fecret, yet afraid to reveal



A. Bell Prin. Wal. Sculptor fecit.

MICROSCOPE. Plate CCCXXXVIII.

A. Bell Prin. Wal. Sculptor fecit.

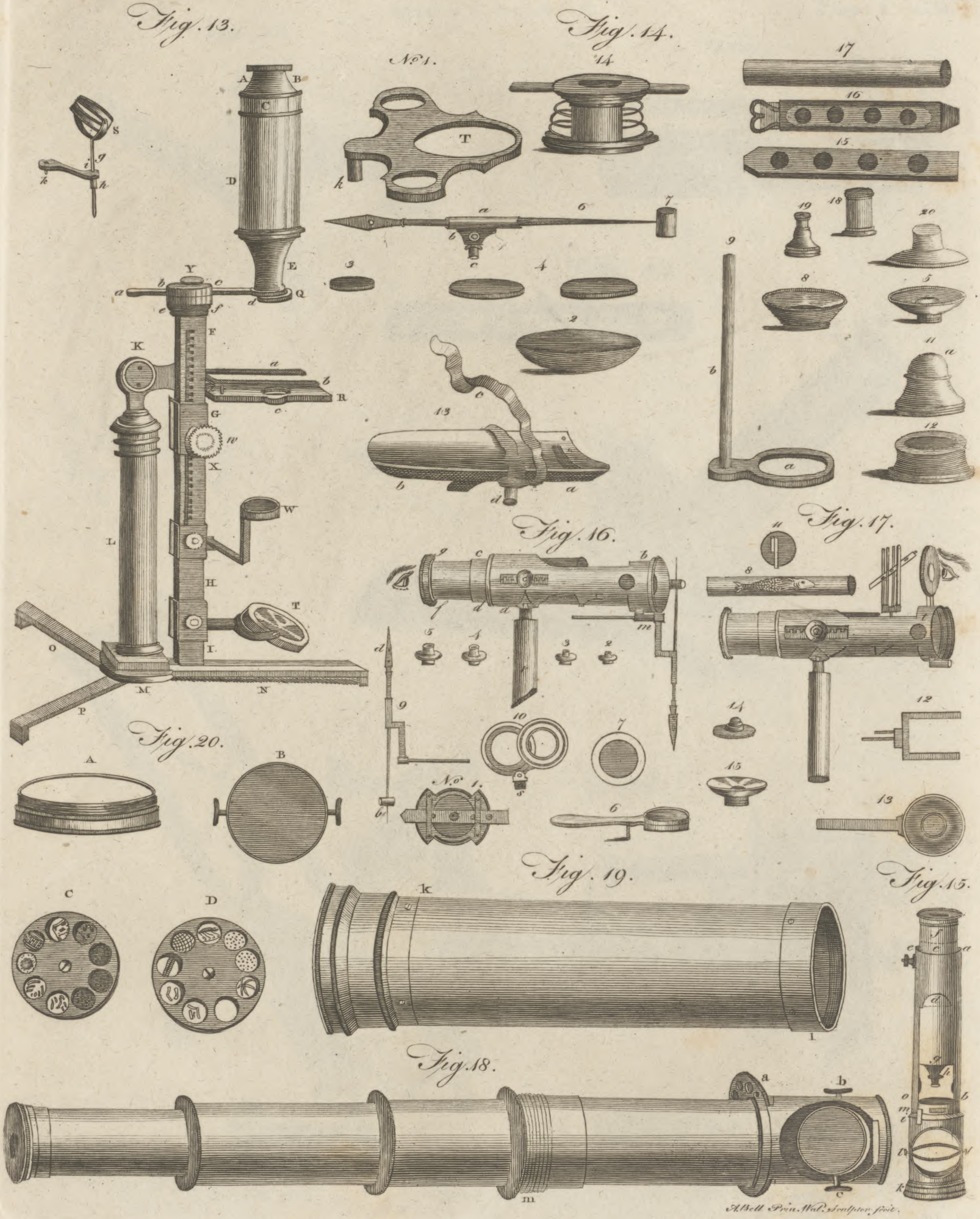


Fig. 13.
Fig. 14.
Fig. 16.
Fig. 17.
Fig. 20.
Fig. 19.
Fig. 15.
Fig. 18.
A. Bell Prin. Wal. Sculptor fecit.

Fig. 21.

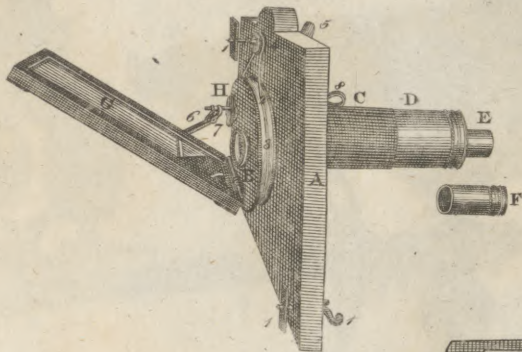


Fig. 25.

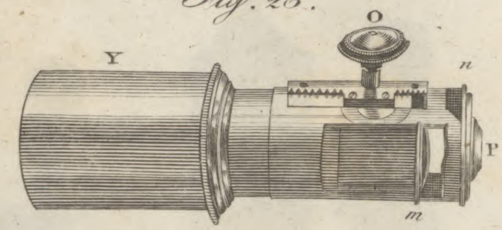


Fig. 22.

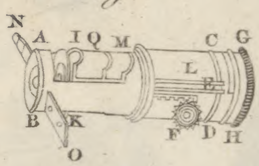


Fig. 23.

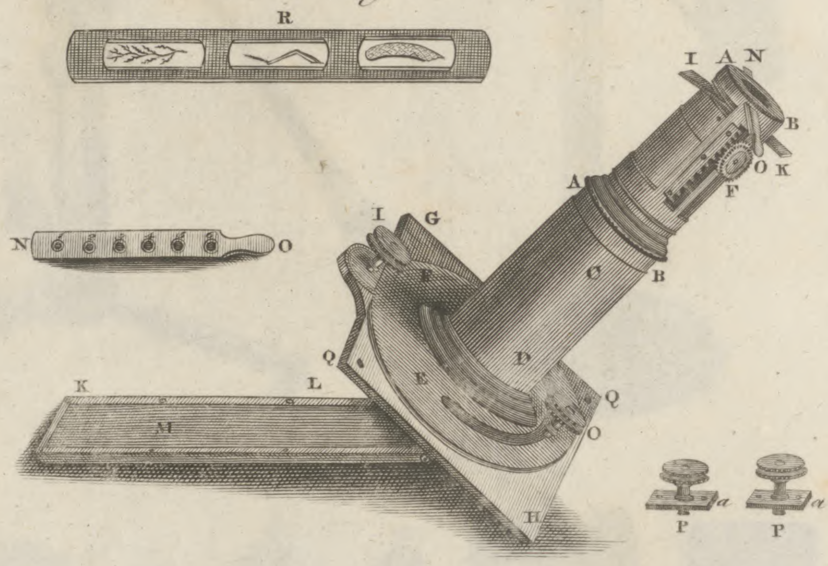
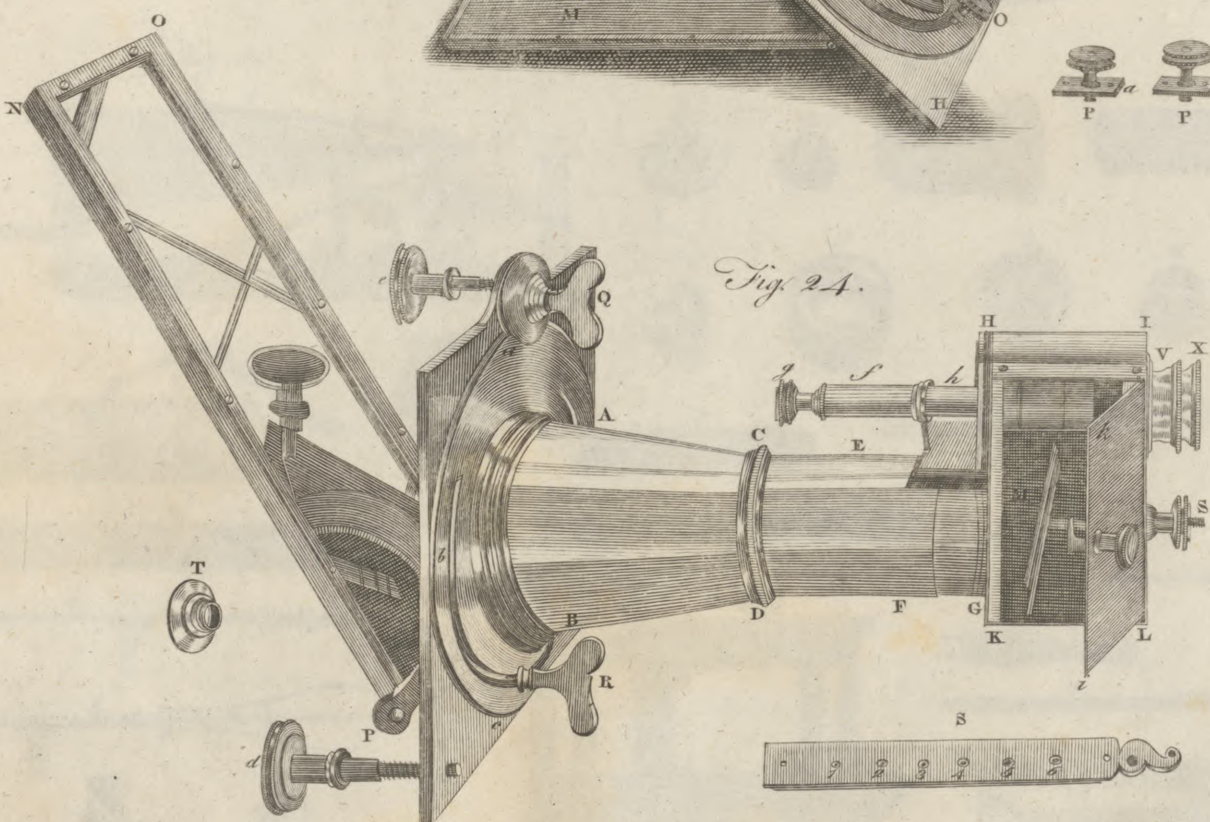
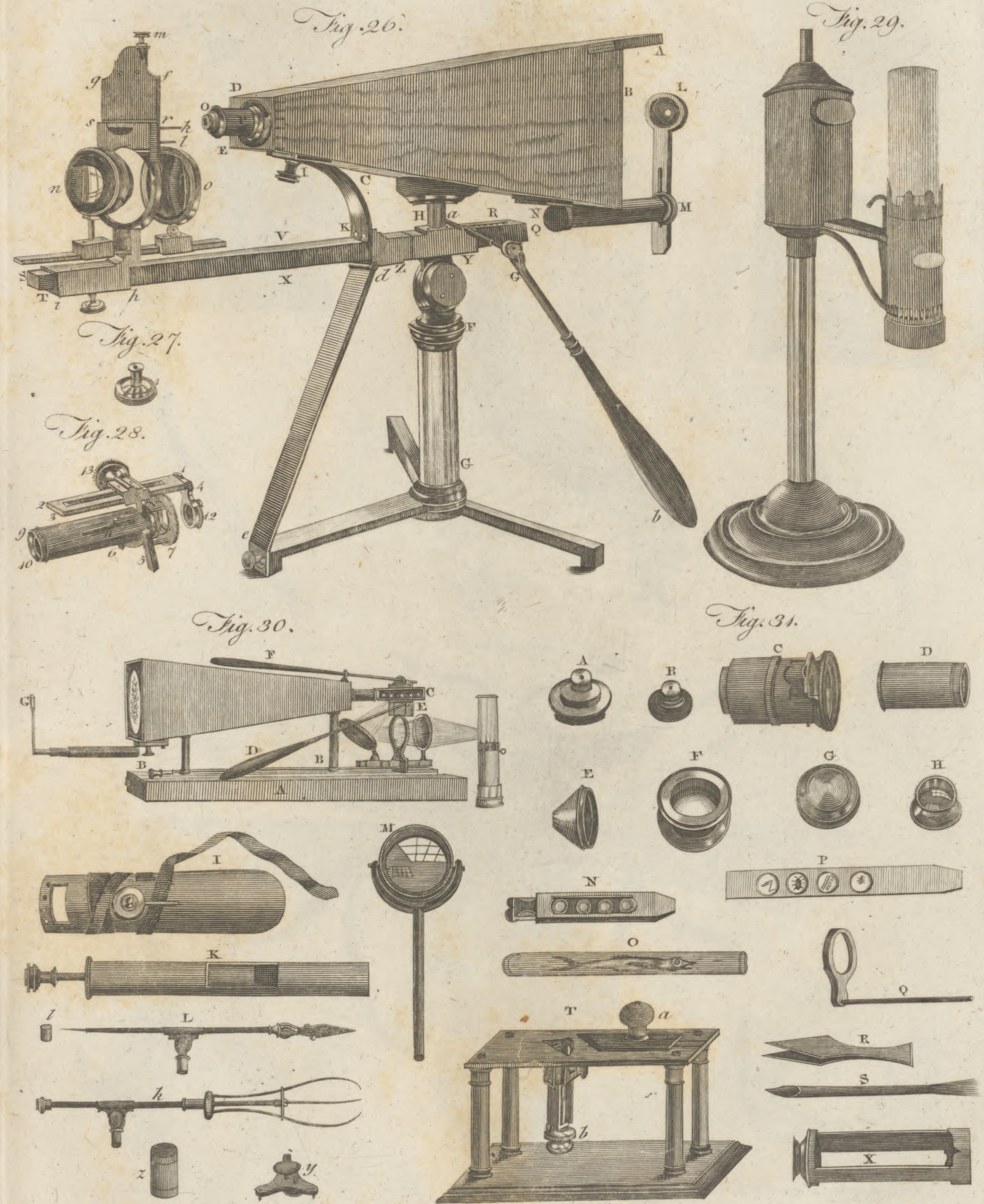


Fig. 24.



A. Bell Prin. Wal. Sculptor fecit.

MICROSCOPE. Plate CCCXLI.



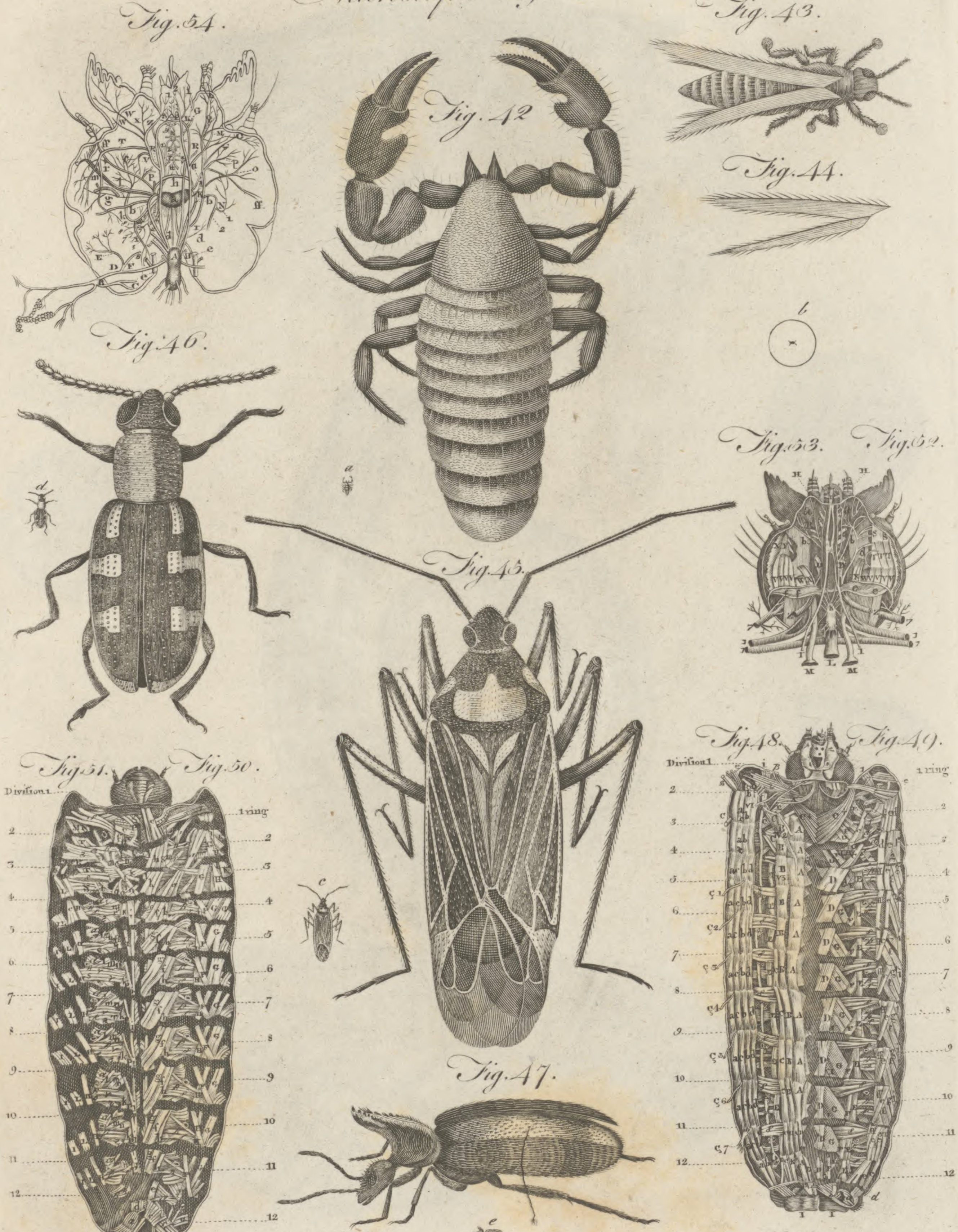
A. Bell Prin Wal Sculptor fecit.

Microscopic Objects.

Plate CCCXLII.

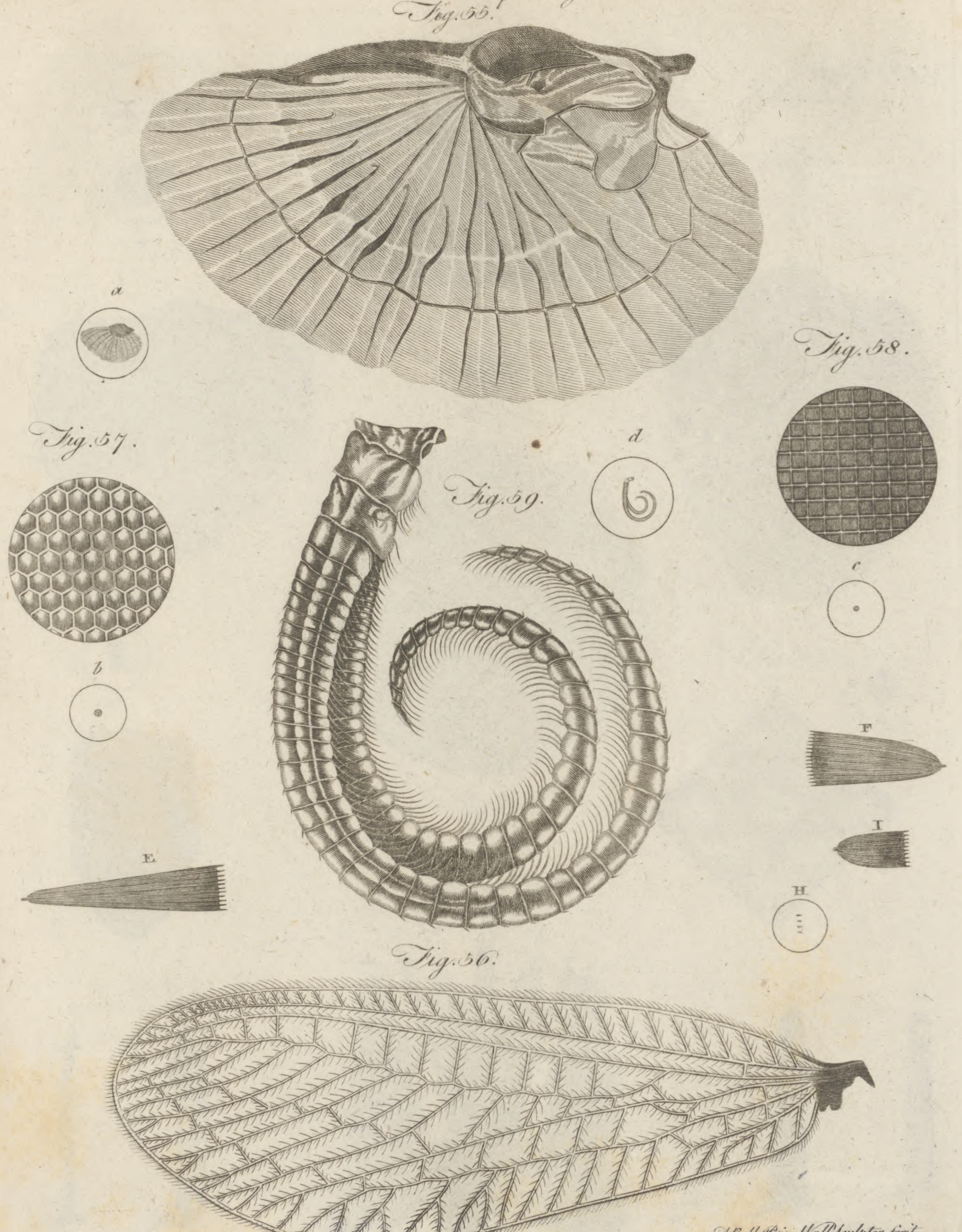
A.Bell Prin. Wal. Sculptor fecit.

Microscopic Objects. Plate CCCXLIII



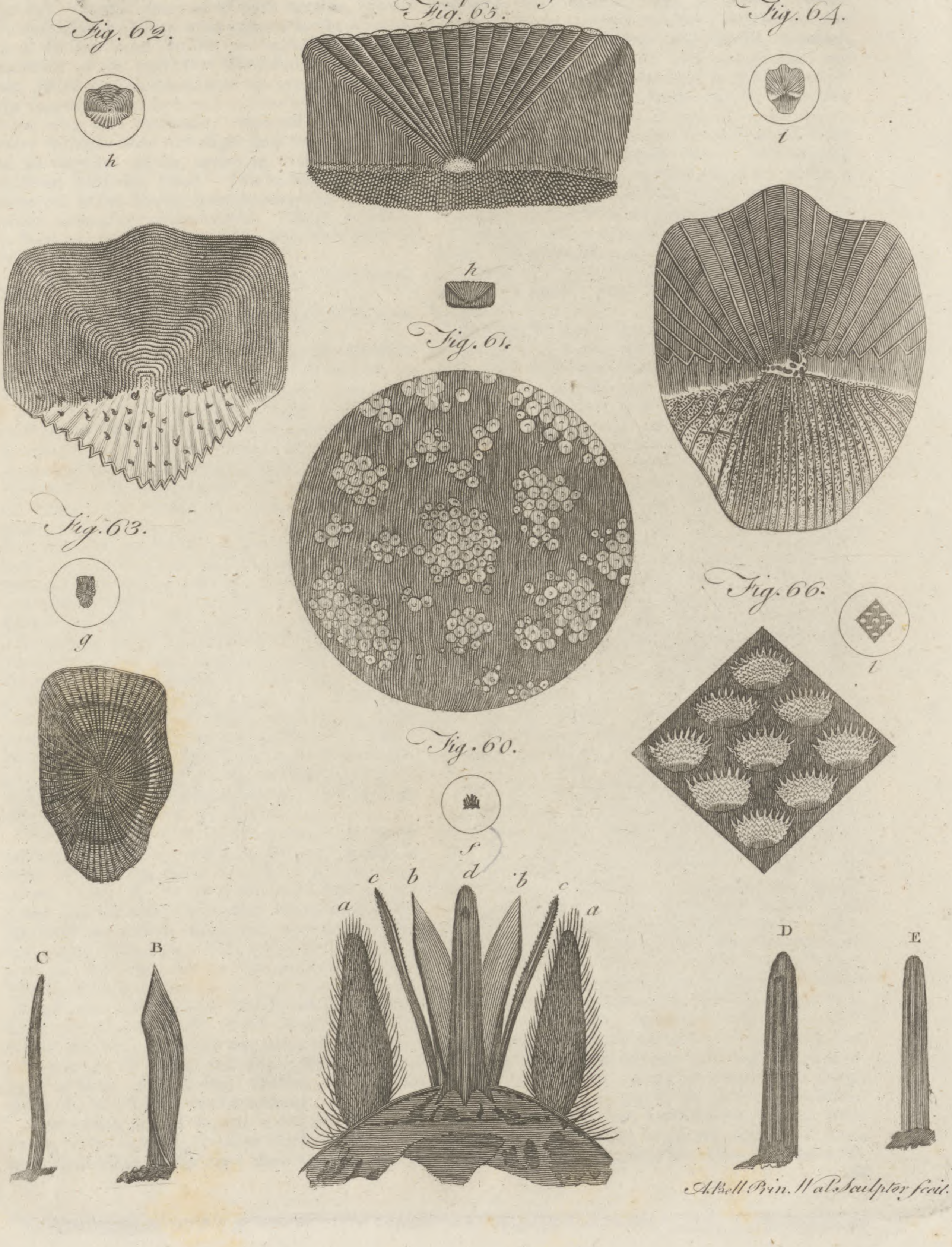
A. Bell Prin. Wal. Sculptor fecit.

Microscopic Objects.



A. Bell Prin. Wall. Sculptor fecit.

Microscopic Objects Plate CCCXIV.



A. Bell Prin. Wal. Sculptor fecit.

veal it from apprehenfion of the king's refentment, he opened a hole in the earth, and after he had whifpered there that Midas had the ears of an afs, he covered the place as before, as if he had buried his words in the ground. On that place, as the poets mention, grew a number of reeds, which when agitated by the wind uttered the fame found that had been buried beneath, and publifhed to the world that Midas had the ears of an afs. Some explain the fable of the ears of Midas, by the fuppofition that he kept a number of informers and fpies, who were continually employed in gathering every feditious word that might drop from the mouths of his fubjects. Midas, according to Strabo, died of drinking bull's hot blood. This he did, as Plutarch mentions, to free himfelf from the numerous ill dreams which continually tormented him. Midas, according to fome, was fon of Cybele. He built a town which he called *Ancyræ*.

Midas, *Ear-fhell*. See Haliotis, Conchology *Index*.

MID-heaven, the point of the ecliptic that culminates, or in which it cuts the meridian.

MIDDLEBURG, one of the Friendly iflands in the South fea. The ifland was firft difcovered by Tafman, a Dutch navigator, in January 1742-3; and is called by the natives *Ea-Oo-whe*: it is about 16 miles from north to fouth, and in the wideft part about 8 miles from eaft to weft. The fkirts are chiefly laid out in plantations, the fouth-weft and north-weft fides efpecially. The interior parts are but little cultivated, though very capable of it: but this neglect adds greatly to the beauty of the ifland; for here are agreeably difperfed grooves of cocoa-nuts and other trees, lawns covered with thick grafs, here and there plantations and paths leading to every part of the ifland, in fuch beautiful diforder, as greatly to enliven the profpect. The hills are low; the air is delightful; but unfortunately water is denied to this charming fpot. Yams, with other roots, bananas, and bread-fruit, are the principal articles of food; but the latter appeared to be fcarce. Here is the pepper tree, or *ava-ava*, with which they make an intoxicating liquor, in the fame difgufting manner as is practifed in the Society iflands. Here are feveral odoriferous trees and fhrubs, particularly a fpecies of the lemon tribe; and the botanical gentlemen met with various new fpecies of plants. Here alfo are a few hogs and fowls.

There are no towns or villages; moft of the houfes are built in plantations, which are laid out in different parts, with no other order than what convenience requires. They are neatly conftructed, but are lefs roomy and convenient than thofe in the Society ifles. The floors are a little raifed, and covered with thick ftrong mats. The fame fort of matting ferves to enclofe them on the windward fide, the others being open. They have little areas before moft of them, which are planted round with trees or ornamental fhrubs, whofe fragrance perfumes the air. Their houfehold furniture confifts of a few wooden platters, cocoa-nut fhells, and pillows made of wood, and fhaped like four-footed ftools or forms: their common clothing, with the addition of a mat, ferves them for bedding.

The natives are of a clear mahogany or chefnut brown, with black hair, in fhort frizzled curls, which feems to be burnt at the tips; their beards are cut or fhaven. The general ftature of the men is equal to our middle fize, from five feet three to five feet ten inches; the proportions of the body are very fine, and the *contours* of the limbs extremely elegant, though fomething more mufcular than at Otaheite, which may be owing to a greater and more conftant exertion of ftrength in their agriculture and domeftic economy. Their features are extremely mild and pleafing; and differ from the old Otaheitian faces in being more oblong than round, the nofe fharper, and the lips rather thinner. The women are, in general, a few inches fhorter than the men, but not fo fmall as the lower clafs of women at the Society iflands. The practice of puncturing the fkin, and blacking it, which is called *tattowing*, is in full force among the men here, for their belly and loins are very ftrongly marked in configurations more compounded than thofe at Otaheite. The tendereft parts of the body were not free from thefe punctures; the application of which, befides being very painful, muft be extremely dangerous on glandulous extremities.

The men in general go almoft naked, having only a fmall piece of cloth round the loins, but fome wrap it in great abundance round them from their waift: this cloth is manufactured much like that at Otaheite, but overfpread with a ftrong glue, which makes it ftiff, and fit to refift the wet. The women are likewife covered from the waift downwards: they often have loofe necklaces, confifting of feveral ftrings of fmall fhells, feeds, teeth of fifhes; and in the middle of all, the round *operculum*, or cover of a fhell as large as a crown-piece. The men frequently wear a ftring round their necks, from which a mother-of-pearl fhell hangs down on the breaft; both the ears of the women were perforated with two holes, and a cylinder cut out of tortoife-fhell or bone was ftuck through both the holes. The moft remarkable circumftance obferved of this people was, that moft of them wanted the little finger on one, and fometimes on both hands: the difference of fex or age did not exempt them from this amputation; for even among the few children that were feen running about naked, the greater part had already fuffered fuch lofs. This circumftance was obferved by Tafman. Another fingularity which was obferved to be very general among thefe people, was a round fpot on each cheek-bone, which appeared to have been burnt or bliftered. On fome it feemed to have been recently made, or others it was covered with fcurf, and many had only a flight mark of its former exiftence: how, or for what purpofe it was made, could not be learnt. The women here, in general, were referved; and turned, with difguft, from the immodeft behaviour of ungovernable feamen: there were not, however, wanting fome who appeared to be of eafy virtue, and invited their lovers with lafcivious geftures. The language fpoken here is foft, and not unpleafing; and whatever they faid was fpoken in a kind of finging tone. Omai and Mahine, who were both paffengers on board the fhip, at firft declared that the language was totally new and unintelligible to them; however, the affinity of feveral words being pointed out, they foon caught the particular modification of this dialect, and converfed much better with the natives than any on board the fhips could have done, after a long intercourfe. They have the neat-

eft

Middleburg, Middleham.

eft ornaments imaginable, confifting of a number of little flat fticks, about five inches long, of a yellow wood like box, firmly and elegantly connected together at the bottom by a tiffue of the fibres of cocoanut, fome of which were of their natural colour, and others dyed black; the fame fibres were likewife ufed in the making of bafkets, the tafte of which was highly elegant, and varied into different forms and patterns. Their clubs are of a great variety of fhapes, and many of them fo ponderous as fcarcely to be managed with one hand. The moft common form was quadrangular, fo as to make a rhomboid at the broad end, and gradually tapering into a round handle at the other. Far the greater part were carved all over in many chequered patterns, which feemed to have required a long fpace of time, and incredible patience, to work up; as a fharp ftone, or a piece of coral, are the only tools made ufe of: the whole furface of the plain clubs was as highly polifhed as if an European workman had made them with the beft inftruments. Befides clubs, they have fpears of the fame wood, which were fometimes plain fharp-pointed fticks, and fometimes barbed with a fting-ray's tail. They have likewife bows and arrows of a peculiar conftruction: the bow, which is fix feet long, is about the thicknefs of a little finger, and when flack forms a flight curve; its convex part is channelled with a fingle deep groove, in which the bow-ftring is lodged. The arrow is made of reed, near fix feet long, and pointed with hard wood: when the bow is to be bent, inftead of drawing it fo as to increafe the natural curvature, they draw it the contrary way, make it perfectly ftraight, and then form the curve on the other fide. Moft of their canoes have outriggers, made of poles; and their workmanfhip is very admirable: two of thefe canoes are joined together with a furprifing exactnefs, and the whole furface receives a very curious polifh. Their paddles have fhort broad blades, fomething like thofe at Otaheite, but more neatly wrought and of better wood.

They keep their dead above ground, after the manner of the Society iflands; as a corpfe was feen depofited on a low hut.

Here were feen feveral men and women afflicted with leprous difeafes, in fome of whom the diforder had rifen to a high degree of virulence: one man in particular had his back and fhoulders covered with a large cancerous ulcer, which was perfectly livid within, and of a bright yellow all round the edges. A woman was likewife unfortunate enough to have her face deftroyed by it in the moft fhocking manner; there was only a hole left in the place of her nofe; her cheek was fwelled up, and continually oozing out a purulent matter; and her eyes feemed ready to fall out of her head, being bloody and fore. Though thefe were fome of the moft miferable objects that could poffibly be feen, yet they feemed to be quite unconcerned about their misfortunes, and traded as brifkly as any of the reft.

MIDDLEHAM, a town in the north riding of Yorkfhire, fituated on the river Ure, 255 miles from London. It had once a caftle, where was born Edward prince of Wales, only fon of Richard III; and is noted for a woollen manufactory and frequent horfe-races. Its market is on Monday; and fairs Nov. 6. and 7. The town ftands on a rifing ground; and the caftle, which was on the fouth fide, was formerly moated round by the help of a fpring conveyed in pipes from the higher grounds.

Middlefex, Middleton.

MIDDLESEX, a county of England, which derives its name from its fituation amidft the three kingdoms of the Eaft, Weft, and South Saxons. It is bounded on the north by Hertfordfhire; on the fouth by the river Thames, which divides it from Surry; on the weft by the river Colne, which feparates it from Buckinghamfhire; and on the eaft by the river Lea, which divides it from Effex. It extends about 23 miles in length, but hardly 14 in breadth, and is not more than 115 in circumference; but as it comprehends the two vaft cities of London and Weftminfter, which are fituated in the fouth-eaft part of the county, it is by far the wealthieft and moft populous county in England. It is divided into 602 liberties, containing 200 parifhes, befides a vaft number of chapels of eafe, and 5 market towns, exclufive of the cities of London and Weftminfter. The air is very pleafant and healthy, to which a fine gravelly foil does not a little contribute. The foil produces plenty of corn, and the county abounds with fertile meadows and gardeners grounds. In a word, the greater part of the county is fo prodigioufly affifted by the rich compoft from London, that the whole of the cultivated part may be confidered as a garden. The natural productions are cattle, corn, and fruit; but its manufactures are too many to be enumerated here, there being hardly a fingle manufacture practifed in Great Britain but what is alfo eftablifhed in this county.—Though London is the chief city, Brentford is the county town where the members of parliament are elected. It contains 77,712 houfes, inhabited by 130,742 families, containing 340,958 males, and 294,371 females, fo that the whole amount of its population is 635,329 perfons.

MIDDLESEX is alfo the name of four different counties in the United States of America; one of them is in Maffachuffetts, another in Connecticut, a third in New Jerfey, and the fourth in Virginia.

MIDDLETON, DR CONYERS, a very celebrated Englifh divine, the fon of a clergyman in Yorkfhire, was born at Richmond in 1683. He diftinguifhed himfelf, while fellow of Trinity-college, Cambridge, by his controverfy with Dr Bentley his mafter, relating to fome mercenary conduct of the latter in that ftation. He afterwards had a controverfy with the whole body of phyficians, on the dignity of the medical profeffion; concerning which he publifhed *De medicorum apud veteres Romanos degentium conditione differtatio; qua, contra viros celeberrimos Jacobum Sponium et Richardum Meadium, fervilem atque ignobilem eam fuiffe oftenditur:* and in the courfe of this difpute much refentment and many pamphlets appeared. Hitherto he had ftood well with his clerical brethren; but he drew the refentment of the church on him in 1729, by writing "A Letter from Rome, fhowing an exact conformity between Popery and Paganifm," &c.; as this letter, though politely written, yet attacked Popifh miracles with a gaiety that appeared dangerous to the caufe of miracles in general. Nor were his Objections to Dr Waterland's manner of vindicating Scripture againft Tindal's "Chriftianity as old as the Creation," looked on in a more favourable point of view. In 1741, came out his great work, "The hiftory of the life of M. Tullius Cicero,"

Cicero," 2 vols 4to: which is indeed a fine performance, and will probably be read as long as taste and polite literature subsist among us: the author has nevertheless fallen into the common error of biographers, who often give panegyrics instead of history. In 1748, he published, "A free inquiry into the miraculous powers which are supposed to have subsisted in the Christian church from the earliest ages, through several successive centuries." He was now attacked from all quarters; but before he took any notice of his antagonists, he supplied them with another subject, in "An examination of the Lord Bishop of London's discourses concerning the use and extent of prophecy," &c. Thus Dr Middleton continued to display talents and learning, which are highly esteemed by men of a free turn of mind, but by no means in a method calculated to invite promotion in the clerical line. He was in 1723 chosen principal librarian of the public library at Cambridge; and if he rose not to dignities in the church, he was in easy circumstances, which permitted him to assert a dignity of mind often forgotten in the career of preferment. He died in 1750, at Hildersham in Cambridgeshire, an estate of his own purchasing; and in 1752, all his works, except the life of Cicero, were collected in 4 vols, 4to.

MIDDLEWICH, a town of Cheshire, 167 miles from London. It stands near the conflux of the Croke and Dan, where are two salt-water springs, from which are made great quantities of salt, the brine being said to be so strong as to produce a full fourth part salt. It is an ancient borough, governed by burgesses; and its parish extends into many adjacent townships. It has a spacious church. By means of inland navigation, it has communication with the rivers Mersey, Dee, Ribble, Ouse, Trent, Darwent, Severn, Humber, Thames, Avon, &c. which navigation, including its windings, extends above 500 miles, in the counties of Lincoln, Nottingham, York, Lancaster, Westmoreland, Stafford, Warwick, Leicester, Oxford, Worcester, &c. The river Wheelock, after a course of about 12 miles from Mowcop-hill, runs into the Dan a little above this town.

MIDHURST, a town of Sussex, 52 miles from London, has been represented in parliament every since the 4th of Edward II. It is a neat small town, on a hill surrounded with others, having the river Arun at the bottom; and is a borough by prescription, governed by a bailiff, chosen annually by a jury at a court-leet of the lord of the manor.

MIDIAN, or MADIAN, in *Ancient Geography*, a town on the south side of Arabia Petræa, so called from one of the sons of Abraham by Keturah.—Another *Midian*, near the Arnon and Æoplis, in ruins in Jerome's time. With the daughters of these Midianites the Israelites committed fornication, and were guilty of idolatry. A branch of the Midianites dwelt on the Arabian gulf, and were called *Kenites*: some of whom turned proselytes, and dwelt with the Israelites in the land of Canaan.

MID-LOTHIAN. See LOTHIAN and EDINBURGHSHIRE.

MIDSHIP-FRAME, a name given to that timber, or combination of pieces formed into one timber, which determines the extreme breadth of the ship, as well as the figure and dimension of all the inferior timbers.

In the article *Ship-Building*, the reader will find a full explanation of what is meant by a frame of timbers. He will also perceive the outlines of all the principal frames, with their gradual dimensions, from the midship-frame, delineated in the plane of projection annexed to that article.

MIDSHIPMAN, a sort of naval cadet, appointed by the captain of a ship of war, to second the orders of the superior officers, and assist in the necessary business of the vessel, either aboard or ashore.

The number of midshipmen, like that of several other officers, is always in proportion to the size of the ship to which they belong. Thus a first-rate man of war has 24, and the inferior rates a suitable number in proportion. No person can be appointed lieutenant without having previously served two years in the royal navy in this capacity, or in that of *mate*, besides having been at least four years in actual service at sea, either in merchant ships or in the royal navy.

Midshipman is accordingly the station in which a young volunteer is trained in the several exercises necessary to attain a sufficient knowledge of the machinery, movements, and military operations of a ship, to qualify him for a sea officer.

On his first entrance in a ship of war, every midshipman has several disadvantageous circumstances to encounter. These are partly occasioned by the nature of the sea service; and partly by the mistaken prejudices of people in general respecting naval discipline, and the genius of sailors and their officers. No character, in their opinion, is more excellent than that of the common sailor, whom they generally suppose to be treated with great severity by his officers, drawing a comparison between them not very advantageous to the latter. The midshipman usually comes aboard tinctured with these prejudices, especially if his education has been amongst the higher rank of people; and if the officers happen to answer his opinion, he conceives an early disgust to the service, from a very partial and incompetent view of its operations. Blinded by these prepossessions, he is thrown off his guard, and very soon surprised to find, amongst those honest sailors, a crew of abandoned miscreants, ripe for any mischief or villany. Perhaps, after a little observation, many of them will appear to him equally destitute of gratitude, shame, or justice, and only deterred from the commission of any crimes by the terror of severe punishment. He will discover, that the pernicious example of a few of the vilest in a ship of war is too often apt to poison the principles of the greatest number, especially if the reins of discipline are too much relaxed, so as to foster that idleness and dissipation, which engender sloth, diseases, and an utter profligacy of manners. If the midshipman on many occasions is obliged to mix with these, particularly in the exercises of extending or reducing the sails in the tops, he ought resolutely to guard against this contagion, with which the morals of his inferiors may be infected. He should, however, avail himself of their knowledge, and acquire their expertness in managing and fixing the sails and rigging, and never suffer himself to be excelled by an inferior. He will probably find a virtue in almost

every

Midſhipman.

every private ſailor, which is entirely unknown to many of his officers: that virtue is emulation, which is not indeed mentioned amongſt their qualities by the gentlemen of *terra firma*, by whom their characters are often copiouſly deſcribed with very little judgement. There is hardly a common tar who is not envious of ſuperior ſkill in his fellows, and jealous on all occaſions to be outdone in what he conſiders as a branch of his duty: nor is he more afraid of the dreadful conſequences of whiſtling in a ſtorm, than of being ſtigmatized with the opprobrious epithet of *lubber*. Fortified againſt this ſcandal, by a thorough knowledge of his buſineſs, the ſailor will ſometimes ſneer in private at the execution of orders which to him appear awkward, improper, or unlike a ſeaman. Nay, he will perhaps be malicious enough to ſuppreſs his own judgement, and, by a punctual obedience to command, execute whatever is to be performed in a manner which he knows to be improper, in order to expoſe the perſon commanding to diſgrace and ridicule. Little ſkilled in the method of the ſchools, he conſiders the officer who cons his leſſon by rote as very ill qualified for his ſtation, becauſe particular ſituations might render it neceſſary for the ſaid officer to aſſiſt at putting his own orders in practice. An ignorance in this practical knowledge will therefore neceſſarily be thought an unpardonable deficiency by thoſe who are to follow his directions. Hence the midſhipman who aſſociates with theſe ſailors in the tops, till he has acquired a competent ſkill in the ſervice of extending or reducing the ſails, &c. will be often entertained with a number of ſcurrilous jeſts, at the expence of his ſuperiors. Hence alſo he will learn, that a timely application to thoſe exerciſes can only prevent him from appearing in the ſame deſpicable point of view, which muſt certainly be a cruel mortification to a man of the ſmalleſt ſenſibility.

If the midſhipman is not employed in theſe ſervices, which are undoubtedly neceſſary to give him a clearer idea of the different parts of his occupation, a variety of other objects preſent themſelves to his attention. Without preſuming to dictate the ſtudies which are moſt eſſential to his improvement, we could wiſh to recommend ſuch as are moſt ſuitable to the bent of his inclination. Aſtronomy, geometry, and mechanics, which are in the firſt rank of ſcience, are the materials which form the ſkilful pilot and the ſuperior mariner. The theory of navigation is entirely derived from the two former, and all the machinery and movements of a ſhip are founded upon the latter. The action of the wind upon the ſails, and the reſiſtance of the water at the ſtem, naturally dictate an inquiry into the property of ſolids and fluids; and the ſtate of the ſhip, floating on the water, ſeems to direct his application to the ſtudy of hydroſtatics, and the effects of gravity. A proficiency in theſe branches of ſcience will equally enlarge his views, with regard to the operations of naval war, as directed by the efforts of powder and the knowledge of projectiles. The moſt effectual method to excite his application to thoſe ſtudies, is, perhaps, by looking round the navy, to obſerve the characters of individuals. By this inquiry he will probably diſcover, that the officer who is eminently ſkilled in the ſciences, will command univerſal reſpect and approbation; and that whoever is ſatisfied with the deſpicable ambition of ſhining the hero of an aſſembly, will be the object of univerſal contempt. The attention of the former will be engaged in thoſe ſtudies which are highly uſeful to himſelf in particular, and to the ſervice in general. The employment of the latter is to acquire thoſe ſuperficial accompliſhments that unbend the mind from every uſeful ſcience, emaſculate the judgement, and render the hero infinitely more dexterous at falling into his ſtation in the dance than in the line of battle.

Midſhipman, Midwife.

Unleſs the midſhipman has an unconquerable averſion to the acquiſition of thoſe qualifications which are ſo eſſential to his improvement, he will very rarely want opportunities of making a progreſs therein. Every ſtep he advances in thoſe meritorious employments will facilitate his acceſſion to the next in order. If the dunces, who are his officers or meſſmates, are rattling the dice, roaring bad verſes, hiſſing on the flute, or ſcraping diſcord from the fiddle, his attention to more noble ſtudies will ſweeten the hours of relaxation. He ſhould recollect, that no example from fools ought to influence his conduct, or ſeduce him from that laudable ambition which his honour and advantage are equally concerned to purſue.

MIDWIFE, one whoſe profeſſion is to deliver women in labour. See MIDWIFERY.

MIDWIFERY,

1 Definition.

THE art of aſſiſting women in labour. In a more extended ſenſe, it is underſtood to comprehend alſo the treatment of the diſeaſes of women and children. In this work we ſhall conſider it in the former limited ſenſe, viz. as relating to the birth of the offspring of man.

2 *Hiſtory of Midwifery*.—It muſt be very obvious that this art muſt have been almoſt coeval with mankind: but in Europe it continued in a very rude ſtate till the 17th century; and even after phyſic and ſurgery had become diſtinct profeſſions, it remained almoſt totally uncultivated.

It is a curious fact, that in the empire of China the very reverſe of this has taken place. In that empire, according to the lateſt accounts, both phyſic and ſurgery are ſtill in a ſtate of the utmoſt degradation, even more ſo than among the ſavages of America; 3
but for ſome hundred years, the art of midwifery has been practiſed by a ſet of men deſtined to the purpoſe by order of government. Theſe men, who hold in ſociety the ſame rank which lithotomiſts did in this country about the beginning of laſt century, are called in whenever a woman has been above a certain number of hours in labour, and employ a mechanical contrivance

for

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for completing the delivery without injury to the infant. A certain number of ſuch individuals is allotted to each diſtrict of a certain population.

It is ſaid, that the Chineſe government was led to make this proviſion for alleviating the ſufferings of child-bearing women, in conſequence of a repreſentation, that annually many women died undelivered, and that in the majority of caſes the cauſe of obſtruction might have been removed by very ſimple mechanical expedients.

Both Sir George Staunton and Mr Barrow were ignorant of this fact; and the latter in particular expreſsly mentions, that there are no men-midwives in China. But the writer of this article had his information from a more authentic ſource than the works of gentlemen who were only a few months in that country, and were in a great meaſure treated as ſtate priſoners. He has it, through the medium of a friend, from a gentleman who reſided upwards of twenty years as ſurgeon to the Britiſh factory at Canton, and who had both the ability and the inclination to learn, during the courſe of ſo long a reſidence, all the cuſtoms and prejudices of the natives relating to the preſervation of human health.

4 Towards the end of the 17th century, the ſame cauſes which had ſo long before led to the cultivation of midwifery in China produced the ſame effect in Europe. The dangers to which women are ſometimes expoſed during labour excited the compaſſion of the benevolent; ſo that a conſiderable part of the firſt hoſpital which was eſtabliſhed for the reception of the indigent ſick, the Hotel Dieu of Paris, was appropriated to lying-in women.

The opportunities of practice which that hoſpital afforded, directed the attention of medical men to the numerous accidents which happen during labour, and to the various diſeaſes which occur after delivery. Public teaching followed, and ſoon after the cuſtom of employing men in the practice of midwifery began.

From this period the art became rapidly improved; and it is now in many parts of Europe, and particularly in Great Britain, in as great a ſtate of perfection as phyſic or ſurgery.

5 In the year 1725, a profeſſorſhip of midwifery was eſtabliſhed in the univerſity of Edinburgh; and the town council at the ſame time ordained, that no woman ſhould be allowed to practiſe midwifery within the liberties of the city, without having previouſly obtained a certificate from the profeſſor of her being properly qualified. This ſalutary regulation has fallen into deſuetude.

There can be no doubt that the improvement of the art of midwifery was chiefly in conſequence of medical men directing their attention to the ſubject; but the propriety of men being employed in ſuch a profeſſion is much queſtioned by many individuals of conſiderable reſpectability.

6 Dr John Gregory, in his Comparative View, p. 22. ſays, "every other animal brings forth its young without any aſſiſtance, but we think a midwife underſtands it better." Had this eminent philoſopher ſaid, "other animals content themſelves with the clothing which providence has beſtowed, but we think it neceſſary to cover our bodies with the workmanſhip of weavers," very few in this northern climate would have attended to the ſneer. His ſon, the preſent profeſſor, has improved upon the idea. He ſeems to ſuppoſe that women without any inſtruction, and of courſe without any knowledge of the ſubject, are capable of aſſiſting one another while in labour; and in the ſportiveneſs of his lively imagination, he compares men-midwives to that ſpecies of frog, in which, according to the allegation of Reaumur, the male draws out the ova from the female, or, to uſe the naturaliſt's words, "*accouche la femelle.*"

Of Conception.

It appears to us that this queſtion, on which much declamation has been employed by the parties who have agitated it, may be brought within a very narrow compaſs. It may be aſſumed as a fact eſtabliſhed beyond the reach of controverſy, that ſometimes dangers and difficulties occur during labour (from cauſes to be explained in a ſubſequent part of this eſſay), which can be leſſened or removed by thoſe only who have an intimate knowledge of the ſtructure of the human body and of the practice of phyſic. On ſuch occaſions, it muſt be admitted, medical men alone can be uſeful. But as ſuch labours occur only in the proportion of two or three in the hundred, the general practice might be confided to midwives, if they could be taught to manage ordinary caſes, and to foreſee and diſtinguiſh difficulties or dangers, ſo as to procure in ſufficient time additional aſſiſtance. It is on this point that the deciſion of the queſtion muſt depend. It conſiſts with the knowledge of the writer of this article, that women may be taught all this. But there are many who allege, that a little knowledge being a dangerous thing, midwives acquire a ſelf-ſufficiency which renders them averſe from calling in ſuperior aſſiſtance, and that, in conſequence, they often occaſion the moſt deplorable accidents both to mother and child. In England this is the popular opinion, ſo that there women are almoſt entirely excluded from the practice of midwifery. A ſimilar prejudice againſt midwives has, it is believed, begun in ſome parts of Scotland; but it is preſumed this will gradually ceaſe, when it is conſidered that, in general, the Scotch midwives are regularly inſtructed, and are at the ſame time both virtuous and induſtrious. If they attend ſtrictly to their duty, and invariably prefer their patients ſafety to their own feelings or ſuppoſed intereſt, they will deſervedly retain the public confidence. But if in caſes of difficulty or danger they truſt to their own exertions, or from intereſted motives decline the aſſiſtance of able practitioners, and if they interfere in the treatment of the diſeaſes of women and children, they will in a few years be excluded from practice.

Diviſion of the ſubject. In order to exhibit an accurate view of what relates to the birth of man, we ſhall conſider, in the firſt place, conception; ſecondly the effects of impregnation; thirdly, the act of childbearing; and laſtly, the deviations from the ordinary courſe which ſometimes happen. Theſe topics will form the ſubjects of the following chapters. 7

Chap. I. *Of Conception.*

Three circumſtances are required for conception in the human race, viz. puberty; a healthy, vigorous, and natural ſtate of the parts ſubſervient to the operation in both ſexes; and ſucceſsful ſexual intercourſe. 8

1. The age of puberty in women differs conſiderably

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in different climates. In Europe it takes place commonly between the fourteenth and ſixteenth year. This important era is marked by certain changes both in the mind and body. The girl feels ſenſations to which ſhe had been formerly unaccuſtomed. She loſes a reliſh for her former amuſements, and even for her youthful companions. She ſeeks ſolitude, indulges in the depreſſing paſſions, and theſe are excited by the moſt apparently trifling cauſes. She feels occaſionally certain deſires which modeſty repreſſes; and it is by degrees only that ſhe regains her former tranquillity.

The changes in her body are even more ſtrongly marked than thoſe in her mind. Her breaſts aſſume that form which adds to the beauty of her perſon, and renders them fit for nouriſhing her infant; and every part of the genital ſyſtem is enlarged. A periodical diſcharge from the uterus renders the woman perfect.

9 In young men the ſame cauſes produce very different effects. The lad, about fifteen or ſixteen, feels a great increaſe of ſtrength; his features expand, his voice becomes rough, his ſtep firm, his body athletic; and he engages voluntarily in exerciſes which require an exertion of ſtrength and activity. The changes in his mind are as ſtrongly marked as thoſe in his body. He loſes that reſtleſs puerility which had diſtinguiſhed his early years, and becomes capable of attending ſteadily to one object. His behaviour to the fair ſex is ſuddenly altered. He no longer ſhews that contempt for women, which he had formerly betrayed. He is ſoftened, approaches them with deference, and experiences a degree of pleaſure in their company, for which he can ſcarcely account. In him too there is an important change in the condition of the genital organs.

10 2. Unleſs the parts which conſtitute peculiarity of ſex be in a healthy, vigorous, and natural ſtate, conception cannot take place.

In women, conception is prevented if the organs be too much relaxed; if there be obſtruction between the external and internal parts; if any preternatural diſcharge take place from the internal parts; if the menſtrual evacuation be not natural in every reſpect, and if the appendages of the uterus, called fallopian tubes, and ovaria, be not of the natural ſtructure.

In men, the ſame circumſtance happens if the organs be too much relaxed; if the orifice of the urethra be in an improper ſituation; if the urethra be diſeaſed; if the teſtes be not in a natural healthy ſtate; and if there be any defect in the erectores penis, which prevents the proper erection of that organ.

11 3. The ſexual intercourſe cannot be ſucceſsful unleſs ſomewhat neceſſary for conception be furniſhed by both ſexes. This conſiſts in the male of a fluid ſecreted by the teſtes; and in the female, of the detachment of a ſubſtance, ſuppoſed to reſemble a very minute veſicle ſituated in the ovarium, and called by phyſiologiſts ovum. Each ovarium contains a number of theſe veſicles. After every conception, certain marks of the detachment of the ovum remain in the reſpective ovarium.

When the circumſtances required for conception concur, a being is produced which generally reſembles both parents. This reſemblance is moſt ſtrikingly marked in the human ſubject, when one of the parents is an European, and the other an African. What is called a mulatto is produced.

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The human race poſſeſſes the power of propagation 12
in common with all the other ſpecies of the animal kingdom, and alſo, it has been ſaid, with the vegetable kingdom.

As generation then, as it has been ſtyled, is common to two of the kingdoms of nature, it has been imagined by ingenious men, that this wonderful operation is regulated in both by a certain general law. But they have differed much in their account of this law. The queſtion at iſſue between the two parties is whether the embryos of animals be prepared by the ſexual intercourſe out of inorganic materials, or whether they pre-exiſt in the bodies of animals, and are only developed as it were by that intercourſe. The former of theſe opinions is called the doctrine of epigeneſis, the latter that of evolution.

Both doctrines have been maintained with much ingenuity by equally reſpectable authorities. Negative arguments have been adduced in favour of the one, poſitive in ſupport of the other, and it muſt be confeſſed that the balance between them ſeems nearly equal. The pre exiſtence of ova in the oviparous animals appears a poſitive argument in favour of evolution; but the ſatirical remark of a late witty author, * that, were this theory true, every individual of the human race muſt have been lodged in the ovaria of our firſt parent, by affording a negative argument in favour of epigeneſis, reſtores the balance.

* *Blumenbach.*

The various arguments advanced on each ſide by the oppoſite parties in this diſpute are ſo very numerous, that we cannot attempt to detail them in this work; and on a ſubject which has divided the opinions of ſo many able phyſiologiſts, it would be preſumption to decide peremptorily.

If generation be regarded as an animal operation, one is led to inquire whether the product be the reſult of the combined influence of both ſexes, or whether it be produced by either ſex alone.

The firſt opinion was generally adopted by phyſiolo- 13
giſts, till about the end of the 17th century, when an accidental diſcovery convinced many that the embryo was produced by the male parent alone; and another diſcovery ſome years afterwards again overturned that opinion, and rendered it believed by not a few that the embryo is furniſhed excluſively by the female parent.

Several circumſtances concurred to render the firſt opinion probable; the ſtructure of the organs which conſtitute peculiarity of ſex in both parents, the circumſtances neceſſary for ſucceſsful impregnation, and the ſimilitude of children to both parents, appear very ſtrong arguments in its favour.

The ſecond theory, although firſt brought into vogue 14
about the end of the 17th century by the diſcoveries of Leeuwenhoeck, had been formerly propoſed by the followers of Pythagoras. Their argument was analogy: the ſeed, ſaid they, is ſown in the earth, nouriſhed and evolved there; ſo the male ſemen is ſown in the uterus, and in the ſame manner nouriſhed and evolved.

Leeuwenhoeck's diſcovery ſeemed a more concluſive argument in favour of the theory than vague analogy. He

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He obſerved innumerable animalcula in the ſeminal fluid of the males of many animals. Theſe he imagined to be embryos.

But as animalcula of apparently the ſame nature have been obſerved in many animal fluids beſides the ſemen maſculinum, the opinion of Leeuwenhoeck and the theory itſelf are overturned.

15 It was owing principally to the labours, induſtry, and ingenuity of Baron Haller, that the third theory, that of the pre-exiſting germ, became faſhionable.

His obſervations ſeem to contain a demonſtration of the fact.

Thoſe who have adopted this theory, imagine that the ſemen maſculinum poſſeſſes the power of ſtimulating the various parts of the pre-exiſting embryo. And hence they explain the ſimilitude to both parents, and particularly the appearance of the hybrid productions, to that fluid nouriſhing certain parts, and new-arranging others. But if this were true, then the ſemen maſculinum of all animals ſhould poſſeſs the power of ſtimulating the forms of all female animals; and beſides, in each claſs of animals it ſhould poſſeſs certain ſpecific powers of giving a direction to the growth of parts. Experiment, however, has not proved this to be the caſe, for the hybrid productions are very limited; and we may be permitted perhaps, without the imputation of arrogance in pretending to ſearch into the intentions of the Author of nature, to obſerve, that had the ſemen maſculinum been poſſeſſed of ſuch powers, the whole ſpecies of animals would have been ſoon confounded, and the whole animal kingdom would ſoon have returned to that chaos from which it has been allegorically ſaid it originated.

Yet we are reduced to the alternative of either rejecting the theory, or of believing that the ſemen does poſſeſs the powers alluded to. If we examine attentively the anatomical diſcovery on which this theory is built, we ſhall perhaps be inclined to believe that the foundation of the whole is very inſufficient; and hence to conclude that the great ſuperſtructure is in a very tottering condition. If it be poſſible that the attachment of the chick to the yolk of the egg ſhould be in conſequence of inoſculation, the theory muſt fall to the ground. Haller has endeavoured to obviate this objection, but not with his uſual judgement.

16 Two circumſtances, however, ſeem to ſhow that the attachment is really by inoſculation: 1. That veſſels are ſeen in the membrane of the yolk evidently containing blood before the heart of the chick begins to beat; yet theſe veſſels afterwards appear to depend on the vaſcular ſyſtem of the chick. And 2. That in many animals, as in the human ſubject, the umbilical cord ſeems to be attached to the abdomen by inoſculation; for there is a circle round the root of the cord which reſembles a cicatrix, and within a few days after birth, the cord uniformly drops off at that very circle, whatever portion may have been retained after delivery.

17 There is one objection equally applicable to all the three theories, viz. the difficulty of explaining the ſteps of the proceſs. A variety of explanations have been offered by ingenious men. Spallanzani and Mr John Hunter lately, Haller and Bonnet formerly, have rendered themſelves conſpicuous on this ſubject. Spallanzani, in particular, appears to many to have produced by his artificial impregnation, the moſt convincing proofs of the pre-exiſtence of the germ. But to what do his celebrated experiments amount? They ſhow, that in all animals it is neceſſary that the ſemen maſculinum ſhould be applied to the ſomewhat expelled by the female during the coitus, otherwiſe impregnation cannot take place. But was not this univerſally acknowledged before the abbé was born? In the unfortunate frogs who were the ſubjects of his experiments, the whole operation of generation was completed except the application of the male ſemen to the ſubſtances expelled by the female. Nature, by eſtabliſhing that the buſineſs ſhould be carried on in water, ſhows that the ſemen muſt be diluted, otherwiſe it cannot fecundate. The abbé only imitated nature. He left the queſtion in the ſtate in which he found it. His experiment on the bitch may appear more concluſive; but alas! it has never ſucceeded with any perſon but himſelf.

On the whole, ſince the proceſs of generation is ſo obſcure that no rational explanation of it has yet been offered, are we not entitled to conclude that the general theory which accounts moſt ſatisfactorily for the various phenomena which impregnation exhibits is the beſt; and conſequently, that the product of generation cannot pre-exiſt in the body of either parent excluſively?

Effects of Impregnation.

Chap. II. *Effects of Impregnation.* 18

In conſequence of impregnation, certain important changes take place in the uterine ſyſtem of the human ſubject. We ſhall conſider the natural changes only. On ſome occaſions, there are morbid changes; but we ſhall not notice them, except in ſo far as ſome of them ſerve to illuſtrate the nature of the uſual ones.

The firſt viſible change is on the ovarium. One of thoſe organs ſwells out at one point like a ſmall papilla, then burſts, and ſomewhat is diſcharged.

A ſubſtance is found in the ovarium after this, which is called *corpus luteum*. Rœderer has deſcribed very accurately its appearance a few hours after delivery. 19 He ſays "corpus luteum locatur in rotundo apice. Totam ovarii craſſitiem occupat, immediatè pone ovarii membranam illa ſede tenuiorem locatum; ab ovario cum quo celluloſæ ope cohæret ſeparari ſine læſione poteſt; nulli peculiari ovarii rimæ reſpondet: neque canalis in illo excavatus, ſed totum ſolidum eſt. Luteus color eſt, ſubſtantia acinoſa, acinis admodum compactis et ad ſeſe preſſis ambitus rotundus. Poteſt aliquo modo, velut in glandulis ſuprarenalibus, duplex ſubſtantia diſtingui, corticalis et medullaris; quarum illa inæqualis craſſitiei 1—2 lin. lutea comprehendit hanc medullarem albam, quæ tenuis et membrana quaſi calloſa, alium nucleum flavum includit caſſiorem *." It is very large ſoon after conception, and then gradually becomes ſmaller; but never totally diſappears. Rœderer obſerves, "poſt puerperium eo magis contrahi et indurari illa corpora videntur, quo remotior ſit partus; qualia videlicet obſervantur in feminis quæ nuper partum non ediderunt.

"Lutea corpora quo ſerius à partu obſervantur cuncta glandulis ſuprarenalibus ſimilia eſſe videntur, duplice nempe ſubſtantia, exteriore corticali, ſolida ſeu flava lutea et nucleo fuſco: velut etiam illæ glandulæ compreſſa ſunt. †" In caſes where there is a plurality of children,

* Roederer. Icones, Uteri humani obſervat illuſt. p. 42.

† Ibid. p. 39.

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children, there is evidently a corpus luteum to each child. In ſome quadrupeds, as in the bitch or cat, the number of young in the uterus may be generally known by the correſponding corpora lutea in the ovaria.

20 The next change in the human uterine ſyſtem which deſerves notice is that in the fallopian tubes. They ſwell out towards the fimbriated extremity, and form a cavity which has been called antrum. Rœderer was the firſt who obſerved and accurately delineated this change.

He ſays, p. 14. loco citato, "In hoc etiam utero antrum tubæ dextræ apparet, *c. f.* tab. i. not. 5. ubi quidem in utraque tuba adeſt, in hujus iconis utero ad ſolam tubam dextram antrum pertinet. Ad uterum feminæ oćtiduum puerperæ non longe a fimbria in iſtiuſmodi antrum tuba ſiniſtra prominet: dextra quidem ſine antro eſt, ſed verſus fimbriam ita flećtitur ut ultima flexura dimidium pollicem ultra reliquam tubam efferatur. Tubæ feminæ quæ mox a maturo partu mortua eſt, et alterius tres dies puerperæ antris quidem carent, ſed multum verſus fimbrias dilatantur. An eſt facta conceptione iſta antra naſcuntur?

"In uteri, tab. iv. ovario dextro luteum corpus latet in uteri feminæ oćtiduum puerperæ ovario ſiniſtro; in uteri, tab. i. ovario ſiniſtro." He adds, "ulteriori indagine iſta antra non indigna eſſe mihi videntur. Licebit forſan conjećtare aliquid liquoris ex veſicula graafiana in tubam lapſum et ad introitum morans illam dilatam."

21 But the moſt aſtoniſhing changes are thoſe produced in the uterus itſelf. Its parietes ſeparate, a cavity is formed which becomes filled with a fluid, and the os uteri is cloſed up. The matter contained within the cavity ſoon aſſumes an organized form. It is ſaid that ſome time after conception, a ſmall veſicle is obſerved attached at one point to the internal ſurface of the uterus; that the reſt of the parietes is covered with a gelatinous fluid; and that the whole internal ſurface aſſumes a flocculent appearance. By degrees the veſicle, which is in fact the ovum containing the embryo, increaſes ſo much in ſize that it nearly fills the whole cavity in which it is contained, and then its ſtructure becomes the object of our ſenſes.

22 The increaſe of ſize in the uterus is very gradual. It is at firſt confined almoſt entirely to the fundus, and it proceeds ſo ſlowly that it does not leave the cavity of the pelvis till nearly the fourth month. The principal change in the cervix for the firſt five months is the complete cloſure of the orifice, which is effected by a gelatinous fluid: afterwards the cervix is gradually extended, and at laſt its form is obliterated, the whole uterus becoming like an oval pouch.

After the fifth month the increaſe of ſize in the uterus is very rapid. The fundus can be juſt felt above the pubes about the fifth month, but at the end of the ninth month it extends to the ſcrobiculus cordis.

Some authors have alleged that the changes in the cervix and in the ſituation of the fundus are ſo uniformly regular in every caſe, that by attending to them it is poſſible to aſcertain the exact period of impregnation. But in this reſpect they are much miſtaken; the changes being not only different in different women, but alſo in the ſame woman in different pregnancies.

The texture of the parietes of the uterus ſeems much altered after impregnation. It becomes ſpongy and fibrous. The fibres run in very different directions, and from their power and appearance are certainly muſcular. The blood-veſſels become much enlarged, but are ſtill in a tortuous direction. They are particularly large at one part of the uterus.

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The lymphatic veſſels, which in the unimpregnated uterus cannot be demonſtrated by anatomiſts, become, as well as the blood-veſſels, remarkably large.

The ovum is not often expelled entire till after the eighth or twelfth week after conception. It is ſhaped ſomewhat like an egg, and is about the latter period about four inches in length. When cut into, it is found to conſiſt of four layers or membranes, and to contain a fœtus ſurrounded by a certain quantity of water and connected to one part of the parietes (which is conſiderably thicker than the reſt) by a vaſcular cord. 23

The external membrane covers the whole ovum. It is thick, ſpongy, and very vaſcular, the veſſels evidently deriving their blood from the uterus; it has three perforations which correſpond with the openings of the os tincæ and fallopian tubes. It has been called *decidua*, *tunica filamentoſa* &c. but its moſt ordinary appellation is ſpongy chorion. 24

The ſecond membrane proceeds from the edges of that part into which the vaſcular rope which connects the fœtus is attached. It was firſt pointed out to anatomiſts by Dr William Hunter, and called by him *decidua reflexa*. The name unfortunately records to poſterity the abſurd idea reſpecting its origin which was entertained by Dr Hunter. It is not ſo thick and ſpongy as the former membrane, nor ſo vaſcular. It lies looſely between the external membrane and that to be next deſcribed; but it appears only for a ſhort time, as it ſoon becomes blended with the others. 25

The third membrane is thin and tranſparent, but ſtrong. It is lined with the fourth membrane, and lies in the ſame ſituation with it. It contains no veſſels at this period of impregnation conveying red blood in the human ſubject, but in the cow the veſſels are very diſtinct at every period. This membrane however in the early period of impregnation is very vaſcular, and its veſſels are derived from the fœtus. The hiſtory of a caſe of morbid impregnation, where the fœtus was extra-uterine, detailed by Dr Clarke in the "Tranſactions of a Society for the Improvement of Medical and Chirurgical Knowledge," proves this circumſtance very clearly. He ſays, p. 220 "a laceration was found to be in the fallopian tube about an inch and a half in length, each extremity of which was about an equal diſtance from the reſpective termination of the tube in the fimbriæ and in the uterus. The diſtenſion of the tube at this part was nearly of the ſize of a large walnut, forming a kind of pouch. More of the coagulated blood being removed from the lacerated part, the *ſhaggy veſſels of the chorion* immediately appeared, interſperſed with ſmall coagula, and lying in contact with the internal ſurface of the pouch formed by the fallopian tube; theſe being ſeparated, and the chorion divided, the amnios ſhewed itſelf, containing a fœtus perfectly formed of above ſix or ſeven weeks growth &c." 26

This membrane is called the true chorion.

The fourth membrane is even thinner and more tranſparent 27

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parent than the former. It lines the whole internal ſurface of the ovum, and together with the chorion is continued along the vaſcular cord which connects the ovum and fœtus. Between this membrane and the chorion, near the inſertion of the vaſcular cord, a ſmall white veſicle appears very diſtinct at this period; it was firſt deſcribed and delineated by Dr W. Hunter, and was called by him veſicula umbilicalis. At the full period of utero-geſtation it is no longer viſible, being then quite tranſparent.

The fœtus at this period is between two and three inches in length, and its external conformation is nearly complete.

The fluid contained in the ovum is in ſuch quantity as to prevent the fœtus from touching the parietes of the covering in which it is included. It is a clear watery fluid, of greater ſpecific gravity than water, and of a ſaltiſh taſte. When examined chemically it is found not coagulable by heat or alcohol, and to contain a proportion of ammoniacal and ſea ſalt. This fluid is called liquor amnii.

The connexion of the parts thus enumerated with the uterus cannot be explained, unleſs the appearance of the ovum at the full period of geſtation be deſcribed.

28 The ovum then conſiſts of three membranes; a ſpongy vaſcular ſubſtance called placenta, to which the fœtus is connected by a vaſcular rope, and the liquor amnii.

The three membranes conſiſt of the ſpongy chorion, the true chorion, and the amnios.

The ſpongy chorion covers the whole. Its veſſels are numerous, and they can be filled by throwing hot wax into the veſſels of the uterus.

The true chorion and amnios are in the ſame ſituation as in the early months, being continued along the They are quite tranſparent, and contain no viſible veſſels of any deſcription.

The placenta is a large vaſcular ſpongy maſs, of various forms in different caſes, moſt generally approaching to a round one, placed on the outſide of the true chorion, between it and the ſpongy chorion. Its external ſurface is lobulated; its internal or that towards the fœtus is ſmooth, except from the riſing of the blood-veſſels.

It is not attached to the uterus at any regular place, being ſometimes at the cervix or ſide, but moſt generally about the fundus. On the one ſide it receives blood from the mother, and on the other from the child. Mr John Hunter was the firſt who clearly traced the inſertion of the blood-veſſels in the uterus into the placenta. He deſcribes it thus (D): "The late indefatigable Dr M'Kenzie, about the month of May 1754, when aſſiſtant to Dr Smellie, having procured the body of a pregnant woman who had died undelivered at the full term, had injected both the veins and arteries with particular ſucceſs; the veins being filled with yellow, the arteries with red.

"Having opened the abdomen, and expoſed the uterus, he made an inciſion into the fore part, quite through its ſubſtance, and came to ſomewhat having the appearance of an irregular maſs of injected matter, which afterwards proved to be the placenta. This appearance being new, he ſtopped, and greatly obliged me by deſiring my attendance to examine the parts, in which there appeared ſomething ſo uncommon.

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"I firſt raiſed, with great care, part of the uterus from the irregular maſs above mentioned; in doing which, I obſerved regular pieces of wax, paſſing obliquely between it and the uterus, which broke off, leaving part upon this maſs; and when they were attentively examined, towards the uterus, plainly appeared to be a continuation of the veins paſſing from it to this ſubſtance or placenta.

"I likewiſe perceived other veſſels, about the ſize of a crow quill, paſſing in the ſame manner, although not ſo obliquely: theſe alſo broke upon ſeparating the placenta and uterus, leaving a ſmall portion on the ſurface of the placenta; and, on examination, they were diſcovered to be continuations of the arteries of the uterus. My next ſtep was to trace theſe veſſels into the ſubſtance of what appeared placenta, which I firſt attempted in a vein; but that ſoon loſt the regularity of a veſſel, by terminating at once upon the ſurface of the placenta, in a very fine ſpongy ſubſtance, the interſtices of which were filled with the yellow injected matter. This termination being new, I repeated the ſame kind of examination on other veins, which always led me to the ſame terminations, never entering the ſubſtance of the placenta in the form of a veſſel. I next examined the arteries, and, tracing them in the ſame manner toward the placenta, found that they made a twiſt, or cloſe ſpiral turn upon themſelves, and then were loſt on its ſurface. On a more attentive view, I perceived that they terminated in the ſame way as the veins; for oppoſite to the mouth of the artery, the ſpongy ſubſtance of the placenta was readily obſerved, and was intermixed with the red injection.

"Upon cutting into the placenta, I diſcovered, in many places of its ſubſtance, yellow injection; in others red, and in many others theſe two colours mixed. This ſubſtance of the placenta, now filled with injection, had nothing of the vaſcular appearance, nor that of extravaſation, but had a regularity in its form, which ſhewed it to be a natural cellular ſtructure fitted for a reſervoir for blood.

"In ſome of the veſſels leading from the placenta to the uterus, I perceived that the red injection of the arteries (which had been firſt injected) had paſſed into them out of the ſubſtance of the placenta, mixing itſelf with the yellow injection. I alſo obſerved, that the ſpongy chorion, called the decidua by Dr Hunter, was very vaſcular, its veſſels coming from, and returning to, the uterus, being filled with the different coloured injections."

It appears then that the placenta has a cellular ſtructure, which receives blood from the arteries of the mother, and that there are veins by which that blood is returned, ſo that not a drop paſſes into the fœtus. Of this practitioners of midwifery have a very familiar proof. When the placenta is retained attached to the uterus, after the birth of the child, not a drop of blood paſſes from the umbilical cord, except what was contained in the ramifications of the fœtal veſſels when the child 29

(D) Obſervations on certain parts of the Animal Oeconomy, by John Hunter, p. 127.

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child was ſeparated. Yet, if a ſmall portion of the edge of the placenta be detached, ſuch a quantity of blood eſcapes from the uterine veſſels of the mother, as ſometimes proves fatal to life: a circumſtance which clearly ſhews that the blood is ſtill conveyed into the cellular part of the placenta.

It has been ſaid, that the placenta on one ſide receives blood from the fœtus. In fact, the greateſt part of the placenta ſeems to be made up of ramifications of the fœtal veſſels. The internal iliacs of the fœtus are conveyed, through the vaſcular rope which connects the placenta and child, into the placenta: they then ramify into as many minute branches as the pulmonary arteries do in the lungs of the adult; they then terminate in various branches, which, uniting, form one large trunk that is conveyed along the vaſcular rope, and returns all the blood which had been diſtributed by the arteries.

As Mr Hunter remarks, "the arteries from the fœtus paſs out to a conſiderable length, under the name of the umbilical cord; and when they arrive at the placenta, ramify upon its ſurface, ſending into its ſubſtance branches which paſs through it, and divide into ſmaller and ſmaller, till at laſt they terminate in veins: theſe uniting, become larger and larger, and end in one which at laſt terminates in the proper circulation of the fœtus. This courſe of veſſels, and the blood's motion in them, is ſimilar to the courſe of the veſſels, and the motion of the blood, in other parts of the body *."

* *J. Hunter*, loc. cit. p. 135.

30 The fœtus, at the full period, weighs from between 6 and 7, to between 10 and 11 pounds, and meaſures from 18 to 22 inches. It is placed within the ovum in ſuch a manner as to occupy the leaſt poſſible ſpace. This poſition has been beautifully deſcribed by Harvey. "Infans in utero utplurimum reperitur, adductis ad abdomen genibus, flexis retroſum cruribus, pedibus decuſſatis, manibuſque ad caput ſublatis, quarum alteram circa tempora vel auriculas, alteram ad genam detinet, ubi maculæ albæ, tanquam confricationis veſtigia, in cute cernuntur: ſpina in orbem flectitur, caput ad genua incurvato collo propendet. Tali membrorum ſitu qualem in ſomno per quietem quærimus †."

† *Harvey Exercit. de Partu.*

31 The fœtus is diſtinguiſhed from the adult by a great many peculiarities in ſtructure: theſe the limits of this work do not permit us to enumerate. We ſhall therefore notice only one peculiarity, which diſtinguiſhes the fœtus not only from the adult, but even from the natus, viz. the diſtribution of the blood through its body.

It is well known, that, in the adult and in the natus, all the blood of the body, brought by the two cavæ into the anterior auricle of the heart, and from that into the correſponding ventricle, is diſtributed by the pulmonary artery over the whole ſubſtance of the lungs, by means of the moſt minute ramifications; from whence it is returned by the pulmonary veins into the poſterior auricle, and being then ſent into the poſterior ventricle, is, by its action, tranſmitted to every part of the body, through the aorta and its ramifications.

But in the fœtus the blood follows another courſe. All the blood of the fœtus is returned from the placenta by the umbilical vein, which, penetrating the abdomen, paſſes between the lobes of the liver, and thence at right angles divides into two branches nearly, by one of which, called *ductus venoſus*, a conſiderable quantity of blood is carried into the vena cava; by the other the remainder of the blood is ſent to the vena portarum; and, after having circulated through the liver, it too is brought by two ſhort venous trunks, the venæ cavæ hepaticæ, juſt above the diaphragm, into the vena cava. All the blood thus received into the vena cava, is carried to the anterior auricle; but a part only is tranſmitted to the correſponding ventricle, for by a particular apparatus, a quantity is at once ſent into the poſterior or left auricle. Anatomiſts have differed in opinion concerning the apparatus by which this is accompliſhed. As there is a ſmall oval hole of communication between the auricles of the fœtus, called foramen ovale, having a valve placed in ſuch a manner as to prevent any fluid from paſſing from the left into the right, but to admit it from the right into the left, it has been generally imagined that the blood paſſed through that opening. But the ſimultaneous action of the auricles in the natus ſeemed to contradict this opinion. A diſcovery made by Dr Wolfe of Peterſburgh appears to ſolve the riddle. He obſerved, that in the calf, before birth, the vena cava, at its entry into the heart, divides into two branches, by the one of which it ſends blood to the right, and by the other to the left auricle. It is probable that a ſimilar effect is produced in the human fœtus by a different ſtructure.

Of the blood ſent by the right ventricle into the pulmonary artery, a ſmall quantity only is carried to the lungs; for near the point at which that artery is divided into the two branches that go into the lobes of the lungs, a large branch is ſent off, which joining the aorta and pulmonary artery, carries a great proportion of the blood immediately into it. What is circulated through the lungs is conveyed by the pulmonary veins into the left auricle, &c.

All the blood thus received into the aorta is diſtributed through the ſeveral parts of the ſyſtem, and a large part of it is ſent out by the internal iliacs, which, paſſing out at the abdomen, conſtitute the umbilical arteries, and diſtribute the blood in the manner already mentioned over the placenta, from which it is returned by the veins.—The great difference then between the fœtus and natus in the circulation of the blood, conſiſts in the quantity diſtributed through the lungs.

To complete the deſcription of the ovum at the full period of geſtation, it only remains that we ſhould ſay ſomething on the vaſcular rope, which connects the placenta and fœtus, and on the liquor amnii. 32

This rope is called the funis umbilicalis. It terminates by one end at the placenta, and by the other at the centre of the abdomen of the fœtus. Its length and thickneſs differ materially in different caſes. It is longer in the human ſubject than in any other animal. It is found generally to be from eighteen to twenty ſix inches in length, and in thickneſs about the ſize of the little finger. Externally it is formed of the chorion and amnios, together with cellular ſubſtance. Internally it is found to be compoſed of three blood-veſſels, and a quantity of gelatinous matter. The veſſels conſiſt of two arteries and one vein: the vein being as large as both arteries united. Theſe go in a ſpiral direction, and often form knots by their coils or twiſtings. A very ſmall artery and vein are likewiſe perceived to go

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go along the cord between the two layers of chorion and amnios, which cover it, into the veſicula umbilicalis. Theſe are called omphalo-meſenteric.

33 In quadrupeds, a canal, called urachus, is continued from the urinary bladder, along the umbilical cord, and communicates with a membrane, which, like this canal, does not exiſt in the human ſubject, called allantois. The urine of the young animal is collected in that membrane.

Some anatomiſts, as Albinus, have imagined, that the urachus and allantois do exiſt in the human ſubject. They were deceived by the appearance of the veſicula umbilicalis and omphalo-meſenteric veſſels.

The liquor amnii is never in ſuch proportion to the fœtus in the latter, as in the early periods of pregnancy. It is leſs pure too at that period, being often polluted with the ſtools of the fœtus. Except in this circumſtance, its chemical qualities are the ſame.

We ſhall now offer a few obſervations on the changes which have been deſcribed.

34 1. The cauſe of the increaſe of growth in the uterus is very obſcure. The acceſſion of fluids will account for the phenomenon; but a ſtrong objection occurs againſt conſidering that as the cauſe, i. e. that the uterus increaſes to a certain degree in ſize, even although the direction of fluids be to another part, as where the fœtus is extra-uterine. Boehmerus has marked this very accurately in a caſe of extra-uterine conception, which he has detailed (A). The developement of its fibres ſeems to prove, that the increaſe of ſize depends on a certain energy of the uterus itſelf; perhaps this may appear a very ambiguous mode of expreſſion, yet we can offer no other explanation of this curious phenomenon.

35 2. The great bulk of the uterus, during the latter months, ſufficiently explains the cauſe of the various complaints which occur at that period. Van Doeveren has deſcribed this very accurately. He ſays, "uteri gravidi incrementum, adſcenſus è pelvis cavo, et immanis expanſio, innumeros excitat gravidarum morbos; primo quidem arctando abdomen et mechanicè comprimendo viſcera quæ in eo continentur, hepar, lienem, ventriculum, inteſtina, omentum, nec minus partes iis vicinas, nempe, renes, ureteres, aortam, venam cavam, arterias et venas iliacas, nervoſque è medulla ſpinali prodeuntes inferiores; accidit pectoris coarctatio, ſimileſque effectus inde excitati in corde, pulmonibus vaſiſque majoribus; ex quibus multiplici modo circulatio, digeſtio, chylificatio et reſpiratio læduntur, inque tota corporis œconomia, ejuſque functionibus ingentis, ſolent produci turbæ variaque vitia topica excitari, inter quæ tenſiones, ſpaſmi, dolores, ſtupores, obturationes, obſtructiones, inflammationes, congeſtiones præ cæteris memorabiles ſunt; unde naſcitur magna ſeries morborum abdominis, pectoris, ipſiuſque capitis; nec non artuum inferiorum torpores, dolores, crampi, œdemata, eryſipelata, varices, hæmorrhagiæ, ulcera, labiorum vulvæ inflationes, variaque vitia partium genitalium, et alia multa pro diverſa partium compreſſarum aut diſtentarum actione, variis nominibus inſignienda (B)."

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36 3. The origin of the membrane, which appears about the third month, called by Dr Hunter membrana decidua reflexa, has afforded matter of diſpute among phyſiologiſts. Dr Hunter imagined, that the decidua vera conſiſted of two layers, and that the ovum, enveloped in chorion and amnios, got ſomehow between theſe: but this is a very unſatisfactory opinion. The more probable opinion is, that the decidua vera and decidua reflexa are diſtinct membranes, although both formed in the ſame manner. If, as we have already ſtated, the uterus, ſoon after conception, be filled with a gelatinous fluid, and if the ovum be in contact with that organ at one point only, then it is probable that the veſſels of the internal ſurface of the uterus, by ſhooting into the fluid with which it is covered, will form one membrane, the decidua vera; while the veſſels on the external ſurface of the chorion, will ſhoot into the fluid with which the ovum muſt have been covered in its deſcent, and form another membrane, the decidua reflexa.

In proof that both membranes are formed in this way, it may be obſerved, that where the fœtus is extra-uterine, the uterus is lined with the decidua vera, and there is no decidua reflexa.—Boehmer is the firſt who demonſtrated this; and not Dr Hunter, as has been alleged. He ſays, "Quum vero uterus magnitudine gravido unius circiter menſis ſimilis videretur, eundem poſterius longitudinaliter, et ſuperius tranſverſaliter diſſecuimus, inque ejus cavo, intuitu haud impregnati ſatis magno, nihil præter tenacem et flaveſcentem mucum, mollemque poroſo-villoſam et valvuloſam quaſi turgeſcentem membranam undique uteri parietes et tubas inveſtentem, hinc inde inflammatam et eroſam, ſtructuram autem uteri ſatis compactam invenimus *."

4. The formation of the placenta is a curious ſubject of inquiry. That it depends principally on the fœtus, 37 is proved by the appearances in extra-uterine conceptions. In the caſe of ventral conception, publiſhed by Mr Turnbull of London, this circumſtance is very clearly pointed out (C).

38 5. The origin of the liquor amnii has been explained very differently by different phyſiologiſts. Some imagine that it is furniſhed by the mother; others by the child. Baron Haller adopts the former opinion. "Ergo (he ſays) ab utero eſt, et à matre, ſiquidem à fœtu eſſe non poteſt. Non auſim experimentum producere, in quo crocus, quem mater ſumſerat, liquorem amnii tinxit †." But if this were the caſe, How could the liquor amnii exiſt when the fœtus is extra uterine? Yet it cannot be a ſecretion from the fœtus itſelf, becauſe

* *Boehmer.* loc. cit. p. 27.

† *Halleri Phyſiologiæ Elementa*, lib. xxix. ſect. 3. § 9.

(A) D. Philippi Boehmeri Obſervationum Anatomicarum variarum faſciculus notabilia circa uterum humanum continens, p. 52.

(B) Primæ lineæ de cognoſcendis mulierum morbis, in uſus academicos, ductæ à Gualth. van Doeveren, M. D. et Prof. p. 16.

(C) Vid. A Caſe of Extra-Uterine Geſtation of the ventral kind, by William Turnbull, A. M. F. M. S. Lond. 1791. Plate 1ſt.

cause it is in very large proportion when the fœtus is scarcely visible. From what source then does it proceed? Most probably from the coats of the amnios.

39 6. Since from the situation of the fœtus it has no direct communication with the atmospheric air, two questions occur on the subject; first, whether it be necessary that the fœtus should receive the vivifying somewhat which the natus receives from the atmosphere. 2dly, If this be answered in the affirmative, by what means is this somewhat furnished?

1. On looking into the works of Nature, we find that there is a class of animals placed in a similar situation with the fœtus, viz. the locomotive fishes. These receive the vivifying somewhat furnished by the atmosphere through the medium of the fluid in which they are immersed; for their blood is always distributed by the smallest ramifications over a substance in constant contact with the water, before it return into the arterial system to serve for the purposes of nutrition.

From analogy therefore it must be allowed, that the fœtus does receive, through some means or other, the vivifying principle of the atmosphere.

40 2. By what means then is this furnished? Many circumstances concur to prove that it is by means of the placenta. For,

1st, The structure of the placenta resembles much that of the lungs. It is cellular, and has the whole blood of the fœtus distributed in the smallest branches over its substance.

2dly, The blood returning from the placenta is sent by the nearest possible means to the left side of the heart. And 3dly, Compression of the umbilical cord to such a degree as to interrupt the circulation through it, destroys the fœtus as soon as compression of the trachea does the natus.

It appears therefore that the placenta serves to the fœtus the same purpose which lungs do to the natus.

41 The celebrated Haller has objected to this probable use of the placenta in the following words. "Non pauci etiam auctores secundis pulmonis officium tribuerunt, cum in vena umbilicali sanguis ruber sit et floridus, si cum sanguinis sodalis arteriæ comparetur. Id experimentum mea non confirmant. In pullo arteria fere coccinea, vena violacea est. In fœtu humano nunquam floridum sanguinem vidi; neque intelligo ut placenta, in qua certissime nulla sint aereæ mutabiles vesiculæ possit pulmonis munere fungi *."

* *Haller.* loc. cit. lib. xxix. sect. 3. § 37.

But later observations have contradicted the assertions of Haller on this occasion. In particular, Dr Jeffray
42 professor of anatomy in the university of Glasgow, in an inaugural dissertation published here in the year 1786, relates an experiment made by him which is completely opposite to the opinion of Haller. "Puero "he says" in obstetricatoris sinu jacenti, funiculus tribus vinculis circumjectis, et simul in arctum tractis colligatus est; quo dein juxta umbilicum inciso, in arteriis umbilicalibus et venis, inter duo vincula placentam proxime, sanguinis copia interceptum est. Intercepti spatii vasa, gelatinosa funiculi parte cultro dempta, in conspectum venerunt; et arteria, quæ sanguinem jam ante in parte circumlatum, ad placentum perferebat, puncta est; quam prope arteriæ puncturam vena quoque umbilicalis similiter puncta est. Quo facto ex vena sanguis effluens, cum eo qui ex arteria effluebat facile comparari poterat. Ille, venosi sanguinis instar, nigricabat; hic, sanguinis in adulta arteriis mox vivide florebat (D)."

7. The means by which the fætus is nourished have hitherto escaped the investigation of physiologists. 43
That the stomach and intestines do not serve this purpose is obvious from many concurrent testimonies; but particularly from these organs being on some occasions entirely wanting, while other parts of the system of the fœtus were complete. It is probable that the placenta supplies nourishment, as well as the vivifying principle of the air, to the fœtus in utero.

CHAP. III. *Natural Parturition.* 44

HUMAN parturition, where every thing is natural, is perhaps one of the most beautiful and interesting operations in nature; for what can be more beautiful than a process accomplished by the combined action of a number of powers admirably well adapted to the intended purpose? and what can be more interesting than the continuation of our species which depends on the operation?

In treating of this subject, we shall first consider the term of gestation; 2dy, the phenomena of natural parturition; and 3dly, the causes of those phenomena.

SECT. I. *Term of Gestation.* 45

The ancients imagined that although nine kalendar months be the most usual period of human pregnancy, yet on some occasions that period may be, and actually is, protracted even beyond ten kalendar months. Accordingly, it was laid down as a maxim in ancient jurisprudence, that children born within eleven months after the death of their supposed father should be declared legitimate.

In modern times the question has been often agitated, both among medical practitioners and among lawyers. Practitioners of midwifery however have had most frequent occasion to investigate this subject, and they have differed materially in their conclusions.

Rœderer says, "Hunc terminum, finem nempe trigesimæ nonæ et nonnunquum quadragesimæ hebdomadis partui maturo natura, uti accuratior observatio docet constituit, ultraque eum non facile differtur. Nihil hic valet energia seminis deficiens, morbosa vel debilis patris constitutio, matris dispositio phthisica, hectica, qua fœtus sufficienti alimento privatur; nihil, status matris cachecticus, fluxus menstruus tempore gestationis contingens, diarrhœa aliusve morbus; nihil nimia uteri amplitudo; nihil affectus matris vehementior, qualis tristitia; nihil diæta matris extraordinaria, vel inedia; nihil fœtus debilitas et dispositio morbosa; nihil plures fœtus in utero detenti. 46

"Tantum enim abest ut hæ causæ fœtus moram in utero retardent, ut potius accelerent. Viduæ quidem vanis hisce speciebus, illicitam venerem defendere atque hereditates aucupari, quin in eo medicos nimis credulos,

(D) Tentamen medicum inaugurale, quædam de placenta proponens, auctore Jacobo Jeffray &c. Edinburgh 1786, p. 41.

dulos, vel lucri cupidos in ſuas partes trahere ſtudent, ſed mera hæc ſunt ludibria, prætereaque nihil (E)."

But many eminent teachers of midwifery believe that in ſome caſes human pregnancy is protracted for two or three weeks beyond the more common period.

47 Dr Hamilton eſpecially ſays, "In the human ſpecies nine kalendar months ſeem neceſſary for the perfection of the fœtus; that is, nearly thirty-nine weeks, or two hundred and ſeventy-three days from conception. The term does not, however, appear to be ſo arbitrarily eſtabliſhed, but that nature may tranſgreſs her uſual laws; and as many circumſtances frequently concur to anticipate delivery, it certainly may in ſome inſtances be protracted. Individuals in the ſame claſs of quadrupeds, it is well known, vary in their periods of pregnancy. May we not, therefore, from analogy reaſonably infer, that women ſometimes exceed the more ordinary period? In ſeveral tolerably well atteſted caſes, the birth appears to have been protracted ſeveral weeks beyond the common term of delivery. If the character of the woman be unexceptionable, a favourable report may be given for the mother, though the child ſhould not be produced till nearly ten kalendar months after the abſence or ſudden death of her huſband †."

† *Outlines of Midwifery*, p. 192.

Sect. II. *Phenomena of Natural Labour.*

48 The ſufferings of a woman during labour having been compared to the fatigues of a perſon on a journey, the phenomena of labour have been divided into three ſtages. The firſt ſtage conſiſts of the opening of the mouth of the womb; the ſecond, of the actual paſſage of the child; and the third, of the ſeparation and expulſion of the ſecundines.

49 *Phenomena of the Firſt Stage.*—In moſt inſtances the bulk of the belly ſubſides for a day or two before labour begins; but the firſt evidence of the actual commencement of that proceſs is the occurrence of pains in the belly affecting the loins, and ſtriking down the thighs, occaſioning conſiderable irritation of the bladder and bowels. Theſe pains, &c. however, often take place during ſome hours of the night, for days, or even weeks, before true labour begins, and are then ſtyled ſpurious pains. It is not eaſy on many occaſions to diſtinguiſh true labour throes from ſpurious pains, unleſs the ſtate of the mouth of the womb be examined, ſo very nearly do they reſemble each other. But in general ſpurious pains recur at irregular intervals, and do not increaſe in force according to their duration; whereas true pains gradually recur at ſhorter intervals, and become more and more violent.

Spurious pains are ſometimes attended with an occurrence which was firſt publicly noticed and deſcribed by the preſent profeſſor of midwifery in the univerſity of Edinburgh (F), viz. the protruſion of the urinary bladder. This reſembles, to a ſuperficial obſerver, the bag formed by the membranes which incloſe the child, and in conſequence has repeatedly been burſt by the fingers of the operator. Incurable incontinence of urine, inflammation of the paſſages, &c. have followed this accident.

Protruſion of the urinary bladder may be readily diſtinguiſhed from that of the membranes which include the infant by two circumſtances. Firſt, the bag recedes completely during the interval of the pain; and ſecondly, when puſhed down, the finger cannot be paſſed round it at the fore part of the pelvis; it ſeems as if fixed to the pubis. True labour-pains ariſe from the contractions of the womb by which that organ is ſhortened and thickened; and, at the ſame time, its contents are forced through its orifice. When they become regular and forcing, they have the effect of opening the mouth of the womb, ſo that a practitioner can readily aſcertain the difference between them and ſpurious pains. The opening of the mouth of the womb, in moſt inſtances, is accompanied by the diſcharge of a ſlimy, bloody-like matter, termed ſhews; but in many women there is no ſuch circumſtance.

This proceſs is generally gradual, the pains increaſing in frequency and force; and eight, ten, or twelve hours, commonly elapſe before they complete the opening of the womb. In ſome caſes the dilatation takes place to a conſiderable extent before pains occur, ſo that a few pains accompliſh this ſtage. But theſe exceptions are not ſo frequent as thoſe of an oppoſite deſcription, where one or two complete days are required to open the womb, though the pains be unremitting.

In proportion as the firſt ſtage advances, the membranous bag containing the child is puſhed through the mouth of the womb, and forced gradually into the vagina. During the pain it is tenſe, and during the interval it becomes relaxed. When this happens, the head of the infant can be diſtinctly felt behind it. At laſt, the paſſages being ſufficiently opened, the pains having become ſtronger and more frequent, the membranes give way, and the water contained within them is diſcharged; which finiſhes the firſt ſtage. Shivering, vomiting, headach, thirſt, and pain in the back, take place in many inſtances during this ſtage.

Phenomena of the Second Stage.—Sometimes an interval of eaſe of ſome minutes duration ſucceeds the diſcharge of the waters. The pains then become much more violent and forcing, and the head, by the contractions of the uterus thus becoming more powerful, is puſhed through the brim of the pelvis into the vagina. For this purpoſe the vertex is forced foremoſt, and the brow is turned to one ſacro-iliac ſynchondroſis, ſo that the largeſt part of the head is applied to the wideſt part of the baſon; for as the head is oval, and the opening through which it is to paſs is of the ſame form, this is abſolutely neceſſary. 50

After the head is in the vagina, the pains ſtill continuing, the vertex is turned into the arch of the pubis, and the face into the hollow of the ſacrum, by which the largeſt part of the head is brought into the direction of the wideſt part at the outlet. All the ſoft parts are now protruded in the form of a tumour, a portion of the vertex is puſhed through the orifice of the vagina, and every pain advances the progreſs of the infant, till at laſt the head is expelled. An interval of a minute

(E) Rœdereri Elementa Artis Obſtetricæ. Goettingæ, 1766. page 98.
(F) Select Caſes in Midwifery, by James Hamilton, M. D. 1795. page 16.

Natural Parturition.

nute or two now ensues, after which another pain taking place, the face is turned to one thigh and the shoulders of the child being placed towards pubis and sacrum, the whole of the body is born. During this process the patient generally adds voluntary efforts to the contractions of the uterus.

This stage is in many instances extremely tedious; but after the woman has had one child, it often is completed within the time of six or eight pains.

51 *Phenomena of the Third Stage.*—Whenever the infant is born, if there be no other in the womb, the parietes of the abdomen become relaxed, and the womb can be perceived through them, contracted almost into the size of a child's head. An interval of ease of some minutes duration now elapses, after which pains again recur, commonly attended with the discharge of some clots of blood, occasioning a kind of gurgling noise, and the placenta and membranes are thrown off, and the womb remains quite contracted or nearly so, with a cavity scarcely capable of containing a hen's egg. In some cases a single pain accomplishes this, and in others several pains are required; but generally speaking, this stage is completed within an hour after the birth of the child.

It sometimes, however, happens that the natural efforts are inadequate to the expulsion of the secundines. The causes are, want of sufficient contractile power in the uterus, irregular contraction of that organ, and indurated state of the placenta itself.

From the above description it is obvious that all the three stages of labour are completed by one simple power, viz. the contraction of the womb.

52 SECT. III. *Causes of the Phenomena of Labour.*

I. The first phenomenon which requires explanation is the action of the uterus. Why does that organ generally act at a certain period, after having remained in a quiescent state for so long a time?

This question has puzzled physiologists strangely. Some have attributed the circumstance to a stimulus communicated by the fœtus: but their opinion is overturned by a well-known fact, that the same phenomena occur though the fœtus be dead. Others have imagined that the uterus is excited to act in consequence of previous distension. But were this the case, women should never have the uterus of a larger bulk in one pregnancy than in another; whereas, on the contrary, it is well known that women who have twins or triplets often have the womb distended to fully double the usual size.

Physiologists as well as physicians have fallen into very great errors from referring complex phenomena to a single cause. A variety of facts concur to prove, that in the present instance it is absurd to impute the action of the uterus to any single cause.

To what then should we attribute it? To a variety of circumstances.

1st, To the structure of the uterus. From the appearance of that organ in its unimpregnated state, it would seem that nature had laid up in store a certain proportion of fibres to be developed during pregnancy, When these fibres are evolved, if the uterus be distended farther, the edges of the os tincæ must be separated, in consequence of which part of the uterine contents passing through it, the contraction of the uterus follows. A fact very familiar to practitioners of midwifery affords apparently a complete confirmation of this hypothesis, viz. that in some women labour occurs as regularly and naturally, in the seventh or eighth month of gestation, as in others it does at the end of the ninth, the cervix uteri having become quite obliterated.

2d, It is probable, however, that in ordinary cases this store of muscular fibres is seldom entirely exhausted, from the circumstance of women having sometimes twins or triplets; some other cause therefore must concur in exciting the action of the uterus. The contents of the uterus perhaps furnish this cause.

In the latter months of gestation, some parts of the fœtus come in contact with the parietes of the uterus, in consequence of the decrease in proportion of the liquor aninii. This is principally the case with respect to the head, which presses on the cervix, and that part of the uterus, it is probable, is more irritable than any other; for we find that the entrance or exit of all hollow muscular organs is more irritable than the other parts, as we see exemplified in the cardia of the stomach, and in the cervix of the urinary bladder.

3d, It is not improbable too, that the pressure of the neighbouring parts contributes somewhat to induce the action of the uterus; for it is remarked by practitioners of midwifery, that women seldom arrive at the full period of gestation in a first pregnancy, and the parietes of the abdomen yield with difficulty at first, as is observed in cases of dropsy. Besides all farmers know well, that in every succeeding pregnancy, cows exceed their former period of gestation.

II. The next phenomenon worthy of notice is the manner in which the child's head enters the pelvis. 53
Two circumstances contribute towards this, first the connection of the head of the child with the neck; and 2dly, The form of the brim of the pelvis.

The first of these circumstances has been accurately pointed out by Dr Osborn. He says, "after the os uteri has been first opened by the membranes and contained waters, forming a wedge-like bag, the next operation and effect of the labour-pains or contractions of the uterus (for they are convertible terms) must be on the body of the child, *which being united to the basis of the cranium at the great foramen and nearer the occiput than forehead*, the greater pressure will be applied to the occiput, which being likewise smaller, and making less resistance, will be the first part squeezed into the cavity of the pelvis (E)."

The latter circumstance has been clearly explained by Professor Saxtorph. He remarks, "causa hujus directionis capitis, concurrente toto mechanismo perfecti partus, potissimum hæret in pelvi. Nam agente utero in fœtum, in axi pelvis locatum, caput ejus hucusque liberum, in humore amnii fluctuans, propter molam suam majorem in introitum ipso pelvis magnam resistentiam patitur à prominentia ? ossis sacri, quæ in posteriori parte segmenti inferioris uteri ita impressa est, ut promontorii

(E) Essays on the Practice of Midwifery, &c. by William Osborn, M. D.

montorii instar fœtus frontem glabram, rotundam, unico puncto tantummodo illam tangentem et satis mobilem, blando motu ad latus dirigat, in spatium ei exactè respondens inter protuberantiam ipsam et marginem internum acutum ilii excavatum, quam ob rem, sincipitis prævii sutura sagittalis cadit necessario in diametrum obliquum aperturæ superioris pelvis (F)."

It is remarkable, that neither of these celebrated authors discovered that a combination of both the circumstances just enumerated, is necessary to occasion the phenomenon.

Two advantages result from this position of the head of the child; for, 1st, The largest part of the head is applied to the widest part of the superior aperture; and, 2dly, The head, when the occiput is forced foremost, occupies the least possible space.

54 III. The phenomenon which next strikes us, is that change in the position of the head by which the face is turned into the hollow of the sacrum.

Although the advantage, and even necessity, of this change in the position of the head, has been long known to practitioners; yet Dr Osborn is, perhaps, the first author who has clearly explained the efficient cause of this. His remarks are these: "As it (viz. the head) descends obliquely through the pelvis, the pressure of the two converging ischia will not be exactly opposite to each other on the two parietal bones; but one ischium acting or pressing on the part of that bone contiguous to the occiput, and the other on the opposite side next to the face, the head being made up of different bones, united by membranes, and forming various sutures and fontanels, which permit the shape to be changed, and the volume to be lessened, it necessarily follows, that the head, thus compressed, will take a shape nearly resembling the cavity through which it passes; and, as from the convergency of the ischia, the cavity of the pelvis somewhat approaches the form of a cone, the child's head is moulded into that shape, the shape of all others best adapted to open the soft parts, and make its way through the os externum. This unequal pressure of the two ischia upon the head, will, in the first instance, direct the occiput, or apex of the cone, to turn under the arch of the pubis, where there is little or no resistance; while the pressure of the other ischium, in its further descent, will have the same effect on the other side, and direct or compel the face to turn into the hollow of the sacrum †."

† *Dr Osborn*, loc. cit. p. 30.

This change of position is productive of three advantages.

1st, The largest part of the head is again adapted to the widest part of the pelvis.

2dly, The smallest possible surface of the head is applied to the surface of the bones of the pubes. And,

3dly, As Dr Osborn, in the passage quoted, very justly observes, the head is moulded into that shape which is best calculated to pass without doing harm, through the soft parts.

55 IV. The phenomena which occur when the head passes through the external parts, are easily explained.

After the head has made that turn, by which the face is placed in the hollow of the sacrum, the coccyx and perinæum resist its further descent in that direction, and by forcing the nape of the neck against the inferior edge of the symphysis pubis, every successive pain contributes to make the occiput rise up towards the abdomen, by which the chin leaves the top of the thorax, on which it had rested during the preceding process of delivery.

By this simple mechanism, the soft parts are gradually prepared for the passage of the child, while, at the same time, the shoulders are brought into the most favourable position for passing through the pelvis.

V. The phenomena of the third stage of labour obviously originate from the contraction of the uterus, which both separates and expels the secundines. Some authors have imagined that nature has provided for this purpose a particular apparatus, placed at the fundus uteri; but as the placenta, when attached to the cervix uteri, is thrown off as readily as when it is attached to the fundus, it is very evident that these authors have been deceived by a seeming regularity of fibres, which is sometimes observed. 56

Lastly, The obstacles which nature has opposed to the passage of the child, occasion all the difficulties of human parturition. These obstacles are formed by the situation and shape of the pelvis, and the structure of the soft parts concerned in parturition. 57

The pelvis is situated in such a direction, that its axis forms an obtuse angle with that of the body; consequently, it is not placed perpendicularly, but obliquely to the horizon; and hence nothing can pass through it by the force of gravity.

The shape of the pelvis, too, is such, that the head of the child cannot pass through the outlet in the same direction in which it entered the brim; and, from the structure of the soft parts concerned in parturition, they yield with considerable difficulty.

By these means, the Author of our existence has guarded against the effects of the erect posture of the body, and has prevented the premature expulsion of the child and the sudden laceration of the soft parts.

Sect. IV. *Treatment of Natural Labour.* 58

First stage.—When this stage proceeds naturally and regularly, there is very little else to be done, after having ascertained that labour has really begun, and that the child is in the ordinary position, than taking care that the bowels be open, and palliating any unpleasant symptoms, such as shivering or vomiting, &c. which may occur.

But if after the pains have become so regular as, by their continuance, to disturb the ordinary functions of life, that is, most commonly, after they have been quite regular for twelve or fifteen hours; if this stage be not completed, it is necessary to interfere, and to endeavour, by art, to effect the dilatation. The reason for this rule is abundantly evident. If this stage of suffering be longer protracted, the strength of the patient must be exhausted by the long-continued exertion, and, of course, the remaining process of labour cannot be completed. Hence the child may be lost, or alarming discharges

(F) Dissertatio inauguralis de Diverso Partu, &c. Auctore Matthia Saxtorph. Hafniæ, 1771. p. 19.

diſcharges of blood may follow the birth of the infant.

This very obvious effect of the protraction, beyond certain limits, of the firſt ſtage of labour, was firſt publicly inſiſted on by the preſent profeſſor of midwifery in the univerſity of Edinburgh.

The means to be adopted for completing the dilatation, when that aſſiſtance becomes neceſſary, are veneſection or opiates, or ſupporting the os uteri, according to circumſtances.

When the reſiſtance to the opening of the womb ariſes from the premature diſcharge of the water, or from natural rigidity of the womb, copious blood-letting affords the adequate remedy. But if the patient be already reduced by previous diſeaſe, ſo that ſhe cannot ſafely be bled, an opiate, in the form of glyſter, ought to be adminiſtered.

And when, on the recurrence of every pain, the mouth of the womb is forced down upon the external paſſage before the child, its edges ought to be ſupported, *in ſitu*, by the fingers cautiouſly applied to each ſide.

59 *Second ſtage.*—When it is found that the head has begun fairly to enter the pelvis in the natural direction, no aſſiſtance is neceſſary till the perineal tumour be formed; and then ſuch ſupport muſt be given to the protruded parts as ſhall both relieve the diſtreſſing feelings of the patient, and, at the ſame time, prevent any laceration from happening. Of courſe, the preciſe manner of ſupporting the perinæum muſt be varied according to the circumſtances of the caſe. Inattention to this has very frequently occaſioned the moſt deplorable accidents.

After the head is born, it muſt be aſcertained whether there be any portion of the navel-ſtring round the neck of the infant, and if there be, it muſt be ſlackened or drawn over the head, otherwiſe the infant will be loſt.

If poſſible, time ſhould be allowed for the accommodation of the ſhoulders, and the expulſion of the body of the infant; and, at any rate, the utmoſt attention ſhould be paid to ſupporting the perinæum during that part of the proceſs.

60 *Third ſtage.*—When the child is born, and it is aſcertained that there is no other infant remaining in the womb, the patient ſhould be allowed to reſt for a little, unleſs pains again come on, by which the ſecundines are ſeparated. In that caſe, the cord is to be firmly graſped, and pulled gently, till the placenta be brought down to the external parts, when it is to be drawn out carefully, in ſuch a manner as to bring off at the ſame time the complete membranous bag.

Should pains not recur at the diſtance of an hour after the birth of the infant, it becomes neceſſary, for ſeveral reaſons, to introduce the hand into the womb to ſeparate and extract the ſecundines.

Firſt, If the cord were pulled by before the womb had contracted, or the after-birth had become ſeparated, the womb muſt inevitably be turned inſide out; an accident that has occaſionally happened.

Secondly, If a longer period than an hour were ſuffered to elapſe, the paſſages would become ſo much contracted, that the force required again to dilate them, would produce inflammation, with all its alarming conſequences.

Thirdly, If the after-birth were allowed to remain longer than an hour, exceſſive flooding might take place, which would ſoon prove fatal.

Fourthly, Were the patient to eſcape the danger of flooding, ſhe would incur that of putrefaction of the placenta, which is equally, though not ſo rapidly, productive of mortal event.

In thus introducing the hand to ſeparate the placenta, the two great cautions to be attended to, are to apply the fingers to the ſubſtance of the placenta, not to inſinuate them between its ſurface and that of the uterus, and to bring off only that portion of the placenta which can be ſeparated from the uterus without force.

When any alarming circumſtance happens after the birth of the infant, requiring the extraction of the placenta, the practitioner is not to delay for an hour, indeed not for a minute, giving the requiſite aſſiſtance.

Chap. IV. *Of the Deviations from Nature in Human Parturition.* 61

From the view thus given of human parturition, under the moſt favourable circumſtances, it muſt be obvious that many deviations from nature may occur.

Theſe deviations may proceed; firſt, from the propelling powers concerned in parturition; ſecondly, from the ſtate of the ſecundines; thirdly, from the ſtate of the child itſelf; or, fourthly, from the ſtate of the paſſages through which the child is forced. There may alſo be a combination of theſe cauſes. We ſhall conſider each of theſe cauſes of deviation in the order juſt enumerated. But as a minute inveſtigation of the ſubject would far exceed the neceſſary limits of this work, we ſhall treat each of theſe cauſes as ſhortly as poſſible, and notice only the moſt ſtriking circumſtances.

Sect. I. *Of the Deviations from Natural Labour, which proceed from the Propelling Powers.* 62

The propelling powers concerned in parturition conſiſt of voluntary and involuntary muſcular action. The diaphragm and abdominal muſcles furniſh the former, and the uterus the latter.

An exceſs or diminution of the action of thoſe powers muſt interrupt the ordinary progreſs of labour.

a. The violent action of the diaphragm and abdominal muſcles, if exerted at the beginning of labour, tends to exhauſt the patient and to retard delivery, and if induced when the head is within the vagina may, provided proper precautions be not taken, lacerate the perinæum, and render the future life of the patient miſerable. 63

The action of theſe muſcles being quite voluntary, may be readily prevented by the patient ſubmitting to proper advice.

b. Impaired action of the diaphragm and abdominal muſcles, generally originates from the improper exertion of thoſe muſcles at the beginning of labour, or from paſſions of the mind. It always retards delivery, and conſequently protracts the ſufferings of the patient. 64

c. Violent

Preternatural Partution.

65 *c*. Violent action of the uterus at the beginning of labour, is frequently productive of much mischief. It exhausts the patient, and renders the subsequent process of delivery exceedingly tedious and difficult. It also sometimes occasions an accident which generally proves almost immediately fatal, viz. rupture of the uterus.

This accident has been described by authors under the title of spontaneous rupture of the uterus. The laceration in the uterus in those cases is sometimes transverse and sometimes longitudinal. When the accident happens from this cause, the laceration is most frequently in the cervix. The accident is preceded by excruciating pain, especially during the action of the uterus, at one part, as in the loins or towards the pubes; and it is announced by a most agonizing increase of the pain succeeded by violent vomiting, the discharge of a little blood, a total cessation of the labour throes, very great irregularity and feebleness of the pulse, cold sweat, coldness of the extremities, difficulty of breathing, inability to lie in the horizontal posture, and sometimes delirium. Along with these symptoms, it often happens that the presenting part of the child recedes entirely, and the limbs of the infant may be readily distinguished through the parieties of the abdomen. But this circumstance does not always take place, for sometimes the head of the child is so firmly wedged within the pelvis, that it does not recede although the other parts be in the cavity of the abdomen.

The rupture of the uterus is generally fatal. A few cases, however, are on record, where, by prudent management, the patient, even under such dangerous circumstances has been saved. Such are the cases recorded by Dr Hamilton (H), by Dr Douglas (I), and Dr Hamilton, junior (K). But the injuries which must ensue from loss of blood, acute pain, the presence of the child in the cavity of the abdomen, and the probable protrusion and strangulation of the intestines are such, that it cannot be expected that many patients can survive the accident.

The cause of violent action of the uterus at the beginning of labour, is obviously the premature discharge of the liquor amnii. By this circumstance, the body of the child comes in contact with the parietes of the uterus, by which the action of that organ is immediately and violently excited. How much mischief then may the rash interference of an ignorant operator produce?

The cause of rupture of the uterus from its own violent action, is the resistance to the passage of the child, either from undilated os uteri, or from deformities of the pelvis, or from wrong position of the child. Whenever, therefore, the rupture is threatened, means must be instantly adopted to remove the resistance, or to suspend the action of the uterus. The former is in general the more easily accomplished.

When the uterus has actually burst, the only chance which can be afforded to the patient, is instant delivery; *per vias naturales*, where that is practicable; and where there is extreme narrowness of the pelvis, by an incision through the parietes of the abdomen. A case where this latter practice was successfully had recourse to occurred a few years ago in Lancashire.

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Violent action of the uterus during the latter stage of labour, although not productive of the same dangers which ensue from it at the beginning, is by no means exempt from hazard; for if the soft parts be rigid or not sufficiently relaxed, the woman may be miserably torn.

The violent action of the uterus towards the termination of labour proceeds from some power of that organ itself, or from the stimulus communicated by the position of the child.

This circumstance, however, is sometimes beneficial; as, for instance, when the child is in an unfavourable position. Dr Denman was the first who discovered this effect of violent uterine action, and published it in the fifth volume of the London Medical Journal, page 64.

d. Impaired action of the uterus during the first stage of labour is in many instances productive of no 66
other inconvenience than the protraction of labour; but if it exhausts the strength of the patient, it influences materially the subsequent process, as already stated. When it occurs during the second stage, it occasions the most dangerous symptoms. First, If the head of the child continue to press for a considerable time on the soft parts within the pelvis, these parts must necessarily from the impeded circulation become swelled, and consequently the action of the uterus, though it should return, would then be totally insufficient for the expulsion of the child. This effect of the protraction of the second stage was first pointed out to the public in Dr Hamilton's Letters to Dr Osborne. It merits most particular attention; not only as it is one of the most frequent causes of the loss of the infant during labour, and of considerable danger to the parent, but also as it may be very readily prevented by an attentive practitioner. Previous to this swelling becoming so considerable as to impede the progress of the infant, there is a tenderness and heat, and dryness in the passage, which announces the actual commencement of the inflammation. Immediate delivery ought then to be had recourse to.

Many disagreeable symptoms also proceed from the same cause, such as suppression of urine, and violent cramps in the lower extremities.

When it is ascertained, that, in consequence of the deficiency of action of the uterus, the child is detained so long in the passage as to endanger the health or life of the mother, it becomes necessary to extract the infant by mechanical means. Two contrivances have been thought of for this purpose, viz. the vectis or lever, and the forceps.

Roonhuysen, a Dutch practitioner, who flourished 67
about the beginning of the 18th century, contrived the vectis, and from the great success which attended its use in his hands, an edict was issued by the states-general, that no surgeon should practise midwifery without

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(H) Outlines of Midwifery, p. 348.
(I) Observations on the rupture of the gravidutenus, &c. by A. Douglas, M. D. &c. 8vo. London 1789.
(K) Select Cases of Midwifery, p. 138.

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out being poffeffed of the Roonhuyfen fecret, for the inftrument was not publicly known. In the year 1756, however, the fecret having been purchafed by two liberal-minded phyficians, Vifcher and Van de Poll, was publifhed by them for the benefit of mankind. Since that time, the inftrument has undergone a variety of alterations in its form; for a particular account of which, the reader is referred to Mulder's Hiftoria Forcipis.

There can be no doubt that Roonhuyfen and his fucceffors employed the vectis as a lever of the firft fpecies, the head of the infant being the refiftance, the parts of the woman the fulcrum, and the hand of the operator forming the moving power. The injuries arifing from this practice have been well explained by Dr Ofborne in his Effays on Laborious Labours. Although Dr Bland and Dr Denman ftill recommend the fame practice, there can be no doubt that whenever the ufe of the vectis proves fuccefsful according to their directions, the fortunate termination is to be attributed to the action of the uterus being exerted by the preffure of the inftrument; or in other words, the delivery might have been completed without any mechanical interference at all. On the other hand, whenever the action of the uterus is either quite fufpended or much weakened, both mother and child fuffer from the application of the vectis.

68 The late Dr Deafe in altering the fhape of the vectis, wifhed to imprefs upon the profeffion the neceffity for changing the mode of employing it; and accordingly he called his inftrument an *extractor*. This power, however, feems to be poffeffed in a fuperior degree by Dr Lowder's inftrument, of which a defcription is contained in the eighth volume, fecond decade, of Dr Duncan's Medical Commentaries, p. 400. As this inftrument may be ufed with perfect fafety, both to mother and child, and as in fome cafes it is fuperior to the forceps, we have reprefented its form in one of the plates, and now add the defcription and an account of the manner of applying it from the work already referred to.

69 The inftrument "confifts of a blade and handle (between which there is a hinge, that renders it portable), meafuring in length $11\frac{1}{2}$ inches. Its length, before it be curved is $12\frac{1}{4}$ inches. The curve begins about half an inch from the hinge. It defcribes, reckoning an inch from its firft curvature, as nearly as can be eftimated, an arc of 87 degrees of a circle, the radius of which is four inches. The breadth of the blade, at the beginning of the curve, is half an inch, and is gradually increafed, till within three quarters of an inch of the extremity, where it meafures an inch and three-fourths. Its extremity is femicircular. Within $2\frac{1}{2}$ inches of the extremity there is an oval opening, meafuring $2\frac{1}{4}$ inches in length, and $1\frac{1}{4}$ at its greateft breadth. By this opening, the depth of the curve is confiderably increafed, without rendering the inftrument inconvenient in its introduction."

70 Let us fuppofe that it is found neceffary to ufe Lowder's lever, when the head of the child has juft begun to enter the cavity of the pelvis. The patient is to be placed in the ordinary pofition, on the left fide, in bed. The occiput of the child is to be carefully diftinguifhed, and the curve of the inftrument is to be applied, with all the neceffary precautions, over it. The extremity of the blade fhould be within a very little of the nape of the neck. To accomplifh this part of the operation with facility, it is neceffary that the operator be well acquainted with the fhape of the pelvis, and that he have accuftomed himfelf to apply the inftrument over a round fubftance.

When the inftrument is applied in this manner, the operator will find, that he can exert very confiderable power in drawing down, without preffing on any other part than the occiput of the child. The mother cannot poffibly feel the inftrument; while, at the fame time, the many points of the fœtal cranium, on which it refts, prevent any injury whatever to the infant.

If there be any pains, however flight they may be, the operator fhould draw down only during the pain: in the intervals, a foft warm cloth fhould be wrapped round the handle. If there be no pains, he muft draw down from time to time, imitating, as nearly as he can, the natural efforts. It is aftonifhing, of what ufe even the moft trifling pains are, on fuch occafions. Without pains, a long time is required before the head be made to advance in a perceptible degree (though, after it has advanced a little, it foon yields entirely); while, with them, the progrefs is often rapid.

The operator fhould continue to draw down in the fame manner, till the head be completely in the cavity of the pelvis. Should any circumftance, as dangerous uterine hæmorrhagy, or convulfions, require that the delivery be expeditioufly finifhed, after the head is brought into this pofition, the forceps muft be applied; for it is in the power of the operator, by means of them, to accomplifh the extraction of the head within a very fhort fpace of time, or at leaft, within a much fhorter fpace than would be required, were the ufe of Lowder's lever continued.

But if there be no dangerous fymptom, the operation may be completed by the firft inftrument, without any affiftance from the forceps.

For this purpofe, the operator fhould continue to draw down, by preffing on the occiput, as already directed, until the face fhall have turned into the hollow of the facrum. The direction of the inftrument muft then be changed. The reafon of this is very obvious. After the face is in the hollow of the facrum, the occiput becomes engaged in the arch of the pubis, and rifes under it, while, at the fame time, the chin leaves the top of the breaft, on which it had refted during the preceding procefs of labour, and defcribes a courfe equal to a full quarter of a circle, which is the confequence of the occiput defcribing a fimilar courfe under the arch of the pubis. Were the practitioner, then to continue to prefs in the fame direction as he did while the head was paffing through the brim, he would counteract this natural procefs, and hence would retard delivery, and injure the parts againft which he would neceffarily prefs the child.

The inftrument muft, therefore, be withdrawn from the occiput, and applied with the proper precautions over the chin, when the operator is to imitate the procefs of nature, by difengaging the chin from the breaft, and making the occiput rife under the arch of the pubis, while, with his left hand, he protects the perinæum from injury.

From thefe obfervations it is obvious, that the inftrument introduced into practice by Dr Lowder, affords exactly the affiftance, in the firft order of laborious labour, which is required; for it fupplies the place of the

propelling

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propelling powers, or increases their efficacy, by acting on the body of the child, without injuring any part of the mother.

71 "This property renders it of great use in certain cases of deformed pelvis, viz. where the short diameter of the brim is about three inches. In such cases, the long continued strong action of the uterus, often eventually forces the head into the pelvis; but the strength of the patient is in consequence so much reduced, that after it has proceeded so far, the pains are entirely suspended, and the delivery must necessarily be finished by the use of mechanical expedients; but the child's life is commonly previously destroyed, by the compression of the brain.

"If, in such cases, it be possible to increase with safety the vis à tergo, the child would then be forced through the brim of the pelvis before the woman's strength were exhausted, and before its life were endangered; consequently, many children, commonly doomed to inevitable destruction, would be preserved.

"Lowder's lever, I apprehend, possesses this power. It may be calculated, that, by its use, the efficacy of the labour throes is at least doubled. Hence the child, in cases of slight deformity of the pelvis, is forced through the opposing part within one half of the time which would be otherwise required; and this is accomplished without injury either to the mother or infant; for the instrument presses on no part of the former; and it rests on such parts of the latter, that no harm can possibly be done.

"In face-cases, too, where the interference of the practitioner is necessary (which, indeed, is a rare occurrence), this instrument may be employed with much advantage. The great aim should be, to draw down the occiput.

"As it appears, therefore, that Lowder's lever is applicable in many cases where the forceps are inadmissible, and that its use is not productive of so much hazard to the mother as that of the forceps, it might perhaps be inferred, that the latter instrument may be banished from practice, as unnecessary and dangerous. Accordingly, many practitioners of midwifery have adopted an opinion of this kind; and, indeed, there are very few who do not employ one or other of these instruments exclusively.

"But however desirable it may be to lessen the number of mechanical expedients, and to simplify practice, I apprehend, that many lives would be lost if we possessed or employed no such instrument as the forceps. As they have the property of a lever, delivery can in many cases be accomplished much more expeditiously by them than by Dr Lowder's instrument. This seems to be the sole advantage which they possess over it; and that is counterbalanced by several great disadvantages. Many authors, indeed, have alleged, that the forceps have exclusively the power of diminishing the size of the fœtal cranium, by the pressure of their blades, and hence have attributed a degree of preeminence to them, which in fact is not their due; for as the size of the child's head is, in natural cases, diminished as far as is necessary, by the contractions of the uterus forcing it forward through the bones of the pelvis, an increase of the vis à tergo will of course increase that diminution, if the shape of the passage require it. While Lowder's lever, therefore, possesses the power of compressing the cranium in common with the forceps, it has a decided superiority over them in this, that it accomplishes that end by similar means with nature.

"The great disadvantages of the forceps are, that they are inapplicable when the child's head is situated high in the pelvis; that their application is often difficult to the operator, and painful to the patient; and that, as their centre of action is on the parts of the patient, they must injure her in proportion to the resistance opposed to the delivery.

"On the whole, then, in cases of the first order of laborious labours, both instruments must be occasionally had recourse to. When the head is not completely within the cavity of the pelvis, Lowder's lever must be employed; and even when it is in that position, the same means may be used, if there be pains. But, when the labour throes are entirely suspended, or when any circumstance renders it necessary to terminate the delivery with expedition, the forceps ought to be employed in preference to every other instrument, if the head of the child be within their reach."

The forceps are supposed to have been invented by Dr Hugh Chamberlain, who was physician to King Charles II.; but their form has been greatly altered since his time. The most approved form is that represented in the plate. 72

This instrument is only applicable in presentations of the head; but it was formerly, by Dr Smellie and others, recommended in face cases.

In order that this instrument be applicable, it is necessary that the head be completely, or nearly so, in the cavity of the pelvis; but sometimes a lengthened pair is used for cases where the head is situated high. The employment of long forceps, however, being extremely dangerous, is seldom justifiable; and therefore we shall limit our directions to the use of the common short forceps.

There are three principal cases in which that instrument may be had recourse to, viz. 1. where the face is in the hollow of the sacrum; 2. where the face is wedged under the pubis; and 3. where it is on one side of the pelvis. 73

In whatever situation the head is, the instrument is to be applied over the ears, otherwise there could be no safe and secure hold. In the process of extracting the child with this instrument too, it is to be observed, that the convex edge of the blades is to be brought along the hollow of the sacrum.

The instrument being applied so cautiously over the ears of the infant that no part of the woman be injured by their introduction, the locking parts are to be brought together, and secured by a ligature; after which the operator, supporting carefully the perinæum with one hand, is to draw gently in a direction of from blade to blade during a pain, or now and then to imitate labour throes, while he at the same time favours the mechanism of labour by accommodating the child's head to the passage so as to make it take up the least possible room. If this be done with suitable caution and gentleness, no part of the woman should be injured, and the parts of the infant on which the instrument had rested should not even be marked. But as there can be no doubt, that in the process of using the forceps, the parts of the woman are pressed upon by the blades, if much force be exerted, or if due attention be not

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not paid to the adaptation of the head of the infant to the apertures through which it is to be brought, the most dreadful effects result from the operation.

SECT II. *Of the Deviations from Natural Labour, which proceed from the state of the Secundines.*

74 The membranes which envelope the fœtus are in some cases more tender, and in others more rigid, than in general they are found; circumstances which have a considerable effect on the process of parturition. Besides this, the placenta is on some occasions attached to the cervix or os uteri, by which not only is the order of labour interrupted, the placenta being expelled before the child, but also is the patient's life exposed to much danger.

75 *a*. Where the membranes are too tender, the liquor amnii is discharged at the beginning of labour before the os tincæ be dilated, and then all the bad consequences detailed under the article *b*, Sect. I. necessarily ensue.

b. Where the membranes are too rigid, the labour may be protracted to such a period as shall injure the mother most materially, and at last, as the whole ovum may be expelled entire, the life of the child may be endangered.

After the os uteri is completely dilated, if the child included in the membranes do not advance into the cavity of the pelvis, the membranes should be ruptured. But if it do, they ought not to be broken till they press on the external parts.

c. But the most alarming deviation from nature, which can proceed from the state of the secundines, is that which originates from the attachment of the placenta over the cervix or os uteri. As there can be no doubt that the uterine vessels dip into the substance of the placenta, and that they are lacerated when the placenta is separated from its attachment, it is obvious that in such a situation hæmorrhagy to a most dangerous extent must unavoidably ensue during the process of the labour.

76 Mr Rigby of Norwich was the first British practitioner who publicly explained this cause of hæmorrhagy. In the first edition of his work; viz. that published in 1775, he expresses himself in the following words. "But from the uncertainty with which (as before observed) nature fixes the placenta to the uterus, it may happen to be so situated, that when the full term of pregnancy is arrived, and labour begins, a flooding *necessarily* accompanies it, and without the intervention of any of the above *accidental* circumstances; that is, when it is fixed to that part of the womb which always dilates as labour advances, namely, the collum and os uteri, in which case it is very certain that the placenta cannot, as before described, remain secure till the expulsion of the child, but must of necessity be separated from it, in proportion as the uterus opens, and by that means an hæmorrhage must *unavoidably* be produced.

"That floodings, which arise from these two different causes, which I will distinguish by the names of *accidental* and *unavoidable*, though they may appear exactly similar in their first symptoms, should terminate very differently, if left to nature, assisted only by the palliative means before mentioned, cannot seem strange; nor can it be a doubt, that of these two kinds of floodings, only one of them, namely, that which is produced by an accidental separation of the placenta, can be relieved by the use of these palliatives; and that the other, in which the placenta is fixed to the os uteri, and the flooding is therefore *unavoidable*, cannot possibly be suppressed by any other method whatever than the timely removal of the contents of the womb; for supposing the discharge to be for a while restrained by bleeding, medicine, cool air, &c. it will inevitably return, when nature is so far recovered as again to bring on labour: in the first case, if the hæmorrhage have been checked by the use of the above means, it is not impossible but labour may come on, and the child be safely expelled by the natural pains before it returns; or if it should return, it may not increase in quantity; as in this case very probably the separated part of the placenta which occasions the discharge remains nearly the same; whereas in the other case, in which the dilatation of the os uteri produces the separation of the placenta, every return of pain must be a return of the bleeding, and it must become greater and greater as the uterus opens more and more, and the placenta is in proportion detached, till it increases to a degree that exhausts the patient, and she dies before nature has been able to expel the child. That such must inevitably be the progress and event of floodings arising from such a cause, if left to nature, is too obvious further to be insisted on.

"That this attachment of the placenta to the os uteri is much oftener a cause of floodings than authors and practitioners are aware of, I am from experience fully satisfied, and so far am I convinced of its frequent occurrence, that I am ready to believe that most, if not all of those cases which require turning the child are produced by this unfortunate original situation of it (L)."

No case in practice requires more decision and more attention than this. It must be obvious that no internal remedy can be of any avail in flooding from such a cause, and that the life of the patient can be saved by immediate delivery alone, whenever considerable hæmorrhagy takes place. But it is to be recollected that the discharge in many instances threatens for days or even weeks before it becomes serious, and that for the sake of the child, the patient should be allowed to advance as near as her own safety will permit to the full period. These threatenings may often be removed by astringent injections, per vaginam, while at the same time every means of moderating the circulation of the blood should be suggested. 77

But whenever the discharge becomes profuse, delivery by art is to be had recourse to. The rule of Mr Rigby, and of some other eminent practitioners, "to watch from time to time the dilatability of the os uteri," and take advantage of that state, sounds well; but

(L) Essay on the Uterine Hæmorrhagy which precedes the delivery of the full-grown Fœtus, illustrated by cases by Ed. Rigby, London 1775, p. 14. Vide also 3d edition 1784, same page.

but if followed in practice, muſt either give ſuch a ſhock to the woman's conſtitution, as ſhall end in dropſy or maraſmus, or muſt prove immediately fatal. In all thoſe caſes the os uteri may be forced, and although it be not more open than barely to admit the introduction of the finger, it may in a very few minutes, if the operator have ſteadineſs and perſeverance, be rendered capable of allowing the hand to paſs.

If poſſible, the hand ſhould be carried forward at one ſide of the placenta, for if that part be torn (which it muſt be admitted is ſometimes inevitable) the infant muſt be deſtroyed. After the feet are brought down, the child is to be extracted as expeditiouſly as regard to its ſafety will permit, and the hand is then to be again paſſed into the uterus for the purpoſe not merely of detaching completely the ſecundines, but chiefly of ſecuring the contraction of that organ which is the great object of the delivery.

78 Sect. III. *Of the Deviations from Natural Labour, which proceed from the ſtate of the Child.*

The regular proceſs of parturition may be interrupted, in conſequence of the poſition and of the ſhape of the child.

79 1. *Poſition of the child.* The moſt natural poſition of the child, at the beginning of labour, is with the head placed at the brim of the pelvis, the face towards the ſacro-iliac ſynchondroſis of one ſide, and the occiput towards the groin of the oppoſite ſide. But there are many deviations from this natural poſition.

80 *a.* Although the head be applied to the brim of the pelvis, it may be forced with the ſinciput towards the promontory of the ſacrum, and the occiput towards the ſymphyſis pubis. In this ſituation the largeſt diameter of the head is oppoſed to the ſmalleſt of the pelvis, conſequently the head remains firmly fixed in that poſition, for as the ſinciput cannot advance a point beyond the promontory of the ſacrum, the occiput is forced juſt ſo much below the brim at the pubis as to wedge the head firmly between the ſacrum and pubis. By the long-continued preſſure the ſoft parts become much ſwelled, and at laſt the head is found ſo immoveably fixed, that it can neither be made to recede, nor can it advance in the ſame direction. This conſtitutes what has been ſtyled the *caput incuneatum*, or, as it is called by French practitioners, *la tête enclavèe.* This caſe moſt commonly is the effect of miſmanagement; for if a very little preſſure be made on the head when it preſents at the brim of the pelvis in this unfavourable poſition, the pains will readily force it into the paſſage in the proper direction.

When the locked head has actually taken place, the practice muſt be varied according to the circumſtances of the individual caſe; hence the long forceps, and ſometimes even the crotchet, are required. Turning is quite inadmiſſible, and the three-bladed forceps ſo ſtrenuouſly recommended by Dr Leake, in this caſe are totally inapplicable.

81 *b.* The long diameter of the head may alſo be applied to the ſhort diameter at the brim, in a different manner, viz. with the face towards the pubis, and the occiput to the baſe of the ſacrum. The obſtacles to the progreſs of the head are not in this caſe ſo great as in the former (*a*); for as the occiput is round, and its ſurface inconſiderable, while at the ſame time the promontory of the ſacrum is round, the labour throes, after ſome time, force the occiput either a little to one ſide, or at leaſt paſt the promontory. The caſe, however, is tedious, painful, and even dangerous to the patient; for as the face preſents a larger ſurface to the pubis than the occiput, it muſt require longer time to paſs, and as there are many inequalities on the face, the patient muſt ſuffer much pain from their preſſure, and from the ſame circumſtance muſt incur the hazard of having the urinary bladder or the urethra irreparably injured.

In this caſe Profeſſor Saxtorph remarks, "vel occiput primo deſcendit, quod cum accidit, frons ab oſſibus pubis ſuſtentata elevatur, mentumque pectori infantis imprimitur, urgentibus porro doloribus, verſus anum et perinæum, adagitur acuminatum occiput, et nullo modo ſub arcu oſſium pubis extorqueri poteſt inflexile ſinciput, hinc partus in exitu pelvis impoſſibilis redditur." 82

That this is a miſtake, the obſervation of other practitioners has ſufficiently demonſtrated; for it is well known that in ſuch caſes, after the perinæum has been much ſtretched the occiput is forced through the parts, and immediately ſlips back towards the anus, while the nape of the neck being applied to the anterior edge of the perinæum, moves on it as on an axis, ſo that the ſinciput and face emerge from under the ſymphyſis pubis, the chin leaving the top of the thorax in the ſame manner as if the face were ſituated naturally in the hollow of the ſacrum.

Although in this caſe the natural efforts moſt ordinarily complete the proceſs, yet in many inſtances the injury which threatens the urinary bladder renders the application of the forceps expedient.

c. Although the head may have entered the pelvis in the moſt natural poſition, yet it may not make thoſe changes in ſituation which are required to accommodate it to the outlet; for the face may turn under the ſymphyſis pubis inſtead of into the hollow of the ſacrum. When this happens the phenomena already deſcribed (*b*) take place. 83

d. It ſometimes happens, that inſtead of the ſmooth part of the cranium being forced firſt into the pelvis, the face preſents. In this caſe it may be ſituated in three poſitions, viz. with the chin to the ſacrum, or pubis, or ſide. 84

aa. The firſt caſe is eſteemed the moſt dangerous both for the mother and child. For the mother, becauſe the child in this poſition requires more room than the pelvis affords, conſequently the ſoft parts in contact with the chin and ſmooth part of the cranium are much compreſſed, and hence if the delivery be not ſpeedily accompliſhed, much injury to thoſe parts will enſue. As the chin too muſt paſs along a curved line formed by the ſacrum and coccyx, the obſtacles to delivery are very great; and even after the face has been forced ſo low as to preſs on the perinæum, that part is in much hazard of being torn by the violent diſtenſion which it undergoes. The delivery in ſuch caſes is very rarely accompliſhed naturally.

This ſpecies of labour is equally dangerous to the child as to the mother, not only on account of the long-continued preſſure on the brain, but alſo from the occiput being forced ſo ſtrongly on the ſuperior dorſal vertebra that the free return of the blood from the head is

 interrupted,

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interrupted, and hence apoplexy enſues; a circumſtance which is proved even by the appearance of children who in ſuch caſes are born alive, for the face of ſuch children is perfectly livid. Jacobs has pointed out theſe dangers pretty accurately. “ Il eſt dangereux pour l’enfant, (he ſays), parce que la tête etant penchèe et portant ſur ſon cou, elle comprime les vaiſſeaux ſanguins au point que le ſang ne pouvant plus circuler, il meure d’une apoplexie pour peu que l’on tarde à l’extraire.” *Ecole pratique des Accouchemens, par le Profeſſeur J. B. Jacobs. A Paris*, 1785. p. 366.

bb. The ſecond caſe, viz. where the chin is placed towards the pubis and the ſinciput to the ſacrum, is neither ſo dangerous for the mother nor child. For if by the force of the pains the face be puſhed ſo far forward that the chin becomes engaged within the arch of the pubis, then the inferior edge of the ſymphyſis pubis forms a fulcrum on which the inferior jaw moves, by which the ſinciput and occiput paſs readily and eaſily along the hollow of the ſacrum, their ſurface being well adapted to that of the ſacrum, and the ſeveral parts of the face paſs in ſucceſſion through the vulva.

cc. The third caſe, viz. where the chin is to one ſide, is ſtill more favourable than the ſecond; for the face paſſes readily through the oblique diameter of the pelvis till ſtopt by the tuberoſities of the iſchia, when the chin turns into the arch of the pubis, and then the ſame phenomena which occur in the ſecond caſe take place.

The cauſe moſt generally aſſigned for face caſes is the ill directed exertion of the propelling powers. May it not alſo depend in many caſes on the original poſition of the fœtus?

When any extraordinary difficulty occurs in face-caſes, Lowder’s lever is the inſtrument to which recourſe ought to be had. The forceps, as recommended by Smellie and others, being quite inſufficient to afford a ſafe and ſecure hold of the infant.

85 *e.* On ſome rare occaſions the ſide of the head preſents, ſo that one ear is in the centre of the pelvis. In ſuch a caſe, the ſtrongeſt contractions of the uterus cannot make the head enter the pelvis, and the woman would generally die undelivered were it not for the interference of art. Caſes of this kind are remarkably rare

The hand of the operator muſt be carried up in ſuch caſes, and moderate preſſure muſt be made in ſuch a direction as ſhall allow the contractions of the uterus to puſh the ſmooth part of the cranium into the cavity of the pelvis.

86 *f.* The head of the child is not the part always applied to the pelvis; for ſometimes the head paſſes laſt. Whenever any other part than the head preſents, the labour is ſtyled by authors *preternatural.*

All preternatural labours have been divided into two orders. A. Preſentations of the inferior extremities; and B. Preſentations of the ſuperior extremities.

A. Preſentations of the lower extremities comprehend caſes where one or both feet, one or both knees, and the breech preſent.

87 *g.* Caſes where both feet preſent are more frequent than thoſe where one only preſents. It has been calculated that the feet preſent once in 105 caſes of labour.

Some authors have divided labours of this kind into a great variety of ſpecies. There is, however, no neceſſity for ſuch diviſions, and they tend to miſlead and embarraſs practitioners. All the varieties may be reduced under three heads; for the toes muſt be either towards the ſide of the pelvis, or towards the ſacrum or pubes.

dd. Where the toes are towards the ſide of the pelvis, the child is generally placed in ſuch a manner that the abdomen, breaſt, and face paſs in ſucceſſion along the ſacro-iliac ſynchondroſis of that ſide. This is the moſt favourable ſituation in which the child under ſuch circumſtances can be placed; for the largeſt parts of its body paſs through the largeſt aperture of the pelvis.

In this caſe, then, the action of the uterus forcing forward the child, the feet are by degrees excluded through the external parts, the toes being ſituated between the point of the coccyx and the tuberoſity of the iſchium; the thighs follow, then the abdomen and thorax; but the farther progreſs of the child is for ſome time interrupted by the arms paſſing up along each ſide of the head, which add conſiderably to its bulk; at laſt, however, the repeated contractions of the uterus force the face into the hollow of the ſacrum, and then the nape of the neck turning on the inferior edge of the ſymphyſis pubis as on a pivot, the face is excluded, followed by the ſinciput and occiput.

Where the efforts of nature in this proceſs are ſolely truſted, the child, unleſs it be ſmall and the pelvis be very capacious, while the ſoft parts are much relaxed, is generally ſtill-born; for before the obſtacles to the delivery of the head be overcome, the long-continued compreſſion of the funis umbilicalis, by intercepting the courſe of the blood, proves fatal.

ee. Authors have generally conſidered that to be the moſt favourable poſition in which the feet can preſent, where the toes are towards the ſacrum. Roederer for example ſays, “ pedum tunc digiti ſi oſſi ſacro obvertantur, fœtus abdomini incumbens recte ſitus eſt (L).” But two diſadvantages attend this poſition: Firſt, the largeſt part of the child’s body is forced through the ſmalleſt part of the outlet of the pelvis; and 2dly, The longeſt diameter of the head is applied to the ſhorteſt diameter of the brim of the pelvis. In ſuch caſes, therefore, the patient commonly ſuffers much pain, and the child’s life is deſtroyed.

ff. When the toes are turned to the pubes, it has been univerſally acknowledged, that the feet are in the worſt poſſible poſition. Indeed not only do the diſadvantages ſtated as reſulting from the laſt poſition (*ee*) equally take place in this one, but another cauſe of difficulty and danger is added, viz. that the face being applied to the pubes, the progreſs of the child muſt be impeded in no inconſiderable degree. Hence in ſuch a caſe the patient may be very much injured, and the child muſt be almoſt inevitably loſt.

The management of footling caſes was firſt explained, in as far as we know, in Dr Hamilton’s Select Caſes in Midwifery, p. 89.

“ It

(L) Roederer Elementa Artis Obſtetricæ, p. 249.

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" It is a curious circumſtance that the beſt mode of delivery in footling caſes has not yet been explicitly pointed out by any author. This muſt appear ſurpri-
88 ſing when it is conſidered that ſuch preſentations frequently occur; that the life of the child depends upon the practice adopted; and that the management of every preternatural labour muſt be influenced by the rules applicable to footling caſes.

" When the feet preſent, the infant's ſituation relatively to the mother muſt be with its belly placed towards her back, her belly, her ſide, or ſome intermediate point. The firſt of thoſe poſitions has been generally conſidered as the moſt favourable, and the laſt as the reverſe. But a little reflection muſt convince every practitioner that the infant occupies the leaſt poſſible ſpace, when its belly is towards the ſide of the mother, or, to ſpeak more accurately, towards the ſacro-iliac ſynchondroſis; for then the largeſt part of its body is within the largeſt diameter of the pelvis at the brim, while in its progreſs through the pelvis, the breech is not forced through the ſhorteſt diameter at the outlet, viz. that between the tuberoſities of the iſchia.

" In every caſe therefore where the feet are brought down, the toes ſhould in the proceſs of extraction be turned into ſuch a poſition, that the belly, the breaſt, and the face, ſhall be made to paſs in ſucceſſion along the neareſt ſacro-iliac ſynchondroſis. After the arms are diſengaged, the face can be readily turned into the hollow of the ſacrum."

89 *h*. One foot may preſent in the ſame variety of directions as both feet. Where one foot preſents naturally, if the pains be regular and ſtrong, the caſe is attended with leſs pain to the mother and leſs danger to the child, than where under the ſimilar circumſtances both feet preſent. It it leſs painful to the mother, becauſe the child is formed into the ſhape of a cone, and the apex paſſes firſt through the pelvis, by which the parts are gradually prepared, and not ſuddenly forced open; and, it is leſs dangerous for the child, becauſe the one leg being folded along the belly and breaſt, the umbilical cord is protected from compreſſion.

From theſe circumſtances, a very erroneous inference has been deduced by ſome celebrated authors, viz. that in caſes where it is neceſſary to perform the operation ſtyled turning, the one foot ſhould be brought down in preference to both. But as on ſuch occaſions the operator cannot be aſſiſted by pains, it is obvious that he could not have a ſufficient hold of the child by a ſingle foot.

With the exceptions juſt ſtated, the phenomena where one foot preſents are the ſame with thoſe which occur in caſes where both feet are in the paſſage.

90 *i*. When the knees preſent, all the inconveniences of footling caſes take place, with this additional danger to the child, that if the legs be croſſed, one or both may be fractured before the knees be expelled.

The management of knee preſentations muſt depend on the advance which theſe parts have made at the time aſſiſtance is procured. If they be ſtill at the brim of the pelvis, the feet ſhould be hooked down. But if they be fairly within the cavity of the pelvis, or in the vagina, they muſt be allowed to protrude without the parts until the feet be expelled.

91 *k*. Breech caſes occur more frequently than footling ones. It has been calculated that they happen once in 52 caſes of labour.

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The breech may preſent in the ſame variety of poſitions as the feet, viz. with the belly of the child to the back, to the belly, or to the ſide of the mother. Certain advantages and diſadvantages attend each of thoſe poſitions.

When the belly is to the back of the mother, the thigh bones being ſtraight, paſs with difficulty along the curved line of the ſacrum; after that obſtacle is ſurmounted, the largeſt part of the child is applied to the ſmalleſt diameter at the brim of the pelvis; and after the body is delivered, the head is ſituated in ſuch a direction that it cannot enter the brim; for the ſinciput is oppoſite to the promontory of ſacrum and the occiput to the ſymphyſis pubis.

If the belly of the child be to the belly of the mother, then the thigh bones paſs very readily along the bones of the pubes, while the ſpine bending, accommodates itſelf admirably to the hollow of the ſacrum, conſequently at firſt the labour proceeds ſpeedily and ſafely; but after the breech has paſſed through the cavity of the pelvis, it is applied with its largeſt diameter to the ſhorteſt diameter at the outlet, and after it has at laſt overcome the reſiſtance occaſioned by that circumſtance, and the body is expelled, the face, being towards the ſymphyſis pubis, ſubjects the patient to all the pain, and the child to all the dangers, already enumerated (*ff*).

When the belly of the child is placed towards the ſide of the mother in breech caſes, then the ſame advantages attend the ſituation which have been enumerated under the firſt footling caſe (*dd*); for the largeſt part of the child is uniformly applied to the largeſt aperture of the pelvis. Beſides this, the child incurs leſs hazard in this poſition than where the feet originally preſent; for the legs being folded on the belly protect the the funis umbilicalis from compreſſion.

Breech caſes, where the pains are powerful, are to be left entirely to nature, taking care to ſupport the perinæum, till the infant be expelled; the navel-ſtring is then to be taken off the ſtretch, and the child accommodated to the paſſage on the ſame principle as footling caſes.

When the pains prove inadequate to the expulſion of the breech, various methods have been recommended, ſuch as hooking the finger in the groin, firſt on the one ſide, and then on the other; employing a blunt hook for the ſame purpoſe; fixing a garter or piece of tape over one or both thighs, and applying the forceps.

The firſt of theſe methods is uſeful where there are ſlight pains, and the infant is not large. The ſecond and third methods are injurious both to the mother and child, for they add to the vis à tergo, without diminiſhing the reſiſtance. But the fourth method, that is, applying the forceps, is invariably both ſafe and ſucceſsful; becauſe, while it enables the practitioner to draw forward the child without any uterine action, it at the ſame time puts it in his power to accommodate it to the paſſage by turning it round in the proper direction.

B. The ſecond diviſion of preternatural labours, in-
cludes all caſes where any other part than the head 92
or lower extremities preſents; ſuch as the neck, the arm or ſhoulder, the breaſt, the back, the belly or the ſide.

It

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It is obvious, that a full-grown child cannot poſſibly be expelled through the natural paſſages in ſuch poſitions, and conſequently, unleſs nature perform the operation firſt deſcribed by Dr Denman, both mother and child muſt be deſtroyed; for the unavailing contractions of the uterus will firſt operate in impeding the circulation of the child; and then by puſhing forward its body with great force on the ſoft parts of the mother, will induce ſuch a degree of pain and inflammation, that ſhe muſt at laſt ſink exhauſted.

93 The practice of turning, as it is called, that is, of bringing down the feet in caſes belonging to this diviſion of preternatural labours, originally ſuggeſted by Pierre Franco, but firſt properly eſtabliſhed by Ambroſe Parrè, has been the means of ſaving many valuable lives. Indeed the ſuperiority of this practice to that of making the head preſent under ſuch circumſtances muſt be very obvious; for after the operator has got hold of the infant's feet, he can complete the delivery without requiring the aſſiſtance of pains.

The dangers to be dreaded in performing the operation of turning are rupture of the uterus, or ſubſequent inflammation of the paſſages, and loſs of the child.

The firſt of theſe, is to be guarded againſt, by purſuing ſuch means as ſhall ſuſpend the labour-pains, and remove the uterine ſtricture, when the opportunity of turning before the diſcharge of the water which ſurrounds the infant has been loſt. Theſe are blood-letting and opiates in large doſes, ſingly or combined, according to circumſtances.

Great gentleneſs and caution, on the part of the operator, are indiſpenſibly requiſite to prevent both rupture of the uterus and the ſubſequent inflammation of the paſſages. When it is added, that a perſeverance for ſeveral hours is ſometimes neceſſary for accompliſhing this operation, it muſt be obvious, that it demands in many inſtances a greater degree of patience, as well as dexterity, on the part of the operator, than moſt caſes of ſurgery.

The ſafety of the infant, can only be ſecured, by attending very accurately to the rules for the management of footling caſes.

94 Dr Denman, whoſe diſcovery of the ſpontaneous evolution has been already mentioned, at one time ſuppoſed that in the caſes under conſideration, the operation of turning might be diſpenſed with, and that the patient might be ſaved much hazard, and the practitioner great anxiety and trouble, by waiting for that change.

But although in the later editions of his valuable work (Introduction to Midwifery), he has relinquiſhed this idea, his obſervations on the management of preternatural labour of the ſecond order, are evidently influenced by his former opinion.

He ſays (vol. ii. p. 249.), " Yet the knowledge of this fact, however unqueſtionably proved, does not free us from the neceſſity and propriety of turning children preſenting with the ſuperior extremities, in every caſe in which that operation can be performed with ſafety to the mother or give us a better chance of ſaving the child. Under ſuch circumſtances, the inſtructions given by former writers, and the obſervations we have before made, muſt ſtill be conſidered as proper to guide our conduct. But when we are called to a patient with a preternatural labour, in which there is no room to hope for the preſervation of the child, or in which we are aſſured of its death, or when the operation of turning cannot be performed without violence and ſome danger to the mother, then the knowledge of this probability of a ſpontaneous evolution, will ſet our minds at eaſe, and diſengage us from the conſideration of making any haſty attempts to perform a hazardous operation, from which no poſſible good can be derived, except that of extracting a dead child, and which at all events might be effected by a method much more ſafe to the mother.

" The time required for the ſpontaneous evolution of the child, and the facility with which it may be made, will depend upon a variety of circumſtances, but chiefly upon the ſize of the child, the aptitude of its poſition, the dimenſions of the pelvis, and the power exerted by the uterus. If the child be very large or much below the common ſize, the ſlower I believe will be the evolution, nor can it be made at all without a ſtrong action of the uterus. It is poſſible, therefore, when we have conducted ourſelves on the ground of expectation that the evolution would be made, that the pains may fall off or be unequal to the effect, and we may be diſappointed. It might then be apprehended, that the difficulty of extracting the child would be infinitely increaſed. But though the evolution was not perfected, I have not found this conſequence; for the child, though not expelled, has been brought into ſuch a ſtate that I could afterwards paſs my hand with eaſe, and bring down its feet, though in an attempt to do this at the beginning of the labour I had been foiled. In one caſe in which the evolution did not take place, I could not bring down the inferior extremities, but I had no difficulty in fixing an inſtrument upon the curved part of the body of the child, or in bringing it away with entire ſafety to the mother. It was before preſumed that the child was dead, and the ſole object was to free the mother from her danger; and with her ſafety no appearances of the child, however diſagreeable, are to be put in competition. In caſes of this kind another mode of practice has been recommended, that of ſeparating the head from the body with a blunt hook or other convenient ſafe inſtrument; but as I have never practiſed the method, I give the deſcription of it in a note."

There are two points in the above obſervations, in which it appears that Dr Denman has erred. In the firſt place, in ſanctioning delay in having recourſe to the operation of turning where the ſuperior extremity preſents. In many ſuch caſes, if the pains be not ſpeedily ſuſpended, or the poſition of the child altered, the uterus would burſt; an accident which has repeatedly fallen under the obſervation of the writer of this article. 95

The ſecond error is, the ſuppoſition that, after it has been found by experience in any given caſe, that the ſpontaneous evolution is not to happen, it is eaſy to extract the child either by the feet or by ſome inſtrument. But it will be found in the majority of ſuch caſes, that the infant is impacted into ſo cloſe a body, while the parts are all in a ſtate of ſwelling and inflammation, that immenſe difficulty and great danger attend the attempt.

The following obſervations on this ſubject cannot be too ſtrongly impreſſed on the minds of, eſpecially young, practitioners.

" Several

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"Several years ago it was discovered by Dr Denman, that in presentations, such as that in the above case, the position of the child is sometimes altered, and
96 its expulsion accomplished, by the natural contractions of the uterus. Although the doctor, with his usual candour, has allowed, that this favourable event, under such alarming circumstances, is rather to be wished than expected; yet he has offered it as his opinion, that if all interference of art were avoided, "the woman would not, in this case, die undelivered."

"The preceding history, however, affords a melancholy contradiction to this opinion. The midwife, who attended from the beginning, did nothing to interrupt the natural process, as far as could be learned. Her fatal error was having only looked on, and having neither given that assistance which was necessary, nor sent for others who could do so.

"The spontaneous evolution, as Dr Denman has called it, can only take place where the child lies in a particular situation, viz. where the action of the uterus cannot be exerted on the presenting part, or where that part is so shaped that it cannot be wedged within the pelvis. A practitioner may, therefore, by a careful examination, be able to decide whether the evolution will happen or not. This observation is by no means a matter of speculation, being, on the contrary, of much practical utility; for, if there be signs which indicate the event alluded to, it follows, as a consequence, not only that the natural process is not to be counteracted, but also, that it is to be assisted. Two cases occurred during one year, where the author of these remarks had an opportunity of prognosticating and assisting the evolution, in presence of two gentlemen then attending the professor of midwifery, as annual pupils.

"That the uterus should continue rigidly contracted on the body of the child, while the strength of the woman was so much exhausted that no pulse could be felt, and that she appeared sinking very fast, is a singular and an instructive fact. It will, it is to be hoped, teach practitioners the fallacy of the assertion, *that the longer the operation of turning is delayed, the more easily it will be accomplished.*

"It may seem astonishing, that the body of the child could not be drawn down with the crotchet, since it was in a state of great putridity: But when it is considered, that the long-continued action of the uterus had wedged it very strongly within the pelvis, while, at the same time, the pressure on the soft parts lining that cavity had swelled them much, the circumstance will be readily understood. (N)"

97 Authors have endeavoured to ascertain the causes of preternatural labours; but little satisfaction has been derived from their researches. It is probable, that some cases depend on different causes from others. For example, in some women preternatural labour occurs more than once. Such cases seem to depend on some peculiarity in the uterus or ovum. Again, it is well known to practitioners of midwifery, that, on some occasions, where the child had been found to present naturally at the commencement of labour, the position is perceived to be preternatural after the first stage is completed (O). In these cases, the change of position may perhaps be justly attributed to irregularity of action of the uterus. Besides, there can be little doubt that some cases of preternatural labours originate from the premature rupture of the membranes.

2. The bulk of the fœtus also occasions considerable deviations from nature in labour; for it may be either too small or too large. 98

l. The fœtus, at the full period of gestation, is never of so small a size as to occasion any deviation from nature, unless it have been for some time dead. It is indeed a very remarkable fact, that women often carry to the full time a fœtus which had died about the fifth or sixth month.

In such cases, the child is sometimes expelled so rapidly, the passages opposing little or no resistance, that the uterus is suddenly emptied of its contents; and hence, from the irregularity of its contraction, the placenta is retained, or uterine hæmorrhagy takes place.

m. The patient, however, is exposed to more dangers from the increased than the diminished bulk of the fœtus. The fœtus may exceed the ordinary size, either from a natural increase of bulk, or from monstrosity, or from disease. 99

k k. It has been already stated that the fœtus at the full term of gestation, generally weighs from seven to nine pounds; but on some rare occasions it is found to exceed ten or twelve pounds, or even thirteen. Although, however, the process of delivery is not so rapid where the child is so large, yet if no other circumstance occurs to impede labour, it will be eventually terminated with safety both to mother and child in most cases. Where indeed, under such circumstances, the patient has not formerly had a child, there is always reason to apprehend that the infant may be destroyed by apoplexy, or the mother may be very much bruised. In some cases of this kind, it becomes necessary to open the head of the infant.

l l. When the child is monstrous, from the redundancy of some large parts, as from two heads or two bodies, it is sufficiently obvious that if the mother be at the full term of gestation, the obstacles to delivery will be insurmountable by the natural powers. Fortunately, however, in by far the greatest number of cases of monsters of that kind, the action of the uterus is excited before the ordinary period.

m m. The most frequent disease of children, which proves an obstacle to labour, is the enlargement of the head from hydrocephalus. On some occasions the head is enlarged to an extraordinary size.

Sometimes too, the thorax or abdomen is distended and enlarged by a watery fluid. Professor Saxtorph has recorded the following example of an obstacle to delivery from a very uncommon disease. "D. 18. Sept. 1775. in domo obstetricia regia, mox paritura admittebatur gravida. Instante partus principio dolores partus veri debito modo alternantes, sed solita proportione vehementia, duratione et celeriori recursu infligebant. Rite tendebatur 100

(N) Select Cases in Midwifery, p. 110.
(O) Vide Denman's Introduction, vol. ii. p. 254.

tendebatur orificium poſteriora verſus inclinans; juſta erant capitis ſitus, directio et aquarum formatio; pelvis parteſque molliores, viam partus conſtituentes, nullo laborabant vitio; quibus omnibus acceſſit adhuc ſanus et robuſtus corporis feminei habitus, et partus aliquoties antea perpeſſi felix eventus, quæ indubie ominabantur inceptum hocce negotium partus feliciter quoque finiendum fore. In progreſſivo rite procedebat partus.

"In fine vero capite ſponte nato, truncus ſolita facilitate ſequi nolebat, quare obſtetrix in arte adhuc novitia conſtitutam domus obſtetricem expertem ſatis ſociam ſibi advocabat.

"Corpore fœtus ad latus revoluto, ut humeri in majore diametro aperturæ pelvis inferiori minorem facerent reſiſtentiam, brachiiſque eductis, junctis viribus truncum ad axin pelvis extrahere moliebantur; attamen obſtabat abdomen nulla illarum vi ulterius cedens.

"In auxilium tunc accedens, qui domum iſto tempore artem addiſcendi gratia habitabat ſtudioſus, manum ſub abdomine prudenter intulit, quod tenſum atque complanatum ſine omni obſtaculo inveniebat; ulterius vero manum protrudens pedes tetigit, interque crura tumorem ingentem tenſum fluidoque contento plenum reperiebat.

"Compreſſa hocce tumore, dum adſtantes omni vi truncum ſimul attrahebant, diſrumpebatur ſubito, inſigniſque aquæ copia effluxit; ſuperato ſic obſtaculo, facillime extrahebatur fœtus, vitam per biduum trahens.

"Fœtus poſtea examinatus fæmellus erat, ingentem ſaccum inter femora gerens, qui ex elongatione integumentorum univerſalium corporis a tergo verſus anteriora ita protractorum, ut orificium ani ex facie anteriore corporis prope vulvam conſpiceretur, ortum habebat. In ipſo ſacco poſt effluxionem humoris, aquæ fere lib. iv. capiente, nihil præter hydatides parvas obſervatu dignum erat. Os ſacro vero, ad angulum rectum verſus poſteriora curvatum caudæ inſtar prominebat." (L)

101 Sect. III. *Of the Deviations from Natural Labour, which depend on the State of the Paſſages through which the Child is forced.*

The deviations from natural labour occaſioned by the ſtate of the paſſages, originate either from the ſoft parts, or the bones.

The obſtacles from the ſoft parts are tumours within the womb, thickening and induration of the neck and mouth of the womb, enlargement of the ovary, cicatrix in the vagina, collection of fæces within the rectum, ſwelling of the parts lining the pelvis, malformation and extreme rigidity of the external parts.

It is a curious fact, not only that conception ſometimes takes place when there is a tumour within the womb, but alſo that pregnancy goes on to the full period. When this has happened, the tumour has been puſhed down before the infant, and has filled up the paſſages.

If this obſtacle be aſcertained at an early period of the labour, which it muſt be if the practitioner be in any ordinary degree ſkilful and attentive, the tumour may be puſhed back, and the feet of the child may be brought down. In a caſe of this kind, where the writer of this article was called in after the tumour had become wedged within the pelvis, and the head had been opened, the delivery was accompliſhed with extreme difficulty, and the poor woman ſurvived only a few hours.

The following ſingular caſe of an excreſcence on the os uteri, is ſtated by Dr Denman, vol. ii. p. 65.

"In June 1770, I was deſired to ſee a patient in the 102
eighth month of her pregnancy, who in the preceding night had a profuſe hemorrhage. Her countenance ſhewed the effects of the great loſs of blood ſhe had ſuſtained; and from the repreſentation of the caſe given me by the gentleman who was firſt called in, I concluded that the placenta was fixed over the os uteri. On examination I felt a very large fleſhy tumour at the extremity of the vagina, repreſenting and nearly equalling in ſize the placenta, which I judged it to be. Had this been the caſe, there could not be a doubt of the propriety and neceſſity of delivering the patient ſpeedily; and with that intention I paſſed my finger round the tumour, to diſcover the ſtate of the os uteri. But this I could not find, and on a more accurate examination, I was convinced that this tumour was an excreſcence growing from the os uteri, with a very extended and broad baſis. I then concluded that the patient was not with child, notwithſtanding the diſtention of the abdomen, but that ſhe laboured under ſome diſeaſe which reſembled pregnancy, and that the hemorrhage was the conſequence of the diſeaſe. A motion which was very evidently perceived when I applied my hand to the abdomen, did not prevail with me to alter this opinion.

"It was of all others a caſe in which a conſultation was deſirable, both to decide upon the diſeaſe, and the meaſures which it might be neceſſary to purſue; and ſeveral gentlemen of eminence were called in. That ſhe was actually pregnant, was afterwards proved to the ſatisfaction of every one; and it was then concluded, that ſuch means ſhould be uſed as might prevent or leſſen the hemorrhage, and that we ſhould wait and ſee what efforts might be naturally made for accompliſhing the delivery.

"No very urgent ſymptom occurred till the latter end of July, when the hemorrhage returned in a very alarming way, and it was thought neceſſary that the patient ſhould be delivered. There was not a poſſibility of extirpating the tumour, and yet it was of ſuch a ſize, as to prevent the child from being born in any other way than by leſſening the head. This was performed; but after many attempts to extract the child, the patient was ſo exhauſted, that it became neceſſary to leave her to her repoſe, and very ſoon after our leaving her, ſhe expired.

"We were permitted to examine the body. There was no appearance of diſeaſe in any of the abdominal viſcera, or on the external ſurface of the uterus, which was of its regular form; and when a large oval piece was taken out of the anterior part, the child, which had

(L) Vide Societatis medicæ Haumenſis Collectanea, vol. 2d, p. 23.

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had no marks of putrefaction, was found in a natural position. An incision was made on each side of the cervix to the vagina, and then a large cauliflower excrescence was found growing to the whole anterior part of the os uteri. The placenta adhered with its whole surface; so that the blood which she had lost must have been wholly discharged from the tumour (M)."

103 In two cases, where a great thickening and induration of the neck and mouth of the womb, approaching to the nature of schirrosity, had taken place previous to conception, the natural action of the uterus, though after a very considerable time indeed, assisted by copious blood-letting, eventually overcame the resistance. One of the patients died ten months after, with all the symptoms of real cancer uteri. The other was restored to perfect health after lying-in.

104 Dr Denman has recorded (vol. ii. p. 73.) two cases, where the enlarged ovarium impeded the progress of the child. In the one case the head of the infant was opened, and the delivery completed by the crotchet; but the patient died at the distance of three weeks. In the other, a trocar was passed into the tumour, and a living child was born. The patient recovered from her lying-in; but died hectic at the end of six months. In such cases, the ovary may be pushed back, if the circumstance be discovered early enough.

105 Cicatrix of the vagina, in consequence of former injury, may appear at first to impede the progress of the infant; but it will always be found to yield to the pains, if the strength of the patient be supported, and proper means be adopted to counteract the effects of the long-continued labour throes. A case occurred some time ago to Dr Hamilton, where a substance, of the hardness of gristle, as thick as an ordinary sized finger, placed between the vagina and rectum, and apparently extending from the ramus of one ischium to that of the other, presented an unsurmountable obstacle to the passage of the child. He was called in after an unsuccessful attempt had been made to tear away the infant, and found the woman in a state of extreme danger. He was informed, that five years before that period, she had had a very severe tedious labour, followed by great inflammation and suppuration of the external parts. The indurated part was cut through without the patient making any complaint, and the child was very easily extracted; but she survived the delivery only two days. The relations would not permit the body to be opened.

106 A collection of fæces within the rectum has been known to occasion such resistance to the passage of the child, that the woman has died undelivered. In general, however, it is in the power of an active practitioner to empty the gut at the beginning of labour. But if, from neglect, the head of the child be jammed in the pelvis, and immoveably wedged in consequence of an accumulation of fæces, it then becomes necessary to open the head.

107 Perhaps the most frequent affection of the soft parts which impedes the process of the infant is, swelling of the parts lining the pelvis. This circumstance has been already hinted at. It can never happen where the practitioner is ordinarily attentive; for the tenderness, heat, and dryness of the passages, which precede the actual swelling, cannot be overlooked by one at all aware of the possibility of such an event. When it has actually happened, nothing can save the mother but opening the head of the infant. After this most unpleasant operation is completed, the extraction of the child is seldom a matter of much difficulty.

Malformation of the external parts in some cases does not prevent conception. Two cases have fallen within the knowledge of the writer of this article, where the woman had conceived though the orifice of the vagina had not been capable of permitting the introduction of even the little finger. And it consists with his knowledge, that about thirty years ago a woman under similar circumstances, was brought into the Royal Infirmary of this place, and was delivered by the cæsarean operation. She died within two days. 108

It is sufficiently obvious that the safe practice under such circumstances is to enlarge the natural opening, by making an incision in the direction of the pærineum, taking care not to wound the sphincter ani.

Extreme rigidity of the external parts is one of the most frequent causes of deviation which depends on the state of the soft parts. It takes place, in a greater or less degree, in the greatest number of women who lie in for the first time; and generally in all women who are considerably advanced in life before they have children. 109

It is seldom that the resistance opposed by the external parts is so very great as to prove an invincible obstacle to labour. But, on many occasions, the long-continued pressure of the child on those parts produces the most disagreeable consequences, as inflammation of all these parts and of the bladder. Inflammation in those parts is always dangerous, for there seems to be a remarkable tendency to gangrene. Cases are on record where the whole parts have sloughed off, and where the rectum, vagina, and bladder, have formed one canal. Perhaps death is much preferable to life under such circumstances.

Copious blood-letting, and the liberal use of some unctuous application, with time and patience, in general overcome the rigidity of the external parts. Placing the patient over the steams of hot water was formerly recommended in such cases, but this practice is now exploded.

B. Many deviations from natural labour occur from the state of the bones of the pelvis, for they may be so much altered in shape as either to increase or diminish considerably the aperture of that part. 110

d. When the apertures of the pelvis are too large, the mother incurs much danger, and the child is not totally exempt from hazard.

aa. The danger incurred by the mother arises from there being no resistance to the passage of the child, so that when the action of the uterus begins, the child may be pushed by the force of the pains through the passage before the soft parts be dilated; hence the uterus may be ruptured, or the soft parts lacerated. If, on

(M) Were such a case again to occur, there could be no doubt respecting the propriety of fixing a ligature round the neck of the tumour.

on the other hand, the external parts be ſoft and yielding, a conſiderable portion of the uterus may be excluded without the parts. There is a very wonderful hiſtory of a caſe of this kind alluded to by Saxtorph in the following words. "Memorabilius adhuc exemplum eſt illud à cel. Wolfg. Mullnero allatum, ubi *totus uterus* una cum fœtu extra genitalia dilapſus, fœtuſque vivus extra pelvim verſione extractus fuit, matre poſt reductionem uteri ſuperſtite. Vide ejus *Bahrnehmung von einer ſamt dem Rinde auſgefallenen Debahrmutter, Nurnberg* 1771 (L.)

111 *bb*. The hazard which the child undergoes is that of being ſuddenly expelled, included within the entire ovum, ſo that it may be loſt before proper aſſiſtance can be afforded. Another danger is, that the membranes having given way, it may be daſhed with violence upon the floor on which the patient walks. Whenever from the great width of the hips, there is reaſon to ſuſpect that the pelvis is too large, the practitioner ſhould continue in conſtant attendance from the very commencement of labour, and ſhould carefully adopt the appropriate and obvious means to prevent the hazards juſt enumerated.

112 *e*. But deficiency of ſpace in the apertures of the pelvis occurs much more frequently than increaſe. The apertures of the pelvis may be diminiſhed from natural ſmall ſize or malformation of the bones, from exoſtoſis, or from altered ſhape in conſequence of mollities oſſium.

Caſes where the ſacrum and ilia are of an uncommon ſmall ſhape are not frequent. Narrowneſs of the baſe of the ſacrum is ſometimes met with; and in a few caſes it has been found that the apex of the ſacrum has approached too nearly to the anterior part of the pelvis, ſo as to diminiſh the apertures at the outlet.

113 Exoſtoſes ſeldom prove an obſtacle to delivery; but one exception to this rule fell under the obſervation of the writer of this article ſeveral years ago. The exoſtoſis extended along the whole extent of the ſymphyſis pubis, and was fully as thick as an ordinary ſized finger. The woman had been delivered previous to his being called in, but the exhauſtion which followed, (for ſhe had been allowed to continue five days and nights in conſtant hard labour) occaſioned her ſinking a very ſhort time after delivery. In this inſtance both mother and child were loſt from the ſelf-ſufficiency and ignorance of the midwife.

The deficiency may exiſt in the brim, the outlet, or the cavity ſingly or combined.

The brim is much more frequently affected by mollities oſſium than the outlet; and, as was long ago remarked by Levret, it generally happens, that when the brim is narrowed from this cauſe, the outlet is widened.

114 The brim may be diminiſhed in ſize by the projection of the promontory of the ſacrum, or by the flattening of the pubes, or by the approximation of the bones where the pubes and ilia unite, or by a combination of ſome of theſe circumſtances. The projection of the promontory of the ſacrum, however, is by far the moſt common. When this happens, the projection ſometimes renders one ſide of the pelvis wider than the other, and this conſtitutes what authors call the diſtorted pelvis. Sometimes, however, it leaves both ſides of an equal width, and this is called the deformed pelvis.

The deficiency in the brim produced by theſe cauſes is very various; moſt frequently ſlight, but ſometimes ſo great that there is not an inch between pubes and ſacrum.

The outlet may be diminiſhed by the approximation of the tuberoſities and rami of the iſchia, or by the apex of the ſacrum and coccyx projecting more than uſually forward, while they are at the ſame time hooked up. 115

When both the brim and outlet are diminiſhed in aperture, the cavity of the pelvis is generally affected alſo; but when the deficiency of ſpace is confined to either, the cavity is commonly more ſhallow than natural, by which both the reſiſtance and the danger are conſiderably leſſened. Melancholy are the caſes where the cavity is rendered deeper than uſual. 116

As the practice in caſes of extreme deficiency in the apertures of the pelvis is to be regulated by the degree of narrowneſs, it is a matter of the firſt importance to be able to aſcertain the dimenſions in any given caſe with tolerable preciſion.

For this purpoſe, inſtruments called pelvimetres have been invented. M. Coutuoli has propoſed one for internal uſe, and M. Baudelocque has recommended one for external application. But however plauſible in theory the uſe of ſuch contrivances may appear, it is now well known that no dependence can be placed upon them in actual practice, and therefore the hand of the operator muſt be had recourſe to for determining both the ſhape and the extent of the apertures of the pelvis, wherever there is any narrowneſs. The following directions for this purpoſe given by Dr Wallace Johnſon are extremely judicious. 117

"On paſſing the finger along the vagina, if the coccyx, or any part of the ſacrum, be felt unuſually forwards or near at hand; or if the ſymphyſis, or any other part of the pubes, is found projecting rather inwards than outwards, it is evident that the pelvis is diſtorted. In which caſe, as well as in thoſe where it is not diſtorted, but only very ſmall, the principal part of the child's head (allowing the preſentation right) remains high, the vertex making only a little round tumor within the brim: ſo that when the os uteri is opened, and come a little forwards towards the pubes, the capacity of the pelvis may be found out by moving the end of the finger round that part of the head which has entered the upper ſtrait. This method is uſed by ſeveral practitioners in London. However, ſhould the finger not be long enough to effect it properly, as ſometimes is the caſe, there is then another method, which, being more certain, may be uſed, provided it be done with tenderneſs and caution, and when the orifices are ſo well opened as to admit of it with ſafety. But previous to it, the operator muſt be well acquainted with the dimenſions of his own hand, viz. 118

"Firſt,

(L) Diſſertatio Inauguralis de Diverſo Partu, &c. Auctore Matth. Saxtorph. p. 46.

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"Firſt, The fingers of a middle-ſized hand (as we may ſuppoſe the operator's to be) being gathered together equally into the palm, and the thumb extended and applied cloſely along the ſecond or middle joint of the finger; the diſtance between the end of the thumb, and outer edge of the middle joint of the little finger, is uſually four inches.

"Secondly, Whilſt they are in the above poſition, the diſtance from the thumb, at the root of the nail, in a ſtraight line to the outſide of the middle joint of the little finger, is full three inches and a half.

"Thirdly, The fingers being ſtill in the ſame ſituation, and the thumb laid obliquely along the joints next the nails of the firſt two fingers, and bent down upon them; the diſtance between the outſide of the middle joint of the fore finger, and the outſide of that of the little finger is three inches and a quarter.

"Fourthly, The hand being opened, and the tops of the four fingers being a little bent, ſo as to come nearly in a ſtraight line; their whole breadth, acroſs the joint next the nails, is two inches and a half.

"Fifthly, When the firſt three fingers are thus bent, their breadth acroſs the ſame joint is two inches.

"Sixthly, The breadth of the firſt two, acroſs the nail of the firſt finger, is one inch and a quarter.

"And ſeventhly, The fingers being gathered into a conical form, the thumb lying obliquely upon the palm of the hand with its point upon the firſt joint of the ring finger, reckoning downwards, will meaſure in thickneſs, between its back and the fore part of the thumb, two inches and two eighths.

"Now, as hands are extremely various, the operator ought always to know how much the ſize of his differeth from the above dimenſions; and this being rightly underſtood, the application may be made as follows:

"The patient, being in the poſition as for natural delivery, and the operator's left hand being well anointed, and the fingers and thumb gathered into a cone, it muſt be gently paſſed into the vagina, and then through the os uteri, unleſs in this part there is ſtill a rigidity to forbid it; if ſo, the fingers only muſt be paſſed, their extremities formed into the fourth dimenſion, and then placed edgeways in the ſtrait; which being done, if the fore finger touch the angle of the ſacrum, and the little one the ſymphyſis of the pubes, the width is then manifeſtly no more than two inches and a half; a ſpace through which a mature child can neither paſs alive, nor be brought ſo by art, unleſs it happens to be preternaturally ſmall indeed."

Three methods of practice have been adopted in caſes of ſuch narrowneſs of the pelvis as renders it impoſſible for the child to be produced alive, viz. the operation of embryulcia or embryotomy, the Cæſarean ſection, and the diviſion of the ſymphyſis pubis.

119 I. *Embryotomy.* The caſes requiring this moſt ſhocking operation are thoſe where the infant cannot be extracted alive through the natural paſſages; while there is, nevertheleſs, ſuch ſpace that it may be torn away piece-meal without injury to the mother. Of courſe, in theſe caſes the life of the woman can be ſaved only at the expence of her infant.

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But although authors and practitioners in modern times adopt in general this principle, they differ materially in their account of the preciſe caſes requiring the operation.

Dr Oſborn alleges, that, as the head of the infant at the full time of utero-geſtation cannot be diminiſhed to leſs than three inches between the parietal protuberances by the natural contractions of the uterus forcing it againſt the bones of the pelvis; wherever the aperture at the brim or outlet falls under three inches, the operator ought to proceed as ſoon as poſſible to open the head of the infant.

But on ſo very ſerious an operation as that by which one life is deſtroyed, it becomes a practitioner to adopt no rule which can be at all liable to error; and it is evident, that there are three very ſtrong objections to this precept of Dr Oſborn.

Firſt, It is impoſſible in any caſe at the beginning 120
of labour, to aſcertain that the infant is at the full term of utero-geſtation; but it is well known, that a child at the age of between ſeven and eight months, if born alive, may be reared to maturity, and that ſuch a child is capable of being expelled without injury, through an aperture incapable of permitting the paſſage of a full grown fœtus.

Secondly, The heads of children, even at the full time, are ſometimes ſo ſmall and ſo yielding as to admit readily of their ſhort diameter being diminiſhed below three inches.

Thirdly, Every candid practitioner muſt allow, that it is quite impoſſible to aſcertain with geometrical accuracy the preciſe dimenſions of the pelvis; and conſequently what in any given caſe may appear to the operator to be leſs than three inches, may in fact be above theſe dimenſions.

For theſe reaſons, wherever the narrowneſs is not obviouſly very conſiderable, the prudent rule is to aſcertain the effect of the labour-throes, ſupporting the ſtrength of the patient, and palliating diſtreſſing ſymptoms. By adopting this rule, the practitioner will not only have the conſciouſneſs of not having deſtroyed life unneceſſarily, where he is eventually forced to open the head, by the conviction that it is too large to paſs unopened, but alſo the innate ſatisfaction of ſometimes ſaving a life, which under leſs cautious management muſt have been ſacrificed. Great care indeed is neceſſary in ſuch caſes not to be deceived in the eſtimate of the progreſs of the child, for the ſwelling of the ſcalp may miſlead a young practitioner.

There has been a variety of opinion too, reſpecting 121
the loweſt dimenſions of the pelvis which permit the operation of embryulcia with ſafety to the mother; and it is ſurely unneceſſary to ſtate, that unleſs there be a moral probability of ſaving the life of the mother by this operation, it ought never to be had recourſe to.

Dr Kellie, of London (P), and Dr Oſborn (Q), have recorded ſome caſes where this operation was performed,

(P) Dr Wallace Johnſon.
(Q) Dr Oſborn's Eſſays.

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although the narrownefs was very great; and the latter gentleman, founding on a fingle cafe, affumes the principle, that whenever there is a fpace equal to an inch and an half between pubes and facrum, the operation of embryulcia is practicable. But a careful perufal of the cafe alluded to (A) muft fatisfy any unprejudiced perfon that there muft have been fome miftake, moft probably, from the fwelling of the foft parts lining the pelvis having added to the apparent narrownefs, and having, after the head had been opened above 36 hours, fubfided. And at any rate, fince experience has now fully eftablifhed the fact, that the danger refulting from this operation is always in proportion to the degree of refiftance, it may be concluded that the operation of embryulcia cannot prove fafe to the mother, unlefs, firft, there be an aperture equal to about two inches by four; and, fecondly, the narrownefs be chiefly, if not altogether, confined either to the brim or the outlet. When both brim and outlet are deficient, and the cavity is deeper than ufual, even although the feveral apertures be quite fufficient to allow the diminifhed head to be extracted, the injury that muft accrue from the violent preffure on all the parts within the pelvis would deter any prudent practitioner from hazarding fuch an operation.

When it is determined to have recourfe to the operation of embryotomy, the inftruments required are the perforator, the crotchet, and the embryotomy forceps delineated in the plate.

122 The operation is to confift of two different proceffes; firft, the diminution of the head; and, fecondly, the extraction of the mangled child. In many cafes the latter fhould be performed immediately after the former is accomplifhed; but whenever the refiftance is very confiderable, an interval fhould be interpofed between the two. The advantages refulting from this practice were firft publicly noticed by Dr Ofborn, though there can be little doubt that the practice itfelf was the effect of neceffity. By waiting after the head has been opened, the woman's ftrength will be reftored, fo that the affiftance of the pains in the expulfion of the child may be obtained; the fwelling of the foft parts will fubfide, by which the refiftance may be greatly leffened, as well as the danger of inflammation removed, and the child's body will become putrid, by which its extraction may be greatly facilitated.

123 In opening the head, which is to be done by means of the perforator, the two great points to be aimed at are to avoid injuring any part of the woman, and to make a fufficiently large opening of the head. On the complete accomplifhment of the latter, the eventual fuccefs of the operation muft depend in all cafes of extreme deficiency of fpace.

Should it be found expedient to delay the extraction of the infant after the head has been opened and its contents evacuated, the teguments are to be carefully brought over the ragged edges of the bones, fo that in the event of labour throes recurring, there fhall be no rifk of the parts within the pelvis being injured.

When it has been found proper to proceed to the extraction of the infant, the firft thing to be attempted is to diminifh the bulk of the cranium as much as poffible. This may be done by means of the embryulcia forceps, 124
delineated in the plates, and contrived it is believed by Dr Lyon of Liverpool. It is an inftrument far fuperior to the almifdach of the Arabians, in ufe even within thefe fifty years among the practitioners of this ifland (B).

After the head has been fufficiently reduced in bulk, the crotchet is to be fixed at firft on the infide of the cranium; and while two fingers of the left hand are to be kept conftantly fo applied that if the inftrument fhould flip in the procefs of extraction, it fhall be received on the fingers, and cannot poffibly touch any part of the mother, the operator is to draw down with a fuitable exertion of force, in fuch a direction that the largeft part of the head fhall be brought through the wideft part of the pelvis.

In fome cafes, much time and very violent exertions are required to accomplifh the delivery; but, if the proper precautions to prevent any injury to the paffages be adopted, and if at the fame time the operator imitate nature by working only from time to time, and increafe the force employed gradually as may be required, and perfevere patiently, notwithftanding the refiftance, taking care to fupport by nourifhment and cordials the ftrength of the woman, the delivery at laft will be completed.

The dangers to be dreaded from this moft fhocking 125
operation, are injuries of the paffages, from the inftrument's flipping through the embarraffment of the practitioner; or violent inflammation of all the contents of the pelvis extending to the abdomen, in confequence of the parts through which the child muft be fo forcibly extracted being feverely bruifed. Accordingly, a greater number of women die from the effects of this operation than practitioners are willing to admit; and indeed, in every cafe of extreme deficiency of fpace, where embryotomy is performed, the recovery is to be regarded as doubtful.

This operation is fometimes had recourfe to in cafes where the forceps fhould have been ufed had the child been alive. But fuch cafes are very rare, becaufe the evidence of the infant in utero being dead, is feldom fo complete as to juftify the practitioner proceeding on the principle that it is fo.

II. By the *Cæfarean fection* is meant the extraction of 126
the infant through the parietes of the abdomen by an incifion into the uterus.

This bold operation was perhaps never performed by the ancients on the living fubject, and certainly was firft recommended to practitioners by M. Rouffet in his *Traitè nouvelle de l'Hysterotomie*, &c. 1581. Since that time it has been often performed on the continent, and about twenty times in Great Britain. The fuccefs of this operation recorded in the early works has certainly been exaggerated; but it appears by an elaborate memoir by M. Baudelocque, tranflated into Englifh by

(A) Ofborn's Effay, p. 240.

(B) For an account of the ancient inftruments employed in the practice of midwifery, fee Sculteti Armament. Chir.

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by Dr Hull of Manchefter, that during the 50 years preceding 1802, the operation has been had recourfe to on the continent 95 times, and that 37 of thefe cafes proved fuccefsful. In Great Britain, on the contrary, this operation has never yet fucceeded, a circumftance to be attributed partly to the delay which has always taken place after the neceffity for fuch an expedient had been determined, and hence the patient, at the time the operation was performed, muft have been in a ftate of exhauftion; and partly, perhaps chiefly, to the previous very alarming ftate of health of the fubjects of the operation in this ifland. It is at any rate certain that all over the continent practitioners have lefs horror at performing the Cæfarean fection than Britifh practitioners have commonly fhewn; and it is deemed neceffary in cafes where the operation of embryulcia is preferred in this country, and where of courfe the women are not in fuch a precarious ftate of health as thofe commonly are who have extreme narrownefs of the pelvis.

127 In confequence of the fatality of the Cæfarean fection in Great Britain, feveral eminent practitioners have regarded it as unjuftifiable. Dr Ofborn has rendered himfelf particularly confpicuous on this fubject, and ufes very ftrong language in reprobation of it. His arguments are, its acknowledged fatality; the capability of completing the delivery by means of the crotchet, in cafes of fuch deformity of the pelvis, that there is no more than one and a half inch between the pubis and facrum, or to one fide of the projecting facrum; and the impoffibility of impregnation taking place in cafes of greater deficiency of fpace. We fhall notice thefe arguments in their turn.

128 1ft, *The acknowledged fatality of the operation.*— This relates only to the refult of the operation in Great Britain; for, as already mentioned, a great proportion of the patients has been faved on the continent. But in infifting on this argument Dr Ofborn has overlooked that the object of the operation is to fave, if poffible, two lives, and at any rate one. Now if it can be fatisfactorily proved, that on fome occafions the operation of embryotomy is abfolutely impracticable, it becomes the duty of the practitioner to fave one life at leaft; and it is well known that the Cæfarean operation is far lefs painful to the woman than that of embryotomy, even where that latter operation is eventually fuccefsful. In fuch cafes of extreme deformity, either an attempt fhould be made to deliver the woman and fave the child, or both muft be allowed to perifh; for the operation of embryotomy, if attempted, muft be regarded as wilful murder.

129 2dly, The *practicability* of tearing away the child in pieces by means of the perforation and crotchet, in cafes where there is no more than an inch and a half between the pubis and facrum, or to one fide of the projecting facrum, is alleged by the doctor on the foundation of a fingle cafe, that of Elizabeth Sherwood already referred to. But any perfon who fhall take the trouble to have the aperture of Sherwood's pelvis, as ftated by Dr Ofborn cut out in wood, and to compare this with the bafis of an infant's fkull as much diminifhed as poffible by the crotchet (which is done in the courfe of his lectures by the profeffor of midwifery in this univerfity), muft be convinced, that there was fome miftake in the fuppofed dimenfions of that woman's pelvis. And it is quite obvious, that unlefs there be the fpace already ftated, viz. three and a half or four inches by two, it is unfafe to extract the mangled child through the natural paffages.

3dly, The *allegation* that where there is a greater degree of narrownefs of the pelvis than that which was fuppofed to have happened in the cafe of Sherwood impregnation cannot take place, is quite inconfiftent with facts. One of the moft remarkable cafes of extreme deformity is that of Elizabeth Thompfon, on whom the Cæfarean operation was performed at Manchefter in 1802. The defcription as given by Dr Hull (G) is as follows: "The pelvis of this patient was not nearly fo foft as has fometimes been obferved. It ftill had a confiderable degree of bony firmnefs. The offa innominata at their facro-iliac fynchondrofes, and at the fymphyfis pubis, before the pelvis was dried, admitted of a flight degree of motion.—The diftance from the crifta of one os ilium to the other, at their moft remote points, meafures ten inches and a half. 130

"The alæ of both offa ilia are very much bent; and on the left fide the curvature is fo great, that it meafures only two inches from the anterior and inferior fpinous procefs to the oppofite pofterior point. The lumbar vertebræ project forwards or inwards, and make a confiderable curve to the left fide of the pelvis. The diftance from the lower part of the fecond lumbar vertebra to the anterior part of the fpine of the os ilium, on the left fide, is two inches. The diftance from the loweft part of the fecond lumbar vertebra to the anterior part of the fpine of the os ilium, on the right fide, is five inches.

"*Superior aperture.* The conjugate or antero-pofterior diameter, from the fymphyfis pubis to the upper edge of the laft lumbar vertebra is one inch and a half. 132
—This diameter is not taken from the os facrum, or its junction with the laft lumbar vertebra, becaufe the point of their junction is fo much funk into the pelvis, that the place it fhould have occupied, is reprefented by the junction of the fourth and fifth lumbar vertebra. The tranfverfe diameter meafures four inches and five-eighths. It is taken from one facro-iliac fymphyfis to the other. The diftance of the point of this aperture, which is oppofite to the anterior part of the right acetabulum, from the lumbar vertebra, is only half an inch. The diftance from that part of this aperture, which correfponds with the pofterior part of the right acetabulum, to the os facrum is three-fourths of an inch. The diftance of the point, correfponding with the anterior part of the left acetabulum, from the lumbar vertebra is five-eighths of an inch. The diftance of the point of this aperture, oppofite to the pofterior part of the left acetabulum, from the os facrum, is three-fourths of an inch. The diftance of one os pubis from the other, in the points marked in the plate, is feven-eighths of an inch. The diftance from the right facro-iliac fymphyfis to the fymphyfis pubis is three inches and three-fourths. The diftance

(G) Obfervations on Mr Simmons's Detection, &c. p. 195.

ſtance from the right ſacro-iliac ſymphyſis to the left os pubis is three inches and three-eighths. The diſtance from the left ſacro-iliac ſymphyſis to the ſymphyſis pubis is three inches and five-eighths. The diſtance from the left ſacro-iliac ſymphyſis to the right os pubis is three inches and one-fourth. The largeſt circle, that can be formed in any part of the ſuperior aperture, does not exceed in diameter one inch.

132 " *Inferior aperture.* The diſtance from one ramus oſſis iſchii to the other, where they are united with the rami oſſium pubis, meaſures only half an inch. The diſtance from the tuberoſity of one os iſchium to the other meaſures one inch and two-tenths. The conjugate or antero-poſterior diameter, taken from the ſymphyſis pubis to the point of the os coccygis is three inches.

" The angle, included by the rami of the oſſa pubis, is very acute, viz. an angle of about 20 degrees. The perpendicular height from the tubera of the oſſa iſchia to the inferior margin of the ſymphyſis pubis is two inches and a half. The perpendicular height of the ſymphyſis pubis is one inch and a half. The tuberoſity of the left os iſchium advances forwards, beyond that of the right, about ſix-tenths of an inch, and the whole of the rami oſſis pubis and iſchii on the left ſide projects beyond thoſe of the right. The perpendicular height of the os ſacrum and coccyx is two inches and one-fourth only, the os ſacrum being bent ſo as to form a very acute angle. The acetabula, at their neareſt points, are only three inches diſtant. The ſymphyſis pubis is much more prominent than natural. The upper margin of the ſymphyſis pubis is ſituated as high as the bottom of the fourth lumbar vertebra."

It appears then, that Dr Oſborn's arguments are fallacious, and that caſes occur where the operation of embryotomy is neither ſafe nor practicable. Under ſuch circumſtances, the Cæſarean ſection muſt be had recourſe to; and it is therefore to be regarded as an operation of neceſſity, not one of choice. If this rule be adopted, the caſes requiring ſo formidable an expedient will happily be very ſeldom met with.

133 Mr Simmons of Mancheſter, obſerving that Dr Oſborn's third argument is untenable, has propoſed in the following words, another ſubſtitute for the Cæſarean operation.

" When a caſe ſhall ariſe in which the child cannot be delivered by the crotchet, from the brim of the pelvis being no more than one inch in diameter; I propoſe to combine the two operations, and to divide the ſymphyſis pubis to make way for the crotchet. Dr Oſborn has urged ſeveral objections againſt this propoſal, although he admits that the operation at the ſymphyſis is not ſo certainly fatal as the Cæſarean ſection. Weighty objections doubtleſs preſs againſt it; but whilſt there are no other means for preſerving life, bad as the chance is, it becomes a queſtion whether it be worth riſking; and, after maturely conſidering the caſe, ſhould an attempt for ſaving the life of the mother be judged expedient, as the laſt reſource it may be adopted.

" The ſpace gained has been differently ſtated at from three to eight or nine lines in the diameter;—the medium diſtance would probably be ſufficient to accompliſh the delivery by the crotchet.

" The objections urged againſt this mode of delivery, when the head is of the full ſize, will not apply to its reduced bulk; and it ſhould be remembered, that the ſymphyſis is formed of cartilage and ligament; ſo that whatever preſſure ſhall be made againſt the divided edges, will not be made againſt the ſharp angles of bone. That much injury may be done anteriorly will not be denied; but, does the continued preſſure of the child's head never produce miſchief in other caſes? By the introduction of a female ſound for a guide, a cautious and ſteady operator will avoid wounding the urethra; and, as the baſe of the ſkull will probably be turned ſideways, it will ſuffer leſs in extraction than in other caſes of the crotchet; in which it muſt in general be injured from preſſure againſt the pubis. If the ſeparation, however, be carried beyond a certain length, laceration will probably enſue; and, ſhould this accident occur, I ſee no reaſon to apprehend more danger from it than follows the extraction of a large ſtone from the bladder through a ſmall opening, which will induce a lacerated wound, but which we know will not uncommonly heal. The ſacro-iliac ligaments would certainly not be injured by choice, but the conſequences, I believe, are not generally fatal; and, ſhould it be urged that great pain and lameneſs will afflict the patient for a long time after, a reply will readily occur, that life was at ſtake; and ſurely there are few who would not compound, for the proſpect of temporary pain and inconvenience, to have it preſerved to them.

" A ſpontaneous ſeparation ſometimes occurs, both there and at the pubis; and yet the patient has been again reſtored to health.

" I do not ſee, in other reſpects, in what this compound operation differs from the moſt difficult crotchet caſe—the Cæſarean ſection is certainly fatal to the mother in this country—the life of the child, it is agreed, ſhall not be put in competition with the parent's life—the ſection of the ſymphyſis is neither ſo formidable nor ſo fatal as the Cæſarean ſection—and the crotchet has been ſucceſsfully applied in dimenſions which will probably be thus acquired.

" Upon the whole, then, in that ſuppoſed caſe of diſtortion (which I hope will never happen) in which the mother muſt be doomed to death, from the impoſſibility of delivering the child by the crotchet, the compound operation I have recommended will furniſh a reſource, approved by reaſon and ſanctioned by experience; inaſmuch as the ſection of the ſymphyſis pubis has been made, and the crotchet has been uſed, though ſeparately, yet with ſafety. Such a caſe will be attended, unqueſtionably, with additional hazard; but it offers the only chance to the mother, to the preſervation of whoſe life our chief care ſhould be directed: and, I hope that in future all trace of the Cæſarean operation will be baniſhed from profeſſional books; for it can never be juſtifiable during the parent's life, and ſtands recorded only to diſgrace the art."

He himſelf has afforded the moſt ſatisfactory evidence of the abſurdity of his own propoſal; for he had not publiſhed it many months when the very caſe he had deſcribed as ideal actually occurred in his neighbourhood, and he had the opportunity of making the experiment of his own plan. But he ſhrunk from it, and no wonder; for the woman was Elizabeth Thompſon, whoſe pelvis has juſt been deſcribed. It is unfortunate that Mr Simmons has not had the candour to confeſs his error, and to retract his opinions, more eſpecially ſince his reflections 134

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flections againſt the Cæſarean operation, were couched in language peculiarly bitter and invective.

With reſpect to the mode of performing the Cæſarean
135 ſection, there has been conſiderable variety of opinion. On theoretical principles, the external inciſion, viz. that through the parietes abdominis, ought to be in the direction of the linea alba, becauſe there is leſs chance of any conſiderable retraction of muſcular fibres, or of interfering with the inteſtines, than if it were made in any other direction. But the reſult of the practice ſeems at variance with the theory. According to the teſtimony of Baudeloque, of 35 operations, where the inciſion was made on the ſide of the abdomen, eighteen proved ſucceſsful; of thirty in the direction of the linea alba, ten only ſucceeded; and of eight in the manner recommended by Lauverjat, that is, by a tranſverſe inciſion between the recti muſcles and ſpina dorſi, three ſucceeded. But it may be remarked, that the event, in many of thoſe caſes, may have been influenced by a variety of circumſtances, totally independent of the line of direction of the external inciſion.

In whatever part of the abdomen the external inciſion be made, it ought to be extended to ſix inches; and, previous to cutting into the uterus, any active arterial branch, which may have been divided, muſt be ſecured; and the liquor amnii, if not already diſcharged, muſt be drawn off. The opening into the uterus need not be above five inches in length, and ſhould be made as much towards the fundus as poſſible. Means are to be employed to prevent the protruſion of the inteſtines at the time the uterus is emptied. Both fœtus and ſecundines are to be quickly extracted; after which, the hand is to be paſſed into the uterus, to clear out any coagula which may have formed within its cavity, to prevent the os tincæ being plugged up, and, at the ſame time, to promote the contraction of the uterus. The wound in the uterus is to be left to nature; but that of the parietes of the abdomen is to be carefully cloſed by means of the interrupted ſuture and adheſive ſtraps; and the whole belly is to be properly ſupported by a ſuitable bandage or waiſtcoat. In the after treatment of the patient, the great objects to be held in view, are to ſupport the ſtrength and moderate the degree of local inflammation.

136 III. *Diviſion of the ſymphyſis pubis.*—This was originally propoſed and performed by M. Sigault of Paris. His propoſal was made in 1768; but he had no opportunity of making the actual experiment till September 1777. —The ſucceſs of his firſt caſe was ſuch, that a medal was ſtruck to commemorate the event; and the operation was admired and recommended, with all the extravagance of French enthuſiaſm.

The operation conſiſts of the diviſion of the ſymphyſis pubis and ſeparation of the innominata. For this purpoſe, a catheter is to be introduced into the urethra, and, with a common ſcalpel, the articulation is to be cut through from the upper edge of the ſymphyſis, to within a quarter of an inch of the inferior edge. By ſeparating the thighs, the divided bones are forced aſunder. After this, the operator is either to turn the child, or to extract it by the forceps, according to the circumſtances of the caſe.

This expedient was propoſed as a ſubſtitute, both for the operation of embryulcia, and for the Cæſarean ſection, as it was alleged to be perfectly conſiſtent with the ſafety both of mother and child.

It is quite unneceſſary for us to offer any theoretical objections to this operation, becauſe we can now reaſon on the event of thirty-ſix caſes, which have been publiſhed.—But thoſe who may wiſh to inveſtigate this ſubject, may conſult Baudelocque, par. 1994. and 2091. incluſive; and Dr Oſborn, p. 271. To that latter practitioner's profeſſional zeal and ability is chiefly to be aſcribed the total rejection of this operation in Great Britain.

Of the thirty-five ſubjects of the publiſhed caſes (for 137
in one woman it was performed twice), fourteen women and eighteen children died.—Of the twenty-one women who ſurvived, nine had either had living children before the Sigaultian operation, or had ſuch at a ſubſequent period. Moſt of the remainder ſuffered much from the operation. Some had incurable incontinence of urine, others lameneſs, &c. But the moſt important fact is, that whenever the bones of the pelvis were ſeparated from each other above an inch (and no ſpace of any conſequence could be added to the brim, unleſs they were ſo), the ſacro-iliac ſynchondroſes were torn, and no woman ſurvived that accident.

Theſe facts have at laſt convinced foreign practitioners of the futility of this expedient; and, accordingly, for above ten years, it has not been performed on the continent by any practitioners of reſpectability.

When a woman, with a narrow pelvis, who has had 138
the good fortune to recover after the operation of embryotomy, again falls with child, ſhe ſhould not incur the hazard of a repetition of ſo horrible an operation; but ought to have premature labour induced between the ſeventh and the eighth month. Under the direction of an intelligent practitioner this operation is eaſily performed; and, while it affords the only chance of ſaving the infant, which it is the duty of the mother and of the practitioner to attempt, it at the ſame time, by leſſening the reſiſtance, diminiſhes both the ſuffering and the riſk of the patient (N).

For a further account of the practice in caſes of extreme deformity of the pelvis, the reader is referred to Oſborn's Eſſays; Hamilton's Letters to Oſborn; Simmons's Reflections, and Hull's Detection of Simmons.

Sect. IV. *Of the Deviations from Natural Labour which happen from anomalous circumſtances.* 139

Certain circumſtances beſides thoſe already enumerated occaſion deviations in the proceſs of labour. Some of theſe reſpect the child, and others the woman.

a. The child's life is endangered if the navel-ſtring 140
be ſo ſtrongly convoluted round its neck, that after the head is born the remainder cannot be expelled without the cord being drawn ſo tight as to interrupt the circulation through it. Dr Denman, vol. ii. p. 16. has ſtated this as a cauſe of protracted labour, and has adviſed

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(N) See a paper on this ſubject, in the 18th volume of the Medical Facts and Obſervations, by Mr Barlow.

viſed certain modes of practice in conſequence. But if there be pains, there cannot be any material protraction of the labour from this cauſe.

All riſk of the infant may be prevented by ſlackening the cord, and waiting for the action of the uterus, if the operator find that he cannot draw the loop of cord which ſurrounds the child's neck eaſily over its head. But this in moſt caſes can be readily done.

141 *b.* The cord is ſometimes puſhed down before the preſenting part of the child.

If this happen before the membranes are burſt, the only certain method of ſaving the child is to perform the operation of turning as ſoon as the ſtate of the paſſages will permit.

When the cord is puſhed down along with ſome other part, as the head, after the waters are diſcharged, a variety of practice is required according to the circumſtances of the particular caſe; hence merely keeping the cord for a little time beyond the preſenting part by means of the fingers, or wrapping it up in a piece of ſoft rag, and puſhing it above the preſenting point, or the application of the forceps, are ſeverally found uſeful in different caſes.

142 *c.* Sometimes one or both arms of the child are forced down along with the head, where proper aſſiſtance is not had at the beginning of labour. If the pelvis be roomy, and the woman have formerly had children, the delivery may be at laſt completed by the natural powers, notwithſtanding this increaſed degree of reſiſtance. But in many caſes of this kind an experienced practitioner is not called in till the ſtrength of the woman be very much exhauſted, and then it becomes neceſſary to uſe the forceps, or even on ſome occaſions to have recourſe to the operation of embryulcia.

143 *d.* It is well known, that ſometimes there is more than one child in the womb. Inſtances where there are twins are not unfrequent; caſes of triplets are alleged to happen once in between three or four thouſand births; four at a birth have not occurred in this city for the laſt twenty-ſeven years; and there are only two, or at moſt three, well-authenticated caſes of five at a birth having happened within a hundred years in this iſland.

All the ſigns by which the exiſtence of more than one child in utero can be aſcertained, previous to the actual commencement of labour, are fallacious; and in general it is not till after the birth of one child that it can be determined that another remains in the womb; and, unleſs under very particular circumſtances, it is of no importance. The circumſtances alluded to are where different parts of both children are forced into the paſſage at the ſame time. Of this a very remarkable caſe is recorded in the book of Geneſis, verſe 27. chap. xxxviii.

When the womb appears to remain bulky and hard after the birth of one child, there is reaſon to ſuppoſe that it contains a ſecond. But if there be any doubt on the ſubject, the practitioner has it in his power to aſcertain the point by examination. When there is no ſecond child in the uterus, the further the fingers are carried up within the paſſages, the more contracted do they feel; whereas, if there be a ſecond child, the more open are they found.

144 When it is aſcertained that another infant remains, the woman's belly ſhould be immediately compreſſed by means of a roller, in order to prevent faintiſhneſs from the ſudden relaxation of the parietes abdominis, and the portion of the naval ſtring remaining attached to the after-birth of the firſt born ſhould be carefully ſecured, leſt the veſſels of the placenta anaſtomoſe.

145 In regard to the ſubſequent treatment, there has been much variety of opinion among practitioners. Some have propoſed waiting till the action of the uterus expel the ſecond as it had done the firſt infant. Others urge ſtrongly the neceſſity for immediate delivery.

Againſt the former of theſe practices it is to be objected; firſt, that in ſome caſes, days or even weeks have been known to intervene between the birth of one child and the action of the uterus which expelled the ſecond. Secondly, that if this happen, the paſſages muſt become contracted and their ſubſequent dilatation may be productive of inflammatory ſymptoms. Thirdly, that during the time the uterine action is ſuſpended, internal hæmorrhagy may take place, and may deſtroy the patient. And, fourthly, the ſecond child may be ſuddenly forced down in ſuch a poſition, as may endanger its life, and at the ſame time occaſion great pain to the mother.

For theſe reaſons it is now an eſtabliſhed rule among judicious practitioners, to examine the ſituation of the ſecond infant, as ſoon as the patient ſhall have recovered from the ſhock of the birth of the firſt child; and, if its poſition be natural and the patient have not been exhauſted by the previous labour, and pains come on, to rupture the membranes, and allow the natural powers to complete the delivery. But if the infant preſent any other part than the head, or though the head do preſent, if the woman be exhauſted, or if there be no appearance of the return of pains within an hour after the birth of the firſt, then the hand is to be paſſed up to bring down the feet of the ſecond child, and the delivery is to be expedited. The extraction of the placentæ is to be conducted with great care, and every poſſible precaution is to be adopted againſt the occurrence of flooding, which is always to be dreaded as the conſequence of plurality of children.

The ſame principles apply to the management of triplets, &c.

146 *d.* Umbilical hernia, to which women are perhaps more ſubject than to any other ſpecies of rupture, may influence the labour materially.

If it be reducible, it diſappears after the fifth month of pregnancy; but immediately after the expulſion of the child it returns, and occaſions frightful faintings and floodings. This may be prevented by the ſimple expedient of having the belly compreſſed by a roller in ſuch a manner, that in proportion as the infant advances, the compreſſion may be increaſed.

Should it be irreducible, if the hernia be affected by the continuance of labour, as may be known by the colour &c. the operation of turning muſt be had recourſe to.

147 *e.* Convulſions ſometimes happen during labour, and occaſion great danger both to the mother and the child. The woman is quite inſenſible during the fit, which conſiſts of violent convulſions of the muſcles which move the body, and of thoſe of the eyes, the face, and the lower jaw; it laſts in ſome caſes only a few ſeconds,

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and in others for several minutes. After the fit has ceased, it sometimes happens that the patient remains in a comatose state; in other cases the sensibility returns.

The circumstances which distinguish this disease from epilepsy were first stated explicitly by Dr Hamilton in the following words: "The old distinction between eclampsia and epilepsia has been rejected by Dr Cullen, without sufficient reason. The convulsions that occur during pregnancy and labour, should be distinguished by the former name, for the disease is always an acute one, and it never, as far as my experience goes, lays the foundation for habitual epilepsy. To an inattentive practitioner, indeed, the phenomena appear similar to those of epilepsy; but, independent of its violence and fatality, there are many circumstances peculiar to it. This has been remarked by several authors, particularly Dr Denman; but those circumstances have never been accurately pointed out in any publication which has fallen into my hands.

Dr Duncan's Annals, vol. v. p 319.

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"The eclampsia, peculiar to pregnancy and labour, differs from epilepsy in the following respects.

"1. The symptoms which precede the attack are well marked, announcing to an experienced practitioner the approach of the disease.

"2. If the first fit do not prove fatal, and if no means of cure be attempted, it is within a few hours followed by other paroxysms, provided delivery do not take place.

"3. After the paroxysms, even where they have been very severe, the patient in many cases continues quite sensible during the intervals, and the sensibility returns the moment the fit is off.

"4. What may appear still more extraordinary is, that, in some cases there is a remarkably increased susceptibility of impression of the external senses; and this supersensation is not confined to patients in whom the convulsions are slight.

"5. The aura epileptica never occurs in the cases alluded to.

"6. The pulse is, in every case, affected in some degree during the remissions of the fits. It is slow, or oppressed, or intermitting, or frequent and rapid. But it is most commonly slow and oppressed, becoming fuller and more frequent after blood-letting.

149 The symptoms above hinted at as preceding the fits are, violent headach, or sudden delirium, or violent tremors during the second stage of labour. Impaired or depraved vision commonly prove the immediate harbingers of the fit. The event of this occurrence is always precarious, for a single fit may destroy the patient. Death happens in such cases in two ways; viz. either by rupture of some of the vessels within the head, or by the rupture of the womb itself.

150 The cause of the disease is evidently an overload in the vessels within the cranium, and this may be occasioned from a variety of causes, as violent labour throes, passions of the mind, irritations in the primæ viæ, &c.

151 In cases of so very alarming a nature, it is not wonderful that practitioners have differed much respecting the practice to be adopted. The following is what has been recommended by Dr Hamilton in the volume of Dr Duncan's annals already referred to.

"When fits have actually occurred during the latter months of pregnancy, the first remedy to be employed, after having adopted the suitable means for protecting the tongue, is blood-letting, both general and topical. Opening the external jugular might answer both purposes, but the restlessness of the patient in many cases makes the surgeon or attendants dread this operation. A quantity of blood, therefore, adapted to the exigency of the case, is to be drawn from the arm, and either a branch of the temporal artery is to be divided, or several leeches are to be applied to the temples. After the bleeding, a powerful laxative glyster ought to be exhibited. And if there be any evidence of disordered primæ viæ, an emetic must, if possible, be given. The state of the os uteri is then to be ascertained; and if labour have not commenced, no attempts whatever are to be made to promote that process. In some rare cases, however, where the bulk of the gravid uterus is enormous, it may be necessary to remove a part of its contents; but such cases cannot happen once in a thousand instances of the disease.

Preternatural Parturition.

"Should the fits still continue, the head must be shaved, and covered with a large blister; and if the oppression or fulness, or hardness of the pulse, be not removed, the blood-letting is to be repeated.

"As soon as the patient becomes capable of swallowing, the camphor, in doses of ten grains, ought to be given every three or four hours. The most efficacious and palatable form in which this medicine can be prescribed, is by suspending it in boiling water, through the medium of alcohol, sugar and magnesia. Its use must be persevered in for several days, gradually lessening the number of doses.

"Where the eclampsia has been preceded by œdema, the digitalis may be employed with much success.

"Convulsions during labour are to be treated upon the same principles, with these additional precautions, that delivery is to be accomplished by the most expeditious possible means, and that if the delivery be followed by uterine hæmorrhagy, the discharge is for some time to be rather encouraged than checked. I knew two instances of the fits, which had been suspended for some hours, recurring, in consequence of the flooding being stopped, and in both cases the convulsions were removed, by allowing the discharge to return.

"When the symptoms that precede eclampsia, take place in the latter months of pregnancy, the most certain method of guarding against the threatening accident is, having recourse to immediate blood-letting, and afterwards prescribing camphor, attention to the state of the bowels, and a spare diet.

"When the same symptoms occur during labour, a copious bleeding should be instantly ordered, and the appropriate means of terminating the delivery should be adopted with as much expedition as may be consistent with the safety both of mother and child.

"In these concise practical suggestions, practitioners will observe circumstances omitted, which have been recommended by gentlemen of deserved professional eminence, and novelties of practice proposed, which I believe have not hitherto been explicitly advised. Some explanation, therefore, of the plan above recommended may perhaps be expected.

"The most obvious remedy apparently omitted is opium. This powerful medicine was not prescribed, as far as we have reason to know, by the practitioners who lived at the end of the 17th and beginning of the 18th centuries. The first author who, in strong terms, asserts the efficacy of opium in such cases, appears to be the translator

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tranſlator of Aſtruc's Midwivery (A); and his opinion has been adopted by Dr Denman (B), and by Dr Bland (C). But in every caſe of true eclampſia, during pregnancy or labour, opiates do irreparable miſchief, where a copious bleeding has not been premiſed; and even where that precaution has been attended to, they have been found uſeleſs, if not hurtful. Melancholy experience has completely eſtabliſhed in my mind this practical precept; and I conſider it to be a matter of very great moment, that it ſhould be univerſally known; for general practitioners, who are often firſt called to thoſe caſes where the fits happen during pregnancy, are extremely apt to preſcribe opium. I can ſolemnly declare, that no patient to whoſe aſſiſtance I have been called, who had taken a doſe of opium previous to my arrival, has recovered, and I have known that medicine given in almoſt every variety of doſe. My father, Dr A. Hamilton, of whoſe judgement and practical knowledge it does not become me to ſpeak in the terms they ſo juſtly merit, prevented my ever employing opium under ſuch circumſtances.

"A ſecond remedy extolled by Dr Denman, and now, after a fair trial, rejected in my practice, is vomiting. This ſeems to have been a very common preſcription in the time of Mauriceau, as he takes great pains to point out its hurtfulneſs in ſeveral parts of his works (D). Where there are unequivocal marks of diſordered ſtomach, an emetic may be preſcribed with advantage after blood-letting, but it ſhould be avoided under all other circumſtances.

"With regard to the warm-bath, which is a favourite remedy among foreign practitioners, and has been adviſed by ſeveral Britiſh authors, I have never had an opportunity of trying its effects. Upon theoretical principles I ſhould reject it; but my chief reaſon for never having directed its uſe, has been the impoſſibility, in ordinary caſes of practice, of commanding a warm-bath into which a woman in ſuch a ſituation could be put.

"Daſhing cold water by ſurpriſe upon the face is a practice ſuggeſted by Dr Denman, and on which he had much dependence at one period. Experience leſſened his hopes, and, many years ago, prevented my ever indulging any. I gave it ſeveral fair trials, (once or twice in public in the lying-in-ward of the Royal Infirmary), and had even reaſon to be convinced, that it rather aggravated than diminiſhed the violence of the paroxyſms."

In addition to theſe obſervations it may be proper to remark, that a much larger quantity of blood ſhould be drawn in thoſe caſes than has commonly been done. Dr H. adviſes forty ounces to be taken at this firſt bleeding, and the ſame quantity to be again drawn within an hour, if the ſymptoms be not mitigated; and he talks with the utmoſt confidence of the utility of this practice.

152 *f.* Although the woman be delivered ſafely both of the child and afterbirth, ſhe may ſink very ſoon after in conſequence of internal flooding. This is to be ſuſpected if the patient ſuddenly complain of giddineſs or ſickneſs, or ſinging in the ears, or impaired viſion; or if ſhe become delirious, with a pallid face and cold limbs. The ſtate of the pulſe at the wriſt too ſhould lead a judicious practitioner to ſuſpect the exiſtence of internal flooding. Poſitive certainty of this accident may be obtained by feeling through the belly the condition of the uterus; or, more certainly ſtill, by feeling the ſtate of the vagina, for if its parietes approach, there is not much probability of there being any conſiderable internal hæmorrhagy; whereas, if it be found filled with coagulated blood, there is a certainty, that the womb too is diſtended from the ſame cauſe.

This accident is entirely owing to the womb not having contracted with ſufficient energy. It very often proves the cauſe of ſudden and unexpected death.

The boldeſt and apparently moſt violent meaſures are required to ſave the patient in many of thoſe
caſes. The womb and vagina muſt be immediately 153
emptied, and ſuch preſſure muſt be made on the inſide of the uterus with the hand, as ſhall force it into contraction. In ſome caſes cold water in great quantity muſt be daſhed from a height on the naked belly at the ſame time; and in the mean while the ſtrength of the patient muſt be ſupported with large doſes of opium. If there be vomiting, which is a frequent ſymptom in ſuch caſes, five grains of ſolid opium ſhould be given at firſt, and afterwards three grains every three or four hours, till the pulſe becomes ſteady and the ſtrength recruited, when the opiates are to be withdrawn and leſſened by degrees. The writer of this article cannot avoid this opportunity of paying a juſt tribute of reſpect to the practical diſcernment of the able editor of the New London Medical Dictionary, who ſeems the firſt author who has mentioned this practice of giving large doſes of opium; a practice by which many valuable lives have been ſaved.

Concluſion.—In the preceding account of the deviations, which ſometimes happen in the proceſs of human parturition, although we have endeavoured to give a full view of the ſubject, we have not purſued the beaten track. But as this article may rather be conſulted by many as a dictionary, than purſued regularly as a treatiſe, we ſhall add the ordinary arrangement of labours, with the reference to the numerical articles, under which the ſeveral varieties may be found.

Labours are divided into four claſſes; viz. natural, laborious, preternatural, and complex.

Natural labour comprehends all caſes where the head of the infant is forced foremoſt; and the whole proceſs is completed with ſafety, both to mother and child, within twenty-fours from the commencement. It is deſcribed under articles 48. to 60.

Laborious labour is that where, although the head of the infant be forced foremoſt, the proceſs is protracted beyond

(A) The Art of Midwifery, &c. 8vo. London, printed for J. Nourſe 1767. Appendix, page 295.

(B) Vol. ii. page 418.

(C) Loco citato, page 136.

(D) Particularly in Aphoriſm 232. "L'émétique eſt pernicieux aux femmes groſſes, ou nouvellement accouchées, qui ſont ſurpriſes des convulſions." And Levret, page 451. of his L'Art des Accouchemens, ſays, in reference to that aphoriſm, "Cete ſentence eſt des mieux fondées, et elle doit être rigoureuſement obſervée dans tous ſes points."

beyond twenty-four hours from the commencement. It is divided into three orders: First, where the natural powers at last, after much suffering on the part of the mother, complete the delivery. See article 64.

Secondly, Where, although the action of the uterus be inadequate to the expulsion of the infant, it is practicable to extract the child through the natural passages, without injury either to it or to the mother. See articles 66. to 74. 82. and 84.

Thirdly, Where it is impossible to extract the child alive through the natural passages. See articles 80. and 99. to 133.

Preternatural labours comprehend all cases where any other part of the child than the head is forced foremost; and consist of two orders:

First, Presentations of the lower extremities, viz. footling cases, article 87. Breech cases, article 91. Cases where one foot presents, article 89. and knee-cases, article 90.

Secondly, Presentations of the superior extremities or other parts than the head or lower extremities, articles 192. to 196.

Complex labours include all cases where any other circumstances than those enumerated under the former three classes take place, viz.

Cases where the pelvis is too large, articles 110. and 111.

Cases where hæmorrhagy occurs at the beginning of labour, article 76. or at the conclusion of that process, articles 152. and 153.

Cases where there is more than one child, articles 143. 144. 145.

Cases where the patient had previously been affected with umbilical herniæ, article 146.

Cases where convulsions happen, articles 147. 148.

Cases where the navel-string is twisted round the neck of the infant, article 140. or where it is forced down along with some part of the child, article 141.

And cases of rupture of the uterus, article 65.

EXPLANATION OF THE PLATES.

Plate CCC.

Fig. 1. A front view of the uterus in the unimpregnated state, *in situ*, suspended in the vagina; the anterior parts of the ossa ischia, with the ossa pubis, pudenda, perineum, and anus being removed, in order to show the internal parts.

A, The last lumbar vertebra.

B, B, The ossa ilia.

C, C, The acetabula.

D, D, The inferior and posterior parts of the ossa ischia.

E, The part covering the extremity of the coccyx.

F, The inferior part of the rectum.

G, G, The vagina cut open longitudinally, and stretched on each side of the cervix uteri, in order to show the manner in which the uterus is suspended in it.

H, H, Part of the urinary bladder stretched on each side of the vagina and inferior part of the fundus uteri.

I, The cervix uteri.

K, The fundus uteri.

L, L, The fallopian tubes.

M, M, The ovaria.

N, N, The broad ligaments.

O,O, The superior part of the rectum.

Fig. 2. A view of the internal parts as seen from the right groin, the pelvis having been divided vertically.

A, The lowest vertebra of the loins.

B, C, The os sacrum and coccyx with the integuments.

D, The left os ilium.

E, The inferior part of the os ischium.

F, The os pubis of the same side.

G, The foramen magnum.

H, The acetabulum.

I, The inferior part of the rectum.

K, The os externum and vagina, the os uteri lying loosely in the latter.

L, The vesica urinaria.

M, N, The cervix and fundus uteri, with a view of the cavity of the uterus. The attachment of the vagina to the uterns, and the situation of the uterus when pressed down by the intestines and bladder into the concave part of the os sacrum, are likewise shown.

O, The broad ligament of the left side.

P, P, The left fallopian tube.

Q, The left ovarium.

R, R, The superior part of the rectum and inferior part of the colon.

Fig. 3. Is a sketch taken from Dr Hunter's magnificent plate, N° 6. of the gravid uterus. All the fore part of the uterus and secundines (which included the placenta) is removed. The navel string is cut, tied, and turned to the left side over the edge of the womb. At the fundus the investing membranes are likewise turned over the edge of the womb, that they might be more apparent. The head of the child is lodged in the lower part of the womb, or in the cavity of the pelvis, and its body lies principally in the right side. Its position is diagonal or oblique, so that its posterior parts are turned forwards, and to the right side of the mother, and its fore parts are directed backwards, and to the left side. Its right foot appears between its left thigh and leg. Every part is stated by Dr Hunter to have been represented just as it was found.

Fig. 4. A front view of the gravid uterus in the first stage of labour; the anterior parts are removed, but the membranes not being ruptured, form a large bag containing the fœtus and the liquor amnii.

A, A, The substance of the uterus.

B, B, C, C, D, D, E, E, The bones of the pelvis.

G, G, The vagina.

H, H, The os uteri dilated during a pain; with

I, The membranes containing the liquor amnii protruding through it.

K, The chorion.

L, The chorion dissected off at the back of the uterus, to show the head of the child through the amnios.

M, The placenta; the lobulated surface, or that which is attached to the uterus, being shown.

Plate CCCI.

Fig. 1. Represents a well-formed pelvis.

A, A, The ossa ilia, properly so called.

a, *a*. The iliac fossæ.

b, *b*, The linea innominata, making part of the brim of the pelvis.

c, *c*, The crista of the ossa ilia.

e, *e*, Their superior anterior spinous processes.

B, B, The os ischium.

f, *f*, Its tuberosities.

h, *h*, Its branches.

C, C, The body of the os pubis.

i, *i*, The crista pubis.

k, *k*, Its descending branch uniting with that of the ischium.

l, The symphysis pubis.

D, D, The os sacrum.

m, *m*, Its base.

n, *n*, The sacro-iliac synchondrosis.

o, Its internal surface called *hollow*.

p, Its apex to which the coccyx is joined.

E, The coccyx.

Fig. 2. Represents a vertical section of the pelvis.

A, The promontory of the sacrum.

B, The point of the coccyx.

The distance from these two points marks the depth of the pelvis behind, which in the majority of cases is six inches.

C, The spinous process of the ischium.

D, The tuberosity of the ischium.

E, The crista pubis, the distance which two points marks the depth of the pelvis at the sides, and is ordinarily about four inches.

F, The foramen thyroideum.

G, The surface by which the two ossa pubis are joined to form the symphysis pubis, and by which junction the depth of the pelvis at the front is reduced to about one and a half inches.

Fig. 3. Represents the brim of a well formed pelvis.

A, B, The short or conjugate diameter between pubis and sacrum, which measures commonly a little less than four inches.

C, D, The long diameter in the skeleton, which, however, in the living subject, is rendered almost as short as the former, in consequence of the bellies of the psoæ muscles being lodged in the lower cavity of the tunica innominata.

E, F, The diagonal diameter in the skeleton, which, in fact, is the long diameter in the living body, and measures somewhat less than five inches.

Fig. 4. Represents the outlet of a well-formed pelvis.

A, B, The short diameter, extending from one tuberosity of the ischium to the other, and measuring less than four inches.

C, D, The long diameter, extending from the lower edge of the symphysis pubis to the point of the coccyx, and measuring nearly five inches.

Fig. 5. Represents the brim of a distorted pelvis.

Fig. 6. Represents the outlet of a deformed pelvis.

Plate CCCII.

Fig. 1. The fœtal heart.

a, The right ventricle.

b, The right auricle.

c, The left auricle.

d, Branches of the pulmonary veins of the right lobe of the lungs, those of the left being cut off short.

e, Arteries of the left lobe of the lungs.

f, The vena cava descendens.

g, The aorta descendens.

h, The trunk of the arteria pulmonalis.

i, The ductus arteriosus.

Fig. 2. Represents the first stage of natural labour, towards its termination.

A, The membranes of the ovum distending the cervix uteri, while the head of the child is just entering the brim of the pelvis.

B, B, The os uteri nearly dilated.

C, The vagina.

D, The orificium externum.

Fig. 3. Represents the second stage of natural labour, when the head has descended into the cavity of the pelvis, while the face is still towards the sacro-iliac synchondrosis.

Fig. 4. Represents the second stage of natural labour, after the head has advanced so far that the face is in the hollow of the sacrum, and the vertex in the arch of the pubis.

Plate CCCIII.

Fig. 1. A view of a deformed pelvis when the deficiency of space is not very considerable.

Fig. 2. The child's skull.

a, The vertex, or posterior fontanelle.

b, The anterior fontanelle.

Fig. 3. and 4. The common short forceps, reduced to one-fourth of the natural size.

The instrument, when of the proper size, is in length 11 inches. The length of each handle is four inches and a half. If a straight line be drawn through the plane surface of one handle, and be produced to the extremity of the instrument (which forms the axis of the handles when both are joined), the convex edge of the blade, at the greatest distance from this line, is distant $1\frac{3}{8}$ inches; and the extreme distance of the point on the opposite edge is $\frac{1}{1}\frac{1}{6}$ths of an inch. When both blades are joined their greatest width is $2\frac{3}{4}$ inches. The right-hand blade has a hinge between the handle and blade, by which it is easily introduced, while the patient lies on the left side.

Fig. 5. and 6. Views of Lowder's lever; for a particular description of which, see par.

Fig. 7. Orme's perforator reduced to one-fourth the natural size.

Fig. 8. Embryotomy forceps, one-fourth the natural size.

Fig. 9. The crotchet, one-fourth the natural size.

Plate CCCIV.

Fig. 1. Represents an ordinary sized child forced against the brim of a deformed pelvis.

Fig. 2. Represents the child when the feet had presented, turned into that direction by which its head is best brought through the brim and cavity of the pelvis, viz. with the face towards the sacro-iliac synchondrosis of one side.

Fig. 3. Represents the ordinary situation of the infant in breech presentations; from which it is evident, that unless the infant be very small, the natural action of the uterus cannot force it through the pelvis in this direction.

Fig. 4. Represents an arm presentation, and communicates an idea of the difficulty of bringing down the feet, and turning the infant in that position.

ERRATA.

Fig. 1.

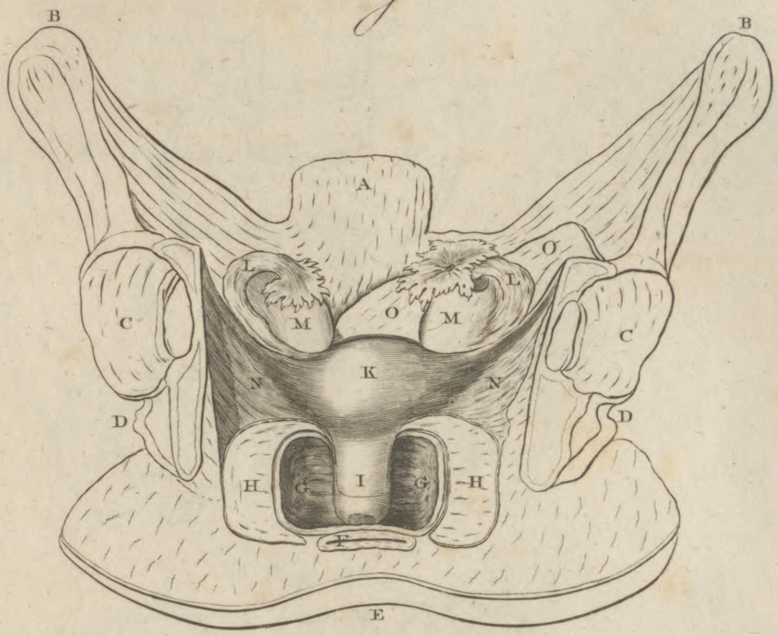

Fig. 2.

Fig. 3.

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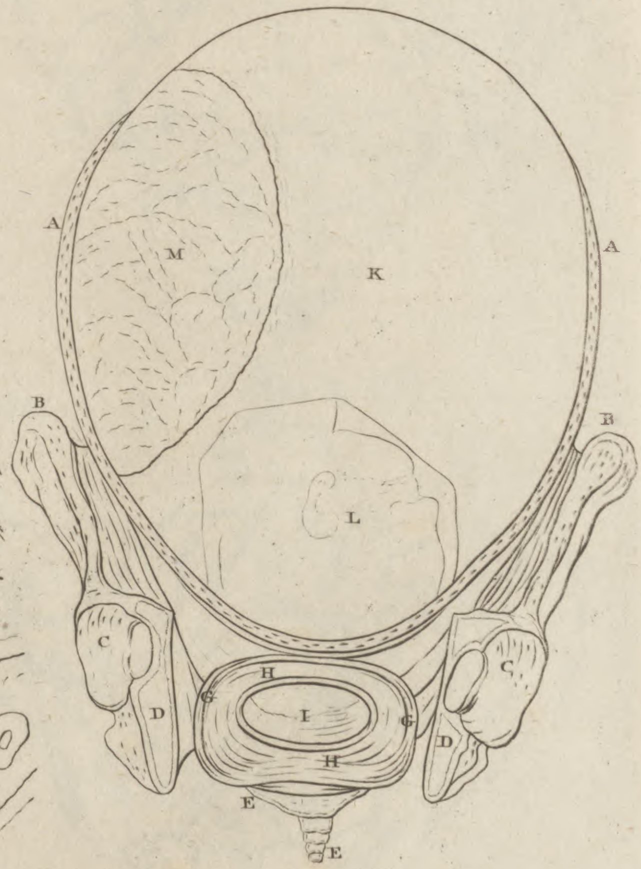

A. Bell Prin. Wal. Sculptor fecit.

Fig. 1.

Fig. 2.

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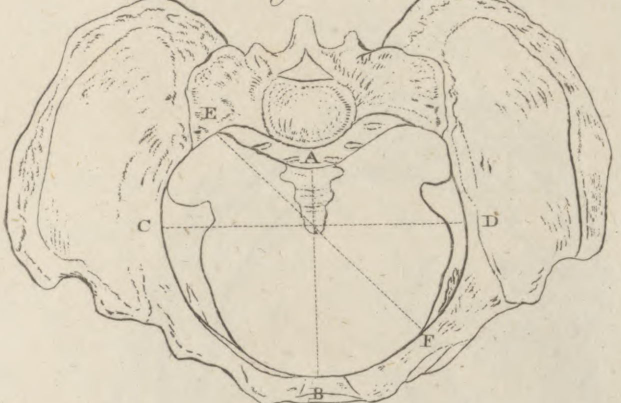

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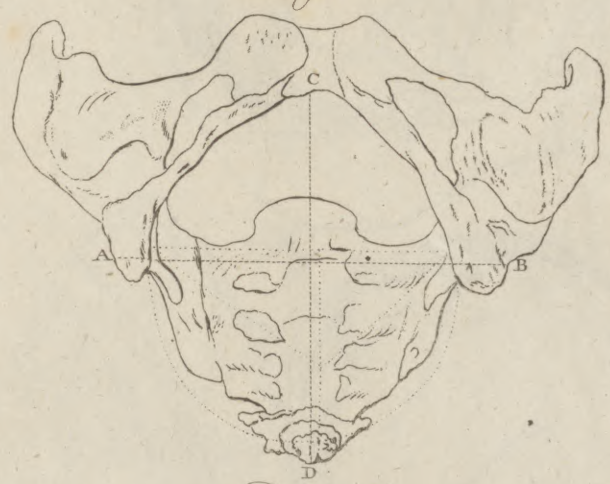

Fig. 5.

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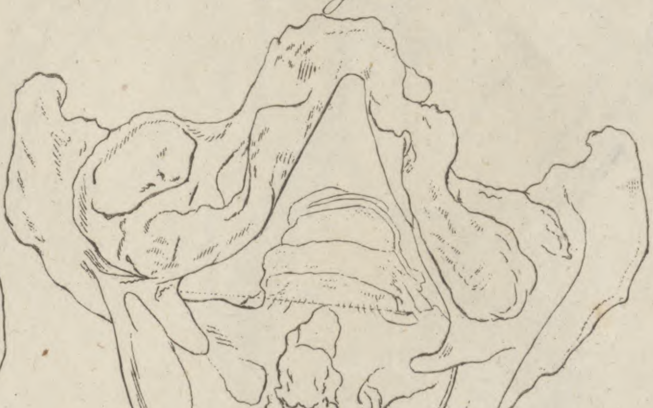

A. Bell Prin. Wal. Sculptor fecit.

Fig. 1.

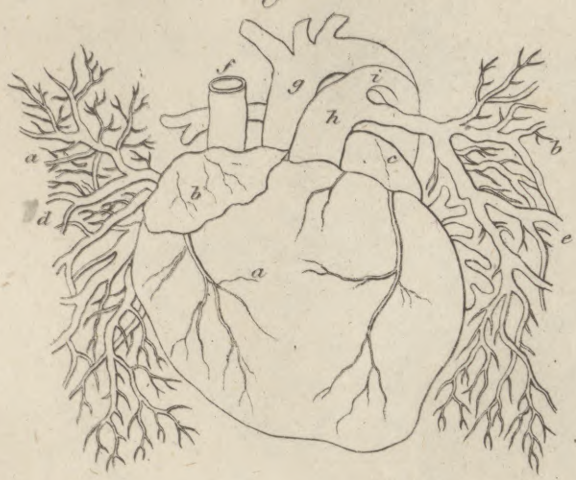

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1.

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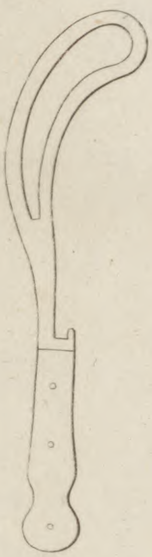

Fig. 9.

Fig. 7.

Fig. 8.

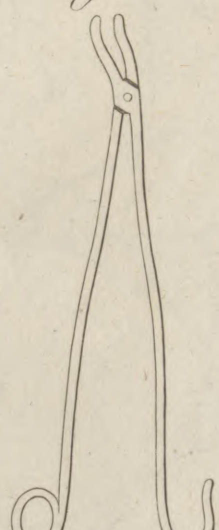

Fig. 5.

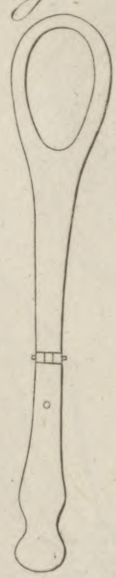

Fig. 6.

A.Bell Prin. Wal. Sculptor fecit.

Fig. 3.

Fig. 2.

Fig. 1.

Fig. 4.

A. Bell Prin. Wal. Sculptor fecit.

ERRATA.

Page 45.	col. 1.	lin. 16.	*for* explain *read* attribute.
—	—	21.	*for* forms *read* germs.
—	—	23.	*for* experiment *read* experience.
47.	1.	35.	*add to* the *at the end of the line*, navel-ſtring.
56.	1.	20.	*for* exerted *read* excited.—*Same line, the paragraphs from Art.* 69. *to the end of the page ſhould have been marked with inverted commas.*
61.	1.	34.	*dele* the.
67.	1.	53.	*for* produced *read* protruded.

Miel, Mieris.

MIEL, JAN, called *Giovanni della Vite*, a moſt eminent painter, was born in Flanders in 1599. He was at firſt a diſciple of Gerard Seghers, in whoſe ſchool he made a diſtinguiſhed figure; but he quitted that artiſt, and went to Italy, to improve himſelf in deſign, and to obtain a more extenſive knowledge of the ſeveral branches of his art. At Rome he particularly ſtudied and copied the works of the Caracci and Corregio; and was admitted into the academy of Andrea Sacchi, where he gave ſuch evident proofs of extraordinary merit and genius, that he was invited by Andrea to aſſiſt him in a grand deſign which he had already begun. But Miel, through ſome diſguſt, rejected thoſe elevated ſubjects which at firſt had engaged his attention, refuſed the friendly propoſal of Sacchi, and choſe to imitate the ſtyle of Bamboccio, as having more of that nature which pleaſed his own imagination. His general ſubjects were huntings, carnivals, gypſies, beggars, paſtoral ſcenes, and converſations; of thoſe he compoſed his eaſel pictures, which are the fineſt of his performances. But he alſo painted hiſtory in a large ſize in freſco, and in oil; which, though they ſeem to want elevation of deſign, and a greater degree of grace in the heads, yet appear ſuperior to what might be expected from a painter of ſuch low ſubjects as he generally was fond of repreſenting. His pictures of huntings are particularly admired: the figures and animals of every ſpecies being deſigned with uncommon ſpirit, nature, and truth. The tranſparence of his colouring, and the clear tints of his ſkies, enliven his compoſitions; nor are his paintings in any degree inferior to thoſe of Bamboccio either in their force or luſtre. His large works are not ſo much to be commended for the goodneſs of the deſign as for the expreſſion and colouring; but it is in his ſmall pieces that the pencil of Miel appears in its greateſt delicacy and beauty. The ſingular merit of this maſter recommended him to the favour of Charles Emanuel duke of Savoy, who invited him to his court, where he appointed Miel his principal painter, and afterwards honoured him with the order of St Mauritius, and made him a preſent of a croſs ſet with diamonds of great value, as a particular mark of his eſteem. He died in 1664.

MIERIS, FRANCIS, the *Old*, a juſtly celebrated painter, was born at Leyden in 1635; and was at firſt placed under the direction of Abraham Toorne Vliet, one of the beſt deſigners of the Low Countries, and afterwards entered himſelf as a diſciple with Gerard Douw. In a ſhort time he far ſurpaſſed all his companions, and was by his maſter called the prince of his diſciples. His manner of painting ſilks, velvets, ſtuffs, or carpets, was ſo ſingular, that the different kinds and fabric of any of them might eaſily be diſtinguiſhed. His pictures are rarely to be ſeen, and as rarely to be ſold; and when they are, the purchaſe is extremely high, their intrinſic value being ſo inconteſtably great. Beſides portraits, his general ſubjects were converſations, perſons performing on muſical inſtruments, patients attended by the apothecary or doctor, chemiſts at work, mercers ſhops, and ſuch like; and the uſual valuation he ſet on his pictures was eſtimated at the rate of a ducat an hour. The fineſt portrait of this maſter's hand is that which he painted for the wife of Cornelius Plaats, which is ſaid to be ſtill preſerved in the family, although very great ſums have been offered for it. In the poſſeſſion of the ſame gentleman was another picture of Mieris, repreſenting a lady fainting, and a phyſician applying the remedies to relieve her. For that performance he was paid (at his uſual rate of a ducat an hour) ſo much money as amounted to fifteen hundred florins when the picture was finiſhed. The grand duke of Tuſcany wiſhed to purchaſe it, and offered three thouſand florins for it; but the offer was not accepted. However, that prince procured ſeveral of his pictures, and they are at this day an ornament to the Florentine collection. One of the moſt curious of them is a girl holding a candle in her hand, and it is accounted ineſtimable. This painter died in 1681.

Mieris.

MIERIS, *William*, called the *Young Mieris*, was ſon of the former, and born at Leyden in 1662. During the life of his father, he made a remarkable progreſs: but, by being deprived of his director when he was only arrived at the age of nineteen, he had recourſe to nature, as the moſt inſtructive guide; and by ſtudying with diligence and judgement to imitate her, he approached near to the merit of his father. At firſt he took his ſubjects from private life, in the manner of Francis; ſuch as tradeſmen in their ſhops, or a peaſant ſelling vegetables and fruit, and ſometimes a woman looking out at a window; all which he copied minutely after nature, nor did he paint a ſingle object without his model. As Mieris had obſerved the compoſitions of Gerard Laireſſe, and other great hiſtorical painters, with ſingular delight, he attempted to deſign ſubjects in that ſtyle; and began with the ſtory of Rinaldo ſleeping on the lap of Armida, ſurrounded with the Loves and Graces, the fore ground being enriched with plants and flowers; a work which added greatly to his fame, and was ſold for a very high price. This maſter alſo painted landſcapes and animals with equal truth and neatneſs; and modelled in clay and wax, in ſo ſharp and accurate a manner, that he might juſtly be

Mieris ‖ Mignon. be ranked among the most eminent sculptors. In the delicate finishing of his works, he imitated his father; as he likewise did in the lustre, harmony, and truth, of his paintings, which makes them to be almost as highly prized; but they are not equal in respect of design, or of the striking effect, nor is his touch so very exquisite as that of the father. The works of the old Mieris are better composed, the figures are better grouped, and they have less confusion; yet the younger Mieris is acknowledged to be an artist of extraordinary merit, although inferior to him, who had scarcely his equal. He died in 1747.

MIERIS, *Francis*, called the *Young Francis*, was the son of William, and the grandson of the celebrated Francis Mieris; and was born at Leyden in 1689. He learned the art of painting from his father, whose manner and style he always imitated; he chose the same subjects, and endeavoured to resemble him in his colouring and pencil. But with all his industry he proved far inferior to him: and most of those pictures which at the public sales are said to be of the young Mieris, and many also in private collections ascribed to the elder Francis, or William, are perhaps originally painted by this master, who was far inferior to both; or are only his copies after the works of those excellent painters, as he spent abundance of his time in copying their performances.

MIEZA, in *Ancient Geography*, a town of Macedonia, which was anciently called *Strymonium*, situated near Stagira. Here, Plutarch informs us, the stone seats and shady walks of Aristotle were shown. Of this place was Peucestas, one of Alexander's generals, and therefore surnamed *Miezæus*, (Arrian.)

MIGDOL, or MAGDOL, in *Ancient Geography*, a place in the Lower Egypt, on this side Pihahiroth, or between it and the Red sea, towards its extremity. The term denotes a tower or fortress. It is probably the *Magdolum* of Herodotus, seeing the Septuagint render it by the same name.

MIGNARD, NICHOLAS, an ingenious French painter, born at Troyes in 1628; but, settling at Avignon, is generally distinguished from his brother Peter by the appellation of *Mignard of Avignon*. He was afterwards employed at court and at Paris, where he became rector of the royal academy of painting.

There is a great number of his historical pieces and portraits in the palace of the Thuilleries. He died in 1690.

MIGNARD, *Peter*, the brother of Nicholas, was born at Troyes in 1610; and acquired so much of the taste of the Italian school, as to be known by the name of the *Roman*. He was generally allowed to have a superior genius to his brother Nicholas; and had the honour of painting the popes Alexander VII. and Urban VIII. besides many of the nobility at Rome, and several of the Italian princes: his patron, Louis, sat ten times to him for his portrait, and respected his talents so much as to ennoble him, make him his principal painter after the death of Le Brun, and appointed him director of the manufactories. He died in 1695. and many of his pieces are to be seen at St Cloud.

MIGNON, or MINJON, *Abraham*, a celebrated painter of flowers and still life, was born at Francfort in 1639; and his father having been deprived of the greatest part of his substance by a series of losses in trade, left him in very necessitous circumstances when he was only seven years of age. From that melancholy situation he was rescued by the friendship of James Murel, a flower painter in that city; who took Mignon into his own house, and instructed him in the art, till he was 17 years old. Murel had often observed an uncommon genius in Mignon: he therefore took him along with him to Holland, where he placed him as a disciple with David de Heem; and while he was under the direction of that master he laboured with incessant application to imitate the manner of De Heem, and ever afterwards adhered to it; only adding daily to his improvement, by studying nature with a most exact and curious observation.—"When we consider the paintings of Mignon, one is at a loss (Mr Pilkington observes) whether most to admire the freshness and beauty of his colouring, the truth in every part, the bloom on his objects, or the perfect resemblance of nature visible in all his performances. He always shows a beautiful choice in those flowers and fruits from which his subjects are composed: and he groups them with uncommon elegance. His touch is exquisitely neat, though apparently easy and unlaboured; and he was fond of introducing insects among the fruits and flowers, wonderfully finished, so that even the drops of dew appear as round and as translucent as nature itself." He had the good fortune to be highly paid for his works in his lifetime; and he certainly would have been accounted the best in his profession even to this day, if John Van Huysum had not appeared. Weyerman, who had seen many admired pictures of Mignon, mentions one of a most capital kind. The subject of it is a cat, which had thrown down a pot of flowers, and they lie scattered on a marble table. That picture is in every respect so wonderfully natural, that the spectator can scarce persuade himself that the water which is spilled from the vessel is not really running down from the marble. This picture is distinguished by the title of *Mignon's Cat*. This painter died in 1679, aged only 40.

Migration. MIGRATION, the passage or a removal of a thing out of one place into another.

MIGRATION of Birds.—It has been generally believed, that many different kinds of birds annually pass from one country to another, and spend the summer or the winter where it is most agreeable to them; and that even the birds of our own island will seek the most distant southern regions of Africa, when directed by a peculiar instinct to leave their own country. It has long been an opinion pretty generally received, that swallows reside during the winter season in the warm southern regions; and Mr Adanson particularly relates his having seen them at Senegal when they were obliged to leave this country. But besides the swallow, Mr Pennant enumerates many other birds which migrate from Britain at different times of the year, and are then to be found in other countries; after which they again leave these countries, and return to Britain. The reason of these migrations he supposes to be a defect of food at certain seasons of the year, or the want of a secure asylum from the persecution of man during the time of courtship, incubation, and nutrition. The following is his list of the migrating species. 1 Migration generally believed.

1. *Crows*. Of this genus, the hooded crow migrates regularly with the woodcock. It inhabits North Britain the whole year: a few are said annually to breed on 2 Birds that migrate.

Migration. on Dartmoor, in Devonſhire. It breeds alſo in Sweden and Auſtria: in ſome of the Swediſh provinces it only ſhifts its quarters, in others it reſides throughout the year. Our author is at a loſs for the ſummer retreat of thoſe which viſit us in ſuch numbers in winter, and quit our country in the ſpring; and for the reaſon why a bird, whoſe food is ſuch that it may be found at all ſeaſons in this country, ſhould leave us.

2. *Cuckoo.* Diſappears early in autumn; the retreat of this and the following bird is quite unknown to us.

3. *Wryneck.* Is a bird that leaves us in the winter. If its diet be ants alone, as ſeveral aſſert, the cauſe of its migration is very evident. This bird diſappears before winter, and reviſits us in the ſpring a little earlier than the cuckoo.

4. *Hoopoe.* Comes to England but by accident; Mr Pennant once indeed heard of a pair that attempted to make their neſt in a meadow at Selborne, Hampſhire, but were frighted away by the curioſity of people. It breeds in Germany.

5. *Grous.* The whole tribe, except the quail, lives here all the year round: that bird either leaves us, or elſe retires towards the ſea coaſts.

6. *Pigeons.* Some few of the ring doves breed here; but the multitude that appears in the winter is ſo diſproportioned to what continue here the whole year, as to make it certain that the greateſt part quit the country in the ſpring. It is moſt probable they go to Sweden to breed, and return from thence in autumn; as Mr Ekmark informs us they entirely quit that country before winter. Multitudes of the common wild pigeons alſo make the northern retreat, and viſit us in winter; not but numbers breed in the high cliffs in all parts of this iſland. The turtle alſo probably leaves us in the winter, at leaſt changes its place, removing to the ſouthern counties.

7. *Stare.* Breeds here. Poſſibly ſeveral remove to other countries for that purpoſe, ſince the produce of thoſe that continue here ſeems unequal to the clouds of them that appear in winter. It is not unlikely that many migrate into Sweden, where Mr Berger obſerves they return in ſpring.

8. *Thruſhes.* The fieldfare and the redwing breed and paſs their ſummers in Norway and other cold countries; their food is berries, which abounding in our kingdoms, tempts them here in the winter. Theſe two and the Royſton crow are the only land birds that regularly and conſtantly migrate into England, and do not breed here. The hawfinch and croſsbill come here at ſuch uncertain times as not to deſerve the name of birds of paſſage.

9. *Chatterer.* The chatterer appears annually about Edinburgh in flocks during winter; and feeds on the berries of the mountain aſh. In South Britain it is an accidental viſitant.

10. *Groſbeaks.* The groſbeak and croſsbill come here but ſeldom; they breed in Auſtria. The pine groſbeak probably breeds in the foreſts of the Highlands of Scotland.

11. *Buntings.* All the genus inhabits England throughout the year; except the greater brambling, which is forced here from the north in very ſevere ſeaſons.

12. *Finches.* All continue in ſome parts of theſe kingdoms, except the ſiſkin, which is an irregular viſitant, ſaid to come from Ruſſia. The linnets ſhift their quarters, breeding in one part of this iſland, and remove with their young to others. All finches feed on the ſeeds of plants. Migration.

13. *Larks, fly-catchers, wagtails,* and *warblers.* All of theſe feed on inſects and worms; yet only part of them quit theſe kingdoms; though the reaſon of migration is the ſame to all. The nightingale, blackcap, fly-catcher, willow-wren, wheat-ear, and white-throat, leave us before winter, while the ſmall and delicate golden-creſted wren braves our ſevereſt froſts. The migrants of this genus continue longeſt in Great Britain in the ſouthern counties, the winter in thoſe parts being later than in thoſe of the north; Mr Stillingfleet having obſerved ſeveral wheat-ears in the iſle of Purbeck on the 18th of November. As theſe birds are incapable of very diſtant flights, Spain, or the ſouth of France, is probably their winter aſylum.

14. *Swallows and goatſucker.* Every ſpecies diſappears at the approach of winter.

Water-Fowl.

Of the vaſt variety of water-fowl that frequent Great Britain, it is amazing to reflect how few are known to breed here: the cauſe that principally urges them to leave this country, ſeems to be not merely the want of food, but the deſire of a ſecure retreat. Our country is too populous for birds ſo ſhy and timid as the bulk of theſe are: when great part of our iſland was a mere waſte, a tract of woods and fen, doubtleſs many ſpecies of birds (which at this time migrate) remained in ſecurity throughout the year.—Egrets, a ſpecies of heron now ſcarcely known in this iſland, were in former times in prodigious plenty; and the crane, that has totally forſaken this country, bred familiarly in our marſhes: their place of incubation, as well as of all other cloven-footed water-fowl (the heron excepted), being on the ground, and expoſed to every one. As rural economy increaſed in this country, theſe animals were more and more diſturbed; at length, by a ſeries of alarms, they were neceſſitated to ſeek, during the ſummer, ſome lonely ſafe habitation. 3 Water fowl.

On the contrary, thoſe that build or lay in the almoſt inacceſſible rocks that impend over the Britiſh ſeas, breed there ſtill in vaſt numbers, having little to fear from the approach of mankind: the only diſturbance they meet with in general being from the deſperate attempts of ſome few to get their eggs.

Cloven-footed Water-Fowl.

15. *Herons.* The white heron is an uncommon bird, and viſits us at uncertain ſeaſons; the common kind and the bittern never leave us.

16. *Curlews.* The curlew breeds ſometimes on our mountains: but, conſidering the vaſt flights that appear in winter, it is probable that the greater part retire to other countries: the whimbrel breeds on the Grampian hills, in the neighbourhood of Invercauld.

17. *Snipes.* The woodcock breeds in the moiſt woods of Sweden, and other cold countries. Some ſnipes breed here, but the greateſt part retire elſewhere: as do every other ſpecies of this genus.

18. *Sandpipers.* The lapwing continues here the whole year; the ruff breeds here, but retires in winter; the

Migration. the redſhank and ſandpiper breed in this country, and reſide here. All the others abſent themſelves during ſummer.

19. *Plovers and oyſter-catcher.* The long-legged plover and ſanderling viſit us only in winter; the dottrel appears in ſpring and in autumn; yet, what is very ſingular, we do not find it breeds in South Britain. The oyſter-catcher lives with us the whole year. The Norfolk plover and ſea-lark breed in England. The green plover breeds on the mountains of the north of England, and on the Grampian hills.

We muſt here remark, that every ſpecies of the genera of curlews, woodcocks, ſandpipers, and plovers, that forſakes us in the ſpring, retires to Sweden, Poland, Pruſſia, Norway, and Lapland, to breed: as ſoon as the young can fly, they return to us again, becauſe the froſts which ſet in early in thoſe countries totally deprive them of the means of ſubſiſting; as the dryneſs and hardneſs of the ground, in general, during our ſummer, prevent them from penetrating the earth with their bills, in ſearch of worms, which are the natural food of theſe birds. Mr Ekmark ſpeaks thus of the retreat of the whole tribe of cloven-footed water-fowl out of his country (Sweden) at the approach of winter; and Mr Klein gives much the ſame account of thoſe of Poland and Pruſſia.

20. *Rails and gallinules.* Every ſpecies of theſe two genera continues with us the whole year; the land-rail excepted, which is not ſeen here in winter. It likewiſe continues in Ireland only during the ſummer months, when they are very numerous, as Mr Smith tells us in the Hiſtory of Waterford, p. 336. Great numbers appear in Angleſea the latter end of May; it is ſuppoſed that they paſs over from Ireland, the paſſage between the two iſlands being but ſmall. As we have inſtances of theſe birds lighting on ſhips in the Channel and the bay of Biſcay, we may conjecture their winter quarters to be in Spain.

Finned-footed Water Birds.

21. *Phalaropes.* Viſit us but ſeldom; their breeding place is Lapland, and other arctic regions.

22. *Grebes.* The great creſted grebe, the black and white grebe, and little grebe, breed with us, and never migrate; the others viſit us accidentally, and breed in Lapland.

Web-footed Birds.

23. *Avoſet.* Breed near Foſsdike in Lincolnſhire, but quit their quarters in winter. They are then ſhot in different parts of the kingdom, which they viſit, not regularly, but accidentally.

24. *Auks and guillemots.* The great auk or pinguin ſometimes breeds in St Kilda. The auk, the guillemot, and puffin, inhabit moſt of the maritime cliffs of Great Britain, in amazing numbers, during ſummer. The black guillemot breeds in the Baſs iſle, and in St Kilda, and ſometimes in Llandidno rocks. We are at a loſs for the breeding place of the other ſpecies; neither can we be very certain of the winter reſidence of any of them, excepting of the leſſer guillemot and black-billed auk, which, during winter, viſit in vaſt flocks the frith of Forth.

25. *Divers.* Theſe chiefly breed in the lakes of Sweden and Lapland, and in ſome countries near the pole; but ſome of the red-throated divers, the northern and the imber, may breed in the north of Scotland and its iſles. Migration.

26. *Terns.* Every ſpecies breeds here; but leaves us in the winter.

27. *Petrels.* The fulmar breeds in the iſle of St Kilda, and continues there the whole year except September and part of October: the ſhearwater viſits the iſle of Man in April; breeds there; and, leaving it in Auguſt or the beginning of September, diſperſes over all parts of the Atlantic ocean. The ſtormfinch is ſeen at all diſtances from land on the ſame vaſt watery tract; nor is ever found near the ſhore except by ſome very rare accident, unleſs in the breeding ſeaſon. Mr Pennant found it on ſome little rocky iſles off the north of Skye. It alſo breeds in St Kilda. He alſo ſuſpects that it neſtles on the Blaſquet iſles off Kerry, and that it is the gourder of Mr Smith.

28. *Merganſers.* This whole genus is mentioned among the birds that fill the Lapland lakes during ſummer. Mr Pennant has ſeen the young of the red-breaſted in the north of Scotland: a few of theſe, and perhaps of the gooſanders, may breed there.

29. *Ducks.* Of the numerous ſpecies that form this genus, we know of few that breed here: The ſwan and gooſe, the ſhield duck, the eider duck, a few ſhovelers, garganies, and teals, and a very ſmall portion of the wild ducks.

The reſt contribute to form that amazing multitude of water-fowl that annually repair from moſt parts of Europe to the woods and lakes of Lapland and other arctic regions, there to perform the functions of incubation and nutrition in full ſecurity. They and their young quit their retreat in September, and diſperſe themſelves over Europe. With us they make their appearance the beginning of October; circulate firſt round our ſhores; and, when compelled by ſevere froſt, betake themſelves to our lakes and rivers. Of the web-footed fowl there are ſome of hardier conſtitutions than others: theſe endure the ordinary winters of the more northern countries; but when the cold reigns there with more than common rigour, they repair for ſhelter to theſe kingdoms: this regulates the appearance of ſome of the diver kind, as alſo of the wild ſwans, the ſwallow-tailed ſhield duck, and the different ſorts of gooſanders which then viſit our coaſts. Barenta found the barnacles with their neſts in great numbers in Nova Zembla. (*Collect. Voy. Dutch Eaſt-India Company*, 8vo, 1703, p. 19.). Cluſius, in his *Exot.* 368. alſo obſerves, that the Dutch diſcovered them on the rocks of that country and in Waygate ſtraits. They, as well as the other ſpecies of wild geeſe, go very far north to breed, as appears from the hiſtories of Greenland and Spitzbergen, by Egede and Crantz. Theſe birds ſeem to make Iceland a reſting place, as Horrebow obſerves: few continue there to breed, but only viſit that iſland in the ſpring, and after a ſhort ſtay retire ſtill further north.

30. *Corvorants.* The corvorant and ſhag breed on moſt of our high rocks: the gannet in ſome of the Scotch iſles and on the coaſt of Kerry: the two firſt continue on our ſhores the whole year. The gannet diſperſes itſelf all round the ſeas of Great Britain, in purſuit of the herring and pilchard, and even as far as the Tagus to prey on the ſardina.

But

Migration.

4 Few breed in this country.

But of the numerous ſpecies of fowl here enumerated, it may be obſerved how very few intruſt themſelves to us in the breeding ſeaſon, and what a diſtant flight they make to perform the firſt great dictate of nature.

There ſeems to be ſcarcely any but what we have traced to Lapland, a country of lakes, rivers, ſwamps, and alps, covered with thick and gloomy foreſts, that afford ſhelter during ſummer to theſe fowls, which in winter diſperſe over the greateſt part of Europe. In thoſe arctic regions, by reaſon of the thickneſs of the woods, the ground remains moiſt and penetrable to the woodcocks, and other ſlender-billed fowl: and for the web-footed birds, the waters afford larvæ innumerable of the tormenting gnat. The days there are long; and the beautiful meteorous nights indulge them with every opportunity of collecting ſo minute a food: whilſt mankind is very ſparingly ſcattered over that vaſt northern waſte.

Why then ſhould Linnæus, the great explorer of theſe rude deſerts, be amazed at the myriads of waterfowl that migrated with him out of Lapland? which exceeded in multitude the army of Xerxes; covering, for eight whole days and nights, the ſurface of the river Calix! His partial obſervation as a botaniſt, would confine their food to the vegetable kingdom, almoſt denied to the Lapland waters; inattentive to a more plenteous table of inſect food, which the all-bountiful Creator had ſpread for them in the wilderneſs. It may be remarked, that the lakes of mountainous rocky countries in general are deſtitute of plants: few or none are ſeen on thoſe of Switzerland; and Linnæus makes the ſame obſervation in reſpect to thoſe of Lapland; having, during his whole tour, diſcovered only a ſingle ſpecimen of a *lemma triſulca*, or "ivy-leaved duck's meat," *Flora Lap.* N° 470.; a few of the *ſcirpus lacuſtris*, or "bullruſh," N° 18.; the *alopecurus geniculatus*, or "flote foxtail-graſs," N° 38.; and the *ranunculus aquatilis*, N° 234.; which are all he enumerates in his *Prolegomena* to that excellent performance.

5 Arguments againſt migration.

We ſhall afterwards ſtate the principal arguments for and againſt the migration of ſwallows; but here we ſhall give a ſhort abſtract of the arguments uſed by the Hon. Daines Barrington againſt the migration of birds in general, from a paper publiſhed by him in the 62d volume of the Philoſophical Tranſactions. This gentleman denies that any well-atteſted inſtances can be produced of this ſuppoſed migration; which, he thinks, if there were any ſuch periodical flight, could not poſſibly have eſcaped the frequent obſervation of ſeamen. It has indeed been aſſerted that birds of paſſage become inviſible in their flight, becauſe they riſe too high in the air to be perceived, and becauſe they chooſe the night for their paſſage. The author, however, expreſſes his doubts "whether any bird was ever ſeen to riſe to a greater height than perhaps twice that of St Paul's croſs;" and he further endeavours to ſhow, that the extent of ſome of theſe ſuppoſed migrations (from the northern parts of Europe, for inſtance, to the line) is too great to be accounted for, by having recourſe to the argument founded on a nocturnal paſſage.

The author next recites, in a chronological order, all the inſtances that he has been able to collect, of birds having been actually ſeen by mariners when they were croſſing a large extent of ſea; and he endeavours to ſhow that no ſtreſs can be laid on the few caſual obſervations of this kind that have been produced in ſupport of the doctrine of a regular and periodical migration.

Mr Barrington afterwards proceeds to invalidate M. Adanſon's celebrated obſervation with reſpect to the migration of the ſwallow in particular, and which has been conſidered by many as perfectly deciſive of the preſent queſtion. He endeavours to ſhow that the four ſwallows which that naturaliſt caught, on their ſettling upon his ſhip, on the 6th of October, at about the diſtance of 50 leagues from the coaſt of Senegal, and which he ſuppoſes to have been then proceeding from Europe to paſs the winter in Africa, could not be true European ſwallows; or, if they were, could not have been on their return from Europe to Africa. His objections are founded principally on ſome proofs which he produces of M. Adanſon's want of accuracy on this ſubject, which has led him, in the preſent inſtance, to miſtake two African ſpecies of the ſwallow tribe, deſcribed and engraved by Briſſon, for European ſwallows, to which they bear a general reſemblance; or granting even that they were European ſwallows, he contends that they were flitting from the Cape de Verd iſlands to the coaſt of Africa; "to which ſhort flight, however, they were unequal, and accordingly fell into the ſailors hands."—We ſhall here only add, in oppoſition to the remarks of Mr Barrington, the following obſervations of the Rev. Mr White * in a letter to Mr Pennant on this ſubject.

* *Natural Hiſtory of Selborne*, letter ix. p. 139.

6 Arguments in ſupport of it.

"We muſt not (ſays he) deny migration in general; becauſe migration certainly does ſubſiſt in ſome places, as my brother in Andaluſia has fully informed me. Of the motions of theſe birds he has ocular demonſtration, for many weeks together, both ſpring and fall: during which periods myriads of the ſwallow kind traverſe the Straits from north to ſouth, and from ſouth to north, according to the ſeaſon. And theſe vaſt migrations conſiſt not only of hirundines, but of bee-birds, hoopoes, oro pendolos, or golden thruſhes, &c. &c. and alſo of many of our ſoft-billed ſummer birds of paſſage; and moreover of birds which never leave ús, ſuch as all the various ſorts of hawks and kites. Old Belon, 200 years ago, gives a curious account of the incredible armies of hawks and kites which he ſaw in the ſpring time traverſing the Thracian Boſphorus from Aſia to Europe. Beſides the above mentioned, he remarks that the proceſſion is ſwelled by whole troops of eagles and vultures.

"Now it is no wonder that birds reſiding in Africa ſhould retreat before the ſun as it advances, and retire to milder regions, and eſpecially birds of prey, whoſe blood being heated with hot animal food, are more impatient of a ſultry climate: but then I cannot help wondering why kites and hawks, and ſuch hardy birds as are known to defy all the ſeverity of England, and even of Sweden and all northern Europe, ſhould want to migrate from the ſouth of Europe, and be diſſatisfied with the winters of Andaluſia.

"It does not appear to me that much ſtreſs may be laid on the difficulty and hazard that birds muſt run in their migrations, by reaſon of vaſt oceans, croſs winds, &c.; becauſe, if we reflect, a bird may travel from England to the equator without launching out and ex-

poſing

poſing itſelf to boundleſs ſeas, and that by croſſing the water at Dover and again at Gibraltar. And I with the more confidence advance this obvious remark, becauſe my brother has always found that ſome of his birds, and particularly the ſwallow kind, are very ſparing of their pains in croſſing the Mediterranean: for when arrived at Gibraltar, they do not,

——— " rang'd in figure, wedge their way,
——— " and ſet forth
" Their airy caravan high over ſeas
" Flying, and over lands with mutual wing
" Eaſing their flight." MILTON.

but ſcout and hurry along in little detached parties of ſix or ſeven in a company; and ſweeping low, juſt over the ſurface of the land and water, direct their courſe to the oppoſite continent at the narroweſt paſſage they can find. They uſually ſlope acroſs the bay to the ſouth-weſt, and ſo paſs over oppoſite to Tangier, which it ſeems is the narroweſt ſpace.

" In former letters we have conſidered whether it was probable that woodcocks in moon-ſhiny nights croſs the German ocean from Scandinavia. As a proof that birds of leſs ſpeed may paſs that ſea, conſiderable as it is, I ſhall relate the following incident, which, though mentioned to have happened ſo many years ago, was ſtrictly matter of fact:—As ſome people were ſhooting in the pariſh of Trotton, in the county of Suſſex, they killed a duck in that dreadful winter 1708-9, with a ſilver collar about its neck (I have read a like anecdote of a ſwan), on which were engraven the arms of the king of Denmark. This anecdote the rector of Trotton at that time has often told to a near relation of mine; and, to the beſt of my remembrance, the collar was in the poſſeſſion of the rector.

" At preſent I do not know any body near the ſea ſide that will take the trouble to remark at what time of the moon woodcocks firſt come. One thing I uſed to obſerve when I was a ſportſman, that there were times in which woodcocks were ſo ſluggiſh and ſleepy that they would drop again when fluſhed juſt before the ſpaniels, nay juſt at the muzzle of a gun that had been fired at them: whether this ſtrange lazineſs was the effect of a recent fatiguing journey, I ſhall not preſume to ſay.

" Nightingales not only never reach Northumberland and Scotland, but alſo, as I have been always told, Devonſhire and Cornwall. In thoſe two laſt counties we cannot attribute the failure of them to the want of warmth: the defect in the weſt is rather a preſumptive argument that theſe birds come over to us from the continent at the narroweſt paſſage, and do not ſtroll ſo far weſtward."

7 Queſtion, What becomes of ſwallows in winter?

Upon the ſubject of the migration of the ſwallow there are three opinions. Some ſay that it migrates to a warmer climate; ſome, that it retires to hollow trees and caverns, where it lies in a torpid ſtate; and others have affirmed, that it lies in the ſame ſtate in the bottom of lakes and under the ice. The firſt opinion is ſupported by Marſigli, Ray, Willoughby, Cateſby, Reaumur, Adanſon, Buffon, &c. The firſt and ſecond opinion are both adopted by Pennant and White. The third is ſanctioned by Schæffer, Hevelius, Derham, Klein, Ellis, Linnæus, Kalm: and the ſecond and third have been ſtrongly defended by the honourable Daines Barrington.

Though we cannot help giving a preference to that opinion which appears the moſt probable, yet we do not think that any one of them is eſtabliſhed upon ſuch evidence as ſo curious a ſubject requires, and as the advanced ſtate of natural hiſtory would lead us to expect. We ſhall therefore ſtate the arguments upon which each opinion is founded as fairly and diſtinctly as we can, and as often as poſſible in the very words of their reſpective advocates. By doing ſo, we ſhall place the whole ſubject before the eyes of our readers, who will thus have an opportunity of examining it attentively, and of making ſuch obſervations and experiments as may lead to the truth.

8 Firſt opinion ſtated, that they migrate to warm climates.

Thoſe who aſſert that the ſwallow migrates to a warmer country in winter, argue in this manner: That many birds migrate, is a fact fully proved by the obſervations of natural hiſtorians. Is it not more probable, therefore, that ſwallows, which diſappear regularly every ſeaſon, retire to ſome other country, than that they lie in a ſtate of torpor in caverns or lakes? But this opinion does not reſt on probability, it is founded on facts.

We often ſee them collected in great flocks on churches, rocks, and trees, about the time when they annually diſappear. The direction of their flight has been obſerved to be ſouthward. Mr White, the ingenious hiſtorian of Selborne, travelling near the coaſt of the Britiſh Channel one morning early, ſaw a flock of ſwallows take their departure. At the beginning of his journey he was environed with a thick fog; but on a large wild heath the miſt began to break, and diſcovered to him numberleſs ſwallows, cluſtered on the ſtanding buſhes, as if they had rooſted there: as ſoon as the ſun burſt out, they were inſtantly on wing, and with an eaſy and placid flight proceeded towards the ſea. After this he ſaw no more flocks, only now and then a ſtraggler. *Natural Hiſtory of Selborne, p. 64.*

Mr Laſkey of Exeter obſerved attentively the direction which a flock of ſwallows took in the autumn of 1793. On the 22d of Sept. about ſeven o'clock in the morning, the wind being eaſterly, accompanied with a cold drizzling rain, Mr Laſkey's houſe was entirely covered with houſe-ſwallows. At intervals large flocks arrived and joined the main body, and at their arrival an unuſual chirping commenced. The appearance of the whole company was ſo lethargic, that he found it an eaſy matter to catch a conſiderable number of them, which he kept in a room all that day. By heating the room they all revived: he opened four of them, and found their ſtomachs quite full. The main body occupied the houſe top all day, except for two hours. About half an hour after nine in the morning of the 23d, there was a great commotion, with very loud chirping, and within a few minutes after, the whole multitude took their flight, in a direct ſouth-eaſt direction, having aſcended to a great height in the atmoſphere. He let go the birds which he had caught, at certain intervals till four o'clock, and they all flew toward the ſame quarter. *Gent. Mag. for 1796.*

Not only has the direction of their flight been obſerved, but they have alſo been found on their paſſage at a great diſtance from land. Mr Adanſon informs us, that about 50 leagues from the coaſt of Senegal four ſwallows ſettled upon the ſhip on the 6th of October; that

Migration. that theſe birds were taken; and that he knew them to be European ſwallows, which, he conjectures, were returning to the coaſt of Africa. Sir Charles Wager's authority may alſo be appealed to: "Returning home (ſays he) in the ſpring of the year, as I came into ſoundings in our channel, a great flock of ſwallows came and ſettled on all my rigging; every rope was covered, they hung on one another like a ſwarm of bees; the decks and carving were filled with them. They ſeemed almoſt famiſhed and ſpent, and were only feathers and bones; but, being recruited with a night's reſt, took their flight in the morning." This vaſt fatigue proves that their journey muſt have been very great, conſidering the amazing ſwiftneſs of theſe birds: in all probability they had croſſed the Atlantic ocean, and were returning from the ſhores of Senegal, or other parts of Africa; ſo that this account from that moſt able and honeſt ſeaman, confirms the later information of Mr Adanſon.

Philoſophical Tranſactions, vol. liii.

Mr Kalm, who is an advocate for the opinion that ſwallows lie immerſed in lakes during winter, acknowledges that in croſſing the Atlantic from Europe a ſwallow lighted on the ſhip on the 2d September, when it had paſſed only two-thirds of the ocean. Since, therefore, ſwallows have been ſeen aſſembled in great flocks in autumn flying off in company towards ſouthern climes, ſince they have been found both in their paſſage from Europe and returning again, can there be any doubt of their annual migration?—Mr Barrington's objections to this opinion have been noticed above in N° 5.

Kalm's Voyage, vol. i. p. 24.

9
Second opinion, that ſome lie in caverns in a torpid ſtate.

The ſecond notion (ſays Mr Pennant) has great antiquity on its ſide. Ariſtotle and Pliny give it as their belief, that ſwallows do not remove very far from their ſummer habitation, but winter in the hollows of rocks, and during that time loſe their feathers. The former part of their opinion has been adopted by ſeveral ingenious men; and of late ſeveral proofs have been brought of ſome ſpecies, at leaſt, having been diſcovered in a torpid ſtate. Mr Collinſon favoured us with the evidence of three gentlemen, eye-witneſſes to numbers of ſand martins being drawn out of a cliff on the Rhine, in the month of March 1762. And the honourable Daines Barrington communicated to us the following fact, on the authority of Lord Belhaven, That numbers of ſwallows have been found in old dry walls and in ſand-hills near his Lordſhip's ſeat in Eaſt Lothian; not once only, but from year to year; and that when they were expoſed to the warmth of a fire, they revived. We have alſo heard of the ſame annual diſcoveries near Morpeth in Northumberland, but cannot ſpeak of them with the ſame aſſurance as the two former: neither in the two laſt inſtances are we certain of the particular ſpecies.

Pennant's Britiſh Zoology, vol. ii. p. 250.

"Other witneſſes crowd on us to prove the reſidence of thoſe birds in a torpid ſtate during the ſevere ſeaſon. Firſt, In the chalky cliffs of Suſſex; as was ſeen on the fall of a great fragment ſome years ago. Secondly, In a decayed hollow tree that was cut down, near Dolgelli, in Merionethſhire. Thirdly, In a cliff near Whitby, Yorkſhire; where, on digging out a fox, whole buſhels of ſwallows were found in a torpid condition. And, laſtly, The reverend Mr Conway of Sychton, Flintſhire, was ſo obliging as to communicate the following fact: A few years ago, on looking down an old lead-mine in that county, he obſerved numbers of ſwallows clinging to the timbers of the ſhaft, ſeemingly aſleep; and on flinging ſome gravel on them, they juſt moved, but never attempted to fly or change their place: this was between All Saints and Chriſtmas.

"Theſe are doubtleſs the lurking places of the later hatches, or of thoſe young birds which are incapable of diſtant migrations. There they continue inſenſible and rigid; but like flies may ſometimes be reanimated by an unſeaſonable hot day in the midſt of winter: for very near Chriſtmas a few appeared on the moulding of a window of Merton college, Oxford, in a remarkably warm nook, which prematurely ſet their blood in motion, having the ſame effect as laying them before a fire at the ſame time of year. Others have been known to make this premature appearance; but as ſoon as the cold natural to the ſeaſon returns, they withdraw again to their former retreats.

"The above are circumſtances we cannot but aſſent to, though ſeemingly contradictory to the common courſe of nature in regard to other birds. We muſt, therefore, divide our belief relating to theſe two ſo different opinions; and conclude, that one part of the ſwallow tribe migrate, and that others have their winter quarters near home. If it ſhould be demanded, why ſwallows alone are found in a torpid ſtate, and not the other many ſpecies of ſoft-billed birds, which likewiſe diſappear about the ſame time? reaſons might be aſſigned." 10

Third opinion, that ſome lie immerſed in water.

The third opinion we ſhall ſtate and ſupport in the words of Mr Kalm. "Natural hiſtory (ſays he), as all other hiſtories, depends not always upon the intrinſic degree of probability, but upon facts founded on the teſtimony of people of noted veracity.—Swallows are ſeldom ſeen ſinking down into water; ſwallows have not ſuch organs as frogs or lizards, which are torpid during winter; *ergo*, ſwallows live not, and cannot live, under water.—This way of arguing, I believe, would carry us, in a great many caſes too far: for though it is not clear to every one, it may however be true; and lizards and frogs are animals of a claſs widely different from that of birds, and muſt therefore of courſe have a different ſtructure; hence it is they are claſſed ſeparately. The bear and marmot are in winter in a torpid ſtate, and have, however, not ſuch organs as lizards and frogs; and nobody doubts of their being, during ſome time, in the moſt rigid climates, in a torpid ſtate: for the Alpine nations hunt the marmots frequently by digging their holes up; and find them ſo torpid, that they cut their throats, without their reviving or giving the leaſt ſign of life during the operation; but when the torpid marmot is brought into a warm room, and placed before the fire, it revives from its lethargy. The queſtion muſt therefore be decided by facts; nor are theſe wanting here. Dr Wallerius, the celebrated Swediſh chemiſt, informs us, That he has ſeen, more than once, ſwallows aſſembling on a reed, till they were all immerſed and went to the bottom; this being preceded by a dirge of a quarter of an hour's length. He atteſts likewiſe, that he had ſeen a ſwallow caught during winter out of a lake with a net, drawn, as is common in northern countries, under the ice; this bird was brought into a warm room, revived, fluttered about, and ſoon after died.

"Mr Klein applied to many farmers-general of the

Migration. king of Pruſſia's domains, who had great lakes in their diſtricts, the fiſhery in them being a part of the revenue. In winter the fiſhery thereon is the moſt conſiderable under the ice, with nets ſpreading more than 200 or 300 fathoms, and they are often wound by ſcrews and engines on account of their weight. All the people that were queſtioned made affidavits upon oath before the magiſtrates. Firſt, The mother of the counteſs Lehndorf ſaid, that ſhe had ſeen a bundle of ſwallows brought from the Friſhe-Haff (a lake communicating with the Baltic at Pillaw), which, when brought into a moderately warm room, revived and fluttered about. Secondly, Count Schileben gave an inſtrument on ſtamped paper, importing, that by fiſhing on the lake belonging to his eſtate of Gerdauen in winter, he ſaw ſeveral ſwallows caught in the net, one of which he took up in his hand, brought it into a warm room, where it lay about an hour, when it began to ſtir, and half an hour after, it flew about in the room. Thirdly, Farmer-general (Amtman) Witkouſki made affidavit, that, in the year 1740, three ſwallows were brought up with the net in the great pond at Didlacken; in the year 1741 he got two ſwallows from another part of the pond, and took them home (they being all caught in his preſence); after an hour's ſpace they revived all in a warm room, fluttered about, and died in three hours after. Fourthly, Amtman Bonke ſays, that having had the eſtate of Kleſkow in farm, he had ſeen nine ſwallows brought up in the net from under the ice, all which he took into a warm room, where he diſtinctly obſerved how they gradually revived; but a few hours after they all died. Another time his people got likewiſe ſome ſwallows in a net, but he ordered them to be again thrown into the water. Fifthly, Andrew Rutta, a maſter fiſherman at Oletſko, made affidavit, in 1747, that 22 years ago, two ſwallows were taken up by him in a net, under the ice, and, being brought into a warm room, they flew about. Sixthly, Jacob Koſiulo, a maſter fiſherman at Stradauen made affidavit, that, in 1736, he brought up in winter, in a net, from under the ice of the lake at Raſki, a ſeemingly dead ſwallow, which revived in half an hour's time in a warm room; and he ſaw, in a quarter of an hour after, the bird grow weaker, and ſoon after dying. Seventhly, I can reckon myſelf (ſays our author) among the eye-witneſſes of this paradox of natural hiſtory. In the year 1735, being a little boy, I ſaw ſeveral ſwallows brought in winter by the fiſhermen from the river Viſtula to my father's houſe; where two of them were brought into a warm room, revived, and flew about. I ſaw them ſeveral times ſettling on the warm ſtove (which the northern nations have in their rooms); and I recollect well, that the ſame forenoon they died, and I had them, when dead, in my hand. In the year 1754, after the death of my uncle Godefroy Wolf, captain in the Poliſh regiment of foot guards, being myſelf one of his heirs, I adminiſtered for my co-heirs ſeveral eſtates called the *Staroſty of Diſchau*, in Poliſh Pruſſia, which my late uncle farmed under the king. In January, the lake of Lybſhaw, belonging to theſe eſtates, being covered with ice, I ordered the fiſhermen to fiſh therein, and in my preſence ſeveral ſwallows were taken, which the fiſhermen threw in again; but one I took up myſelf, brought it home, which was five miles from thence, and it revived, but died about an hour after its reviving.

"Theſe are facts atteſted by people of the higheſt quality, by ſome in public offices, and by others who, though of a low rank, however, made theſe affidavits upon oath. It is impoſſible to ſuppoſe indiſcriminately that they were prompted, by views of intereſt, to aſſert as a fact a thing which had no truth in it. It is therefore highly probable, or rather inconteſtably true, that ſwallows retire in the northern countries, during winter, into the water, and ſtay there in a torpid ſtate till the return of warmth revives them again in ſpring. The queſtion therefore, I believe, ought for the future to be thus ſtated: The ſwallows in Spain, Italy, France, and perhaps ſome from England, remove to warmer climates; ſome Engliſh ones, and ſome in Germany and other mild countries, retire into clefts and holes in rocks, and remain there in a torpid ſtate. In the colder northern countries the ſwallows immerſe in the ſea, in lakes, and rivers; and remain in a torpid ſtate, under ice, during winter. There are ſtill ſome objections to this latter aſſertion, which we muſt remove. It is ſaid, Why do not rapacious fiſh, and aquatic quadrupeds and birds, devour theſe ſwallows? The anſwer is obvious, ſwallows chooſe only ſuch places in the water for their winter retreat as are near reeds and ruſhes; ſo that ſinking down there between them and their roots, they are by them ſecured againſt the rapacioufneſs of their enemies. But others object, Why are not theſe birds caught in ſuch freſh waters as are continually haraſſed by nets? I believe the ſame anſwer which has been made to the firſt objection will ſerve for this likewiſe. Fiſhermen take care to keep off with their nets from places filled with reeds and ruſhes, for fear of entangling and tearing their net; and thus the ſituation of ſwallows under water, is the reaſon that they are ſeldom diſturbed in their ſilent winter retreats. What confirms this opinion ſtill more is, that ſwallows were never caught in Pruſſia according to the above-mentioned affidavits, but with thoſe parts of the net which paſſed near to the reeds and ruſhes; and ſometimes the ſwallows were yet faſtened with their feet to a reed, when they were drawn up by the net. As to the argument taken from their being ſo long under water without corruption, I believe there is a real difference between animals ſuffocated in water and animals being torpid therein. We have examples of things being a long time under water; to which we may add the intenſe cold of theſe northern regions, which preſerves them. Who would have thought that ſnails and polypes might be diſſected, and could reproduce the parts ſevered from their bodies, if it was not a fact? Natural hiſtory ought to be ſtudied as a collection of facts, not as the hiſtory of our gueſſes or opinions. Nature varies in an infinite manner; and Providence has diverſified the inſtinct of animals and their economy, and adapted it to the various ſeaſons and climates."

11
This queſtion ought to be determined, not by reaſoning, but by experiment.

With Mr Kalm's concluding obſervations we heartily concur. Natural hiſtory ought to be ſtudied as a collection of facts; and it was from this very notion that we have ſtated the above-mentioned opinions ſo fully, and brought together the facts which the beſt advocates for each opinion have judged moſt proper for ſupporting

Migration. supporting them. We are ſenſible of the great improbability of the third opinion, and know that many arguments have been uſed to prove its abſurdity: ſuch as theſe, The ſwallow is lighter than water, and therefore cannot ſink; if it moults at all, it muſt moult under water during its torpid ſtate, which is very improbable; there is no inſtance of land animals living ſo long under water without reſpiration. Many other arguments of the ſame ſort have been advanced, and certainly afford a ſhort way of deciding the queſtion; but unleſs they were ſufficient to prove the immerſion of ſwallows a phyſical impoſſibility, they are of no force when oppoſed to the evidence of teſtimony, if there be no cauſe to ſuſpect the witneſſes of inaccuracy or deſign. The true way to refute ſuch an opinion is by accurate obſervation and experiment. We have not heard of any accurate inquiries being made by philoſophers in thoſe northern countries where ſwallows are ſaid to paſs the winter under water. The count de Buffon, indeed, ſhut up ſome ſwallows in an ice-houſe by way of experiment, which died in a few days; but as he does not tell us what precautions he took to make the experiment ſucceed, it is not entitled to any attention.

Mr John Hunter made a very judicious experiment on the banks of the Thames, which is deſcribed by a correſpondent in the Gentleman's Magazine, who aſſerts that he had it from Mr Hunter himſelf.

Gentleman's Magazine, May 1796.

One year in the month of September, he prepared a room, with every accommodation and convenience which he could contrive, to ſerve as a dormitory for ſwallows, if they were diſpoſed to ſleep in winter. He placed in the centre a large tub of water with twigs and reeds, &c. which reached to the bottom. In the corners of the room he contrived artificial caverns and holes, into which they might retire; and he laid on the floor, or ſuſpended in the air, different lengths of old wooden pipes, which had formerly been employed in conveying water through the ſtreets, &c.

12 Mr Hunter's experiment ingenious;

When the receptacle was rendered as complete as poſſible, he then engaged ſome watermen to take by night a large quantity of the ſwallows that hang upon the reeds in the Thames about the time of their departure. They brought him, in a hamper, a conſiderable number; and had ſo nicely hit the time of their capture, that on the very day following there were none to be ſeen.

He put the ſwallows into the room ſo prepared, where they continued to fly about, and occaſionally perch on the twigs, &c. But not one ever retired into the water, the caverns, holes, or wooden pipes, or ſhewed the leaſt diſpoſition to grow torpid, &c. In this ſituation he let them remain till they all died but one. This appearing to retain ſome vigour, was ſet at at liberty; when it mounted out of ſight, and flew away. All the birds lay dead ſcattered about the room; but not one was found aſleep or torpid, or had, if the correſpondent remembers, ſo much as crept into any of the receptacles he had ſo provided.

13 but not deciſive with reſpect to northern climates.

This experiment was ingenious, and certainly does render the doctrine of immerſion much more improbable; but it is not deciſive; for it may ſtill be urged by the advocates for that doctrine, as Mr Kalm has done, that it may only be in the colder countries where ſwallows retire into the water. We formerly ſaid that none of the three opinions is ſupported by ſuch evidence as to ſatisfy the mind completely. Opinions reſpecting events which happen every year ought to be confirmed by a great number of obſervations, and not by a few inſtances diveſted of almoſt all their concomitant circumſtances. Can no better proofs be brought to prove the migration of ſwallows than thoſe of Adanſon and Sir Charles Wager, or the circumſtances mentioned by Mr White and Mr Laſkey reſpecting their diſappearing? We ought not merely to know that ſome ſwallows have taken a ſoutherly flight in autumn, that ſome have been found at a great diſtance from land in the ſpring, or in harveſt; but we ought to know to what countries they actually retire. Before we can reſt ſatisfied, too, that it is a general fact that ſwallows remain in a torpid ſtate during winter, either in caverns or in the bottom of lakes, &c. we muſt have more proofs; we muſt know what ſpecies of ſwallows they are ſaid to be, in what countries this event takes place, and ſeveral other circumſtances of the ſame kind.

14 Many things yet remain to be done in order to determine this point.

We cannot help being of opinion that much remains to be done in order properly to aſcertain what becomes of the ſwallows in Europe during winter. It would be neceſſary, in the firſt place, to know accurately what are the countries in which ſwallows are found. 2. Do they remain viſible the whole year? or, if they diſappear, at what ſeaſon does this happen, and when do they appear again? 3. Do they ever appear while a ſtrong north wind blows, or do they only come in great numbers with a ſouth wind? We will endeavour to anſwer ſome of theſe queſtions in part; but muſt regret, that all the information on this ſubject which we have been able to cull from the beſt writers in natural hiſtory is very ſcanty; and we merely give it by way of ſpecimen, hoping that future obſervations will render it more complete.

15 A few important facts ſtated.

There are five ſpecies which viſit Britain during the ſummer months; the common or chimney ſwallow, the martin, ſand martin, ſwift, and goat-ſucker. 1. The chimney ſwallow frequents almoſt every part of the old continent; being known (ſays Dr Latham) from Norway to the Cape of Good Hope on the one ſide, and from Kamtſchatka to India and Japan on the other. It is alſo found in all parts of North America, and in ſeveral of the Weſt Indian iſlands. In Europe it diſappears during the winter months. It appears generally a little after the vernal equinox; but rather earlier in the ſouthern, and later in the northern latitudes. It adheres to the uſual ſeaſons with much regularity; for though the months of February and March ſhould be uncommonly mild, and April and May remarkably cold, it never deviates from its ordinary time. In the cold ſpring of 1740 ſome appeared in France before the inſects on which they feed had become numerous enough to ſupport them, and great numbers died †. In the mild and even warm ſpring of 1774 they appeared no earlier than uſual. They remain in ſome warm countries the whole year. Kolben aſſures us that this is the caſe at the Cape of Good Hope; but (he ſays) they are more numerous in winter. Some birds of this ſpecies live, during winter, even in Europe; for example, on the coaſt of Genoa, where they ſpend the night in the open country on the orange ſhrubs.

† *Buffon's Natural Hiſtory of Birds*, vol. vi. p. 527.

2. The

2. The *martins* are alſo widely diffuſed through the old continent; but the countries where they reſide or viſit have not been marked by naturaliſts with much attention. 3. The *ſand martins* are found in every part of Europe, and frequently ſpend the winter in Malta ‡. Two birds of this ſpecies were ſeen in Perigord in France, on the 27th December 1775, when there was a ſoutherly wind, attended with a little rain ‖. 4. The *ſwift* viſits the whole continent of Europe; has alſo been obſerved at the Cape of Good Hope, and in Carolina in North America. 5. The *goat-ſuckers* are not very common birds, yet are widely ſcattered. They are found in every country between Sweden and Africa: they are found alſo in India. In April the ſouth-weſt wind brings them to Malta, and in autumn they repaſs in great numbers.

‡ *Ibid.* 527.

‖ *Ibid.* 484.

Tranſactions of the Linnæan Society, vol. i.

Mr Markwick of Catsfield, near Battle in Suſſex, has drawn up an accurate table, expreſſing the day of the month on which the birds, commonly called *migratory*, appeared in ſpring, and diſappeared in autumn, for 16 years, from 1768 to 1783 incluſive. The obſervations were made at Catsfield. From this table we ſhall extract the dates for five years, and add the very few obſervations which we have been able to collect reſpecting the time when the ſwallow appears and diſappears in other countries.

	Firſt ſeen.	*Laſt ſeen.*
	1779.	
Chimney Swallow	April 14.	October 29.
Martins	14.	15.
Sand Martin	May 7.	
Swift	9.	
	1780.	
Chimney Swallow		November 3.
Martins	April 29.	3.
Sand Martin	8.	September 8.
Swift	May 6.	8.
	1781.	
Chimney Swallow	April 8.	October 15.
Martins	May 12.	September 7.
Sand Martin	April 26.	September 1.
Swift	May 12.	1.
	1782.	
Chimney Swallow	April 22.	September 1.
Martins	26.	November 2.
Sand Martin	May 15.	Auguſt 28.
Swift	18.	28.
	1783.	
Chimney Swallow	April 13.	November 6.
Martins	May 1.	6.
Sand Martin	July 25.	September 1.
Swift	May 13.	November 6.

	Chim. Swal.	Swifts.	Martins.	S. Mart.
		Appear about		
In Burgundy †			Ap. 9.	Ap. 12.
In Selborne, Hampſhire ‡	Ap. 4.	Ap. 24.	Ap. 30.	
In South Zele, Devonſhire ‡	25.	May 1.	May 15.	
In Blackburn, Lancaſhire ‡	29.	Ap. 28.		
In Upſal in Sweden §			May 9.	

† *Buffon*, ibid.

‡ *White's Natural Hiſtory of Selborne*,

§ *Buffon*, ibid.

Were tables of the ſame kind made in every different country, particularly within the torrid zone, it would be eaſy to determine the queſtion which we have been conſidering. To many, perhaps, it may not appear a matter of ſuch importance as to be worth the labour. We acknowledge it to be rather a curious than an important inquiry; yet it is one which muſt be highly gratifying to every mind that can admire the wiſdom of the Great Architect of nature. The inſtinct of the ſwallow is indeed wonderful: it appears among us juſt at the time when inſects become numerous; and it continues with us during the hot weather, in order to prevent them from multiplying too much. It diſappears when theſe inſects are no longer troubleſome. It is never found in ſolitude; it is the friend of man, and always takes up its reſidence with us, that it may protect our houſes and our ſtreets from being annoyed with ſwarms of flies.

Migration of Fiſhes. See Clupea.

St MIGUEL, one of the Azore iſlands, ſituated in W. Long. 22. 45. N. Lat. 38. 10. This iſland appears to be entirely volcanic. The beſt account we have of it hath been publiſhed in the 68th volume of the Philoſophical Tranſactions by Mr Francis Maſſon. According to him, the productions differ greatly from thoſe of Madeira, inſomuch that none of the trees of the latter are found here, except the faya: it has a nearer affinity to Europe than Africa. The mountains are covered with the erica vulgaris, and an elegant evergreen ſhrub very like a phillyrea, which gives them a moſt beautiful appearance.

It is one of the principal and moſt fertile of the Azorian iſlands, lying nearly eaſt and weſt. Its length is about 18 or 20 leagues; its breadth unequal, not exceeding five leagues, and in ſome places not more than two. It contains about 80,000 inhabitants.

Its capital, the city of Ponta del Guda, which contains about 12,000 inhabitants, is ſituated on the ſouth ſide of the iſland, on a fine fertile plain country, pretty regularly built; the ſtreets ſtraight, and of a good breadth. It is ſupplied with good water, which is brought about the diſtance of three leagues from the neighbouring mountains. The churches and other religious edifices are elegant and well built for ſuch an iſland. There is a large convent of Franciſcan friars and one of the order of St Auguſtine, four convents for profeſſed nuns, and three Ricolhimentos for young women and widows who are not profeſſed. The veſſels anchor in an open road; but it is not dangerous, as no wind can prevent their going to ſea in caſe of ſtormy weather.

The country round the city is plain for ſeveral miles, well cultivated, and laid out with good taſte into ſpacious fields, which are ſown with wheat, barley, Indian corn, pulſe, &c. and commonly produce annually two crops; for as ſoon as one is taken off, another is immediately ſown in its place. The ſoil is remarkably gentle and eaſy to work, being for the moſt part compoſed of pulverized pumice ſtone. There are in the plains a number of pleaſant country ſeats, with orchards of orange trees, which are eſteemed the beſt in Europe.

The ſecond town is Ribeira Grande, ſituated on the north ſide of the iſland, containing about as many inhabitants as the city; a large convent of Franciſcan friars, and one of nuns. It gives title to a count, called the *Conde Ribeira Grande*, who firſt inſtituted linen and woollen manufactories in the iſland.

The third town is Villa Franca, on the ſouth ſide of the iſland, about ſix leagues eaſt of Ponta del Guda. It

Miguel. It has a convent of Franciſcan friars and one of nuns, which contains about 300. Here, about half a mile from the ſhore, lies a ſmall iſland (Ilhao), which is hollow in the middle, and contains a fine baſon with only one entrance into it, fit to hold 50 ſail of veſſels ſecure from all weather; at preſent it wants cleaning out, as the winter rain waſhes down great quantities of earth into it, which has greatly diminiſhed its depth. But veſſels frequently anchor between this iſland and the main.

Beſides theſe towns are ſeveral ſmaller, viz. Alagao, Agoa de Pao, Brelanha, Fanaes de Ajuda, and a number of hamlets, called *lugars* or *places*.

About four leagues north-eaſt from Villa Franca, lies a place called the Furnas, being a round deep valley in the middle of the eaſt part of the iſland, ſurrounded with high mountains, which, though ſteep, may be eaſily aſcended on horſeback by two roads. The valley is about five or ſix leagues in circuit. The face of the mountains, which are very ſteep, is entirely covered with beautiful evergreens, viz. myrtles, laurels, a large ſpecies of bilberry called *uva de ſerra* &c. and numberleſs rivulets of the pureſt water run down their ſides. The valley below is well cultivated, producing wheat, Indian corn, flax, &c. The fields are planted round with a beautiful ſort of poplars, which grow into pyramidal forms, and by their careleſs irregular diſpoſition, together with the multitude of rivulets, which run in all directions through the valley, a number of boiling fountains throwing up clouds of ſteam, a fine lake in the ſouth-weſt part about two leagues round, compoſe a proſpect the fineſt that can be imagined. In the bottom of the valley the roads are ſmooth and eaſy, there being no rocks, but a fine pulverized pumice ſtone that the earth is compoſed of.

There are numerous hot fountains in different parts of the valley, and alſo on the ſides of the mountains: but the moſt remarkable is that called the *chaldeira*, ſituated in the eaſtern part of the valley, on a ſmall eminence by the ſide of a river, on which is a baſon about 30 feet diameter, where the water continually boils with prodigious fury. A few yards diſtant from it is a cavern in the ſide of the bank, in which the water boils in a dreadful manner, throwing out a thick, muddy, unctuous water, ſeveral yards from its mouth with a hideous noiſe. In the middle of the river are ſeveral places where the water boils up ſo hot, that a perſon cannot dip his finger into it without being ſcalded; alſo along its banks are ſeveral apertures, out of which the ſteam riſes to a conſiderable height, ſo hot that there is no approaching it with one's hand: in other places, a perſon would think that 100 ſmiths bellows were blowing altogether, and ſulphureous ſteams iſſuing out in thouſands of places; ſo that native ſulphur is found in every chink, and the ground covered with it like hoar froſt; even the buſhes that happen to lie near theſe places are covered with pure brimſtone, condenſing from the ſteam that iſſues out of the ground, which in many places is covered over with a ſubſtance like burnt alum. In theſe ſmall caverns, from which the ſteam iſſues, the people often boil their yams.

Near theſe boiling fountains are ſeveral mineral ſprings; two in particular, whoſe waters have a very ſtrong quality, of an acid taſte, and bitter to the tongue. Miguel.

About half a mile to the weſtward, and cloſe by the river ſide, are ſeveral hot ſprings, which are uſed by ſick people with great ſucceſs. Alſo, on the ſide of a hill weſt of St Anne's church, are many others, with three bathing houſes, which are moſt commonly uſed. Theſe waters are very warm, although not boiling hot; but at the ſame place iſſue ſeveral ſtreams of cold mineral water, by which they are tempered, according to every one's liking.

About a mile ſouth of this place, and over a low ridge of hills, lies a fine lake about two leagues in circumference, and very deep, the water thick, and of a greeniſh colour. At the north end is a plain piece of ground, where the ſulphureous ſteams iſſue out in many places, attended with a ſurpriſing blowing noiſe. Our author could obſerve ſtrong ſprings in the lake, but could not determine whether they were hot or cold: this lake ſeems to have no viſible evacuation. The other ſprings immediately form a conſiderable river, called *Ribeira Quente*, which runs a courſe about two or three leagues, through a deep rent in the mountains, on each ſide of which are ſeveral places where the ſmoke iſſues out. It diſcharges itſelf into the ſea on the ſouth ſide, near which are ſome places where the water boils up at ſome diſtance in the ſea.

This wonderful place had been taken little notice of until very lately: ſo little curioſity had the gentlemen of the iſland, that ſcarcely any of them had ſeen it, until of late ſome perſons, afflicted with very virulent diſorders, were perſuaded to try its waters, and found immediate relief from them. Since that time it has become more and more frequented; ſeveral perſons who had loſt the uſe of their limbs by the dead palſy have been cured; and alſo others who were troubled with eruptions on their bodies.

A clergyman, who was greatly afflicted with the gout, tried the ſaid waters, and was in a ſhort time perfectly cured, and has had no return of it ſince. When Mr Maſſon was there, ſeveral old gentlemen, who were quite worn out with the ſaid diſorder, were uſing the waters, and had received incredible benefit from them; in particular, an old gentleman about 60 years of age, who had been tormented with that diſorder more than 20 years, and often confined to his bed for ſix months together: he had uſed theſe waters for about three weeks, had quite recovered the uſe of his limbs, and walked about in the greateſt ſpirits imaginable. A friar alſo who had been troubled with the ſaid diſorder about 12 years, and reduced to a cripple, by uſing them a ſhort time was quite well, and went a-hunting every day.

There are ſeveral other hot ſprings in the iſland, particularly at Ribeira Grande; but they do not poſſeſs the ſame virtues, at leaſt not in ſo great a degree.

The eaſt and weſt part of the iſland riſes into high mountains; but the middle is low, interſperſed with round conic hills, all of which have very recent marks of fire; all the parts below the ſurface conſiſting of melted lava lying very hollow.

Moſt of the mountains to the weſtward have their tops hollowed out like a punch bowl, and contain water.

Milan.

ter. Near the weſt end is an immenſe deep valley like the Furnas, called the *Sete Cidades*. This valley is ſurrounded with very abrupt mountains, about ſeven or eight leagues round; in the bottom is a deep lake of water about three leagues in circuit, furniſhed with great numbers of water fowls. This water has no mineral quality; neither are there any hot ſprings in the valley. All theſe mountains are compoſed of a white crumbly pumice ſtone, which is ſo looſe, that if a perſon thruſt a ſtick into the banks, whole waggon loads of it will tumble down. The inhabitants of the iſland relate a ſtory, that he who firſt diſcovered it obſerved an extraordinary high peak near the weſt end; but the ſecond time he viſited it, no ſuch peak was to be ſeen, which he ſuppoſed muſt have certainly ſunk; but, however improbable this ſtory may be, at ſome period or other it muſt have certainly been the caſe.

MILAN, or the duchy of the Milaneſe, a country of Italy, bounded on the weſt by Savoy, Piedmont, and Montferrat; by Switzerland on the north; by the territories of Venice, the duchies of Mantua, Parma, and Placentia, on the eaſt; and by the territories of Genoa on the ſouth. It is 150 miles long, and 78 broad.

Anciently this duchy, containing the north part of the old Liguria, was called *Inſubria*, from its inhabitants the *Inſubres;* who were conquered by the Romans, as theſe were by the Goths; who in their turn were ſubdued by the Lombards. Didier, the laſt king of the Lombards, was taken priſoner by Charlemagne, who put an end to the Longobardic empire, and appointed governors of Milan. Theſe governors, being at a diſtance from their maſters, ſoon began to aſſume an independency, which brought a dreadful calamity on the country; for, in 1152, the capital itſelf was levelled with the ground by the emperor Frederic Barbaroſſa, who committed great devaſtations otherwiſe throughout the duchy. Under this emperor lived one Galvian, a nobleman who was deſcended from Otho a Milaneſe. Galvian, along with William prince of Montferrat, ſerved in the cruſade, when Godfrey of Boulogne took Jeruſalem: he killed in ſingle combat the Saracen general, whom he ſtripped of his helmet, which was adorned with the image of a ſerpent ſwallowing a youth; and this ever afterwards was the badge of that family. His grandſon Galvian, having oppoſed the emperor, was taken priſoner, and carried in irons into Germany, from whence he made his eſcape, and returning to Milan, died in the ſervice of his country. From him deſcended another Otho, at the time that Otho IV. was emperor of Germany, and who ſoon diſtinguiſhed himſelf by the accompliſhments both of his mind and body. When he grew up, he was received into the family of Cardinal Octavian Ubaldini at Rome. This prelate, who was himſelf aſpiring at the popedom, was in a ſhort time greatly taken with the addreſs and accompliſhments of young Otho, and predicted his future greatneſs. In the mean time, one Torreſs, or Torriano, a Milaneſe nobleman of unbounded ambition, was attempting to make himſelf maſter of Milan. The popular faction had ſome time before been caballing againſt the nobility; and at laſt, Torriano, putting himſelf at their head, expelled the biſhop, and put to death or baniſhed all the nobility; by which means the popular government was fully eſtabliſhed; and Torriano, under this pretence, ruled every thing as he pleaſed. He was, however, ſoon oppoſed by one Franciſco Sepri, who formed a great party, pretending to deliver the city from Torriano's haughtineſs and cruelty. But while the two parties were collecting their forces againſt each other, Cardinal Ubaldini was projecting the deſtruction of both, by means of his favourite Otho. This prelate had for ſome time borne an implacable hatred to Torriano, becauſe he had been by him prevented from carrying out of the treaſury of St Ambroſe's church at Milan, a carbuncle or jewel of great value, which he pretended to reſerve for adorning the papal tiara; for which reaſon he now determined to oppoſe his ambition.

Ubaldini began with naming Otho archbiſhop of Milan; which, as the pope's legate, he had a right to do. This nomination was confirmed by Pope Urban IV.; and the party of the nobility having now got a head from the pope himſelf, began to gather ſtrength. Otho in the mean time employed himſelf in collecting troops; and had no ſooner procured a ſhow of an army, than he advanced towards Lago Maggiore, and took poſſeſſion of Arona, a ſtrong poſt near that lake: but Torriano, marching immediately againſt him with all his troops, obliged him to abandon the place, and leave his party to make the beſt terms they could with the conqueror. This was followed by the deſtruction of the caſtles of Arona, Anghiari, and Brebia: ſoon after which Torriano died, and was ſucceeded by his brother Philip, who had ſufficient intereſt to get himſelf elected podeſta, or prætor of Milan, for ten years. During his lifetime, however, the party of the nobility increaſed conſiderably under Otho, notwithſtanding the check they had received. Philip died in 1265, having loſt ground conſiderably in the affections of the people, though he obtained a great reputation for his courage and conduct. His ſucceſſor Napi rendered himſelf terrible to the nobility, whom he proſcribed, and put to death as often as he could get them into his power. He proceeded ſuch lengths, and acted with ſuch fury againſt that unfortunate party, that Pope Clement IV. who had ſucceeded Urban, at laſt interdicted Milan, and excommunicated Napi and all his party. By this Napi began to loſe his popularity, and the public diſaffection towards him was much heightened by the natural cruelty of his temper. But in the mean time, the party of the nobility was in the utmoſt diſtreſs. Otho himſelf and his friends, having ſpent all their ſubſtance, wandered about from place to place; the pope not being in a capacity of giving them any aſſiſtance. Otho, however, was not diſcouraged by his bad ſucceſs, but found means ſtill to keep up the ſpirits of his party, who now choſe for their general Squarcini Burii, a man of great eminence and courage, whoſe daughter was married to Matthew Viſconti, afterwards called *Matthew the Great*. At the ſame time they renewed their confederacy with the marquis of Montferrat, who was ſon-in-law to the king of Spain. The marquis agreed to this confederacy chiefly with a view to become maſter of the Milaneſe..

The nobility now again began to make head; and having collected an army, which was joined by 600 Spaniſh

Spanish cavalry and a body of foot, gained some advantages. But in the mean time Napi, having gathered together a superior army, suddenly attacked Otho and Burri, and defeated them. After this disaster Otho applied to the pope; from whom, however, he did not obtain the assistance he desired; and in the mean time Napi invited the emperor Rodolph into Italy, with the promise of being crowned at Milan. This invitation was accepted of with great readiness by Rodolph; who constituted Napi his governor and vicar-general in Lombardy, sending to him at the same time a fine body of German horse, the command of which was given to Cassoni, Napi's nephew. On this Otho again applied to the pope (Gregory X.); but he was so far from granting him any assistance; that he is said to have entered into a scheme of assassinating him privately; but Otho escaped the danger, and in 1276 began to recover his affairs. The reason of Pope Gregory's enmity to him was, that he and his party were thought to be Gibelines, and were opposed by great numbers of the nobility themselves; but after that pope's death, the Milanese exiles being united under one head, soon became formidable. They now chose for their general Godfrey count of Langusio, a noble Pavian, and an inveterate enemy of the Torriano family. This nobleman being rich and powerful, enlisted many German and other mercenaries, at whose head he marched towards the Lago Maggiore. All the towns in that country opened their gates to him, through the interest of the Visconti family, who resided in these parts. But this success soon met with a severe check in an unfortunate engagement, wherein Godfrey was defeated and taken prisoner; after which he and 34 nobles had their heads struck off, and sent from the field of battle piled up in a common waggon.

This defeat greatly affected Otho; but having in a short time recovered himself, he again attacked his enemies, and defeated them; but, suffering his troops to grow remiss after their victory, the fugitives rallied, and entirely defeated him. The next year, however, Otho had better success, and totally defeated and took prisoner Napi himself. After this victory Cassoni was obliged to abandon Milan to his competitor, who kept possession of it till his death, which happened in 1295, in the 87th of year of his age.

Otho was succeeded by Matthew Visconti above mentioned; and Milan continued in subjection to that family without any very memorable occurrence till the year 1378, when, by the death of Galeazzo II. his brother Barnabo became sovereign of Milan. He was of a brave and active disposition; but excessively profuse in his expences, as his brother Galeazzo had also been; and to procure money to supply his extravagancies, was obliged to oppress his subjects. Galeazzo had engaged in an enterprise against Bologna, and the siege of it was continued by Barnabo. It lasted for nine years; and during this time is said to have cost 300 millions of gold, a prodigious sum in those days, near 40 millions sterling, the lowest gold coin being in value somewhat more than half-a-crown English. Both the brothers were excessively fond of building. Barnabo erected a bridge over the Adda, consisting of three stories; the lowest for chariots and heavy carriages, the middle for horses, and the uppermost for foot passengers. He built also another bridge which was carried over houses without touching them. To accomplish these, and many other expensive schemes, he became one of the greatest tyrants imaginable, and every day produced fresh instances of his rapacity and cruelty. He instituted a chamber of inquiry, for punishing all those who had for five years before been guilty of killing boars, or even of eating them at the table of another. They who could not redeem themselves by money were hanged, and above 100 wretches perished in that manner. Those who had any thing to lose were stripped of all their substance, and obliged to labour at the fortifications and other public works. He obliged his subjects to maintain a great many hunting dogs, and each district was taxed a certain number. The overseers of his dogs were at the same time the instruments of his rapacity. When the dogs were poor and slender, the owners were always fined; but when the dogs were fat, the owners were also fined for suffering them to live without exercise.

The extravagant behaviour of Barnabo soon rendered public affairs ready for a revolution, which was at last accomplished by his nephew John Galeazzo. He affected a solitary life, void of ambition, and even inclining to devotion; but at the same time took care to have his uncle's court filled with spies, who gave him information of all that passed. He reduced his table and manner of living, pretending that he took these steps as preparatives to a retirement from the world, which was soon to take place, after he had paid a religious vow. In short, he acted his part so well, that even Barnabo, though abundantly cautious, had no suspicion of his having any designs against him; and so entirely did he conceal his ambition, that he several times made application to his uncle for his interest to procure him a quiet retreat as soon as his religious vows were performed. One of these was to pay a visit to the church of the blessed Virgin upon Mount Varezzio. This was to be done with so much secrecy that all kinds of eye witnesses were to be excluded; and it was with difficulty that Barnabo himself and two of his sons were allowed to accompany our devotee. But, in the mean time, the hypocritical Galeazzo had soldiers advancing from all quarters; so that Barnabo and his sons were immediately seized, and the houses of those who had sided with them given up to be plundered. The booty in plate, money, and all kinds of rich furniture, was immense. The ministers of the late government were dragged from their hiding places, and put to death; and at last the citadel itself fell into the hands of Galeazzo, who found in it an immense sum of money. Barnabo was carried prisoner to Tritici, a castle of his own building, where he had the happiness to find one person still faithful to him. This was his mistress, named *Doninia Porra*; who, when he was abandoned by all the world, shut herself up a voluntary prisoner in his chamber, and remained with him as long as he lived, which was only seven months after his degradation.

John Galeazzo was the first who took upon him the title of the *Duke of Milan*, and was a prince of great policy and no less ambition. He made war with the Florentines, became master of Pisa and Bologna, and entirely defeated the emperor in 1401, so that he entertained hopes of becoming master of all Lombardy, and cutting off all possibility of invading it either from

Milan.

France or Germany; but his deſigns were fruſtrated by death, which happened in 1402, in the 55th year of his age. After his deceaſe the Milaneſe government fell into the moſt violent diſtractions, ſo that it could not be ſupported, even in time of peace, without an army of 20,000 foot and as many horſe. In the year 1421, however, Philip duke of Milan became maſter of Genoa; but though he gained great advantages in all parts of Italy, the different ſtates ſtill found means to counterbalance his ſucceſſes, and prevent him from enſlaving them: ſo that Milan never became the capital of any extenſive empire; and in 1437 Genoa revolted, and was never afterwards reduced.

Philip died in 1448, and by his death the male line of the Viſconti family was at an end. The next lawful heir was Valentina his ſiſter, who had married the duke of Orleans, ſon to Charles V. of France. By the contract of that marriage, the lawful progeny of it was to ſucceed to the duchy of Milan in failure of the heirs male of the Viſconti family; but this ſucceſſion was diſputed by Sforza, who had married Philip's natural daughter. It is certain, however, that the rightful ſucceſſion was veſted in the houſe of Orleans and the kings of France; and therefore though the Sforza family got poſſeſſion of the duchy for the preſent, Louis XII. afterwards put in his claim, being a grandſon to John Galeazzo. For ſome time he was ſucceſsful; but the French behaved in ſuch an inſolent manner, that they were driven out of the Milaneſe by the Swiſs and Maximilian Sforza. The Swiſs and Milaneſe were in their turn expelled by Francis I. who obliged the Sforza family to relinquiſh the government for a penſion of 30,000 ducats a-year. Francis Sforza, the ſon of Maximilian, however, being aſſiſted by the emperor and the pope, regained the poſſeſſion of the Milaneſe about the year 1521; and, eight years after, the French king, by the treaty of Cambray, gave up his claim on the duchy.

But, in fact, the emperors of Germany ſeem to have had the faireſt title to the Milaneſe in right of their being for a long time ſovereigns of Italy. On the death of Francis Sforza, therefore, in the year 1536, the emperor Charles V. declared the Milaneſe to be an imperial fief, and granted the inveſtiture of it to his ſon Philip II. king of Spain. In his family it continued till the year 1706, when the French and Spaniards were driven out by the Imperialiſts, and the emperor again took poſſeſſion of it as a fief. It was confirmed to his houſe by the treaty of Baden in 1714, by the quadruple alliance in 1718, and by the treaty of Aix-la-Chapelle in 1748.

The duchy of Milan is one of the fineſt provinces in Italy. It is bounded on the ſouth by the Apennine mountains, and the territory of Genoa; on the north by Switzerland; on the eaſt by the Venetian territories, and the duchies of Mantua, Parma, and Placentia; and on the weſt by Savoy, Piedmont, and Montferrat; extending from north to ſouth about 100 miles, and from eaſt to weſt about 108. It is well watered by the Teſſino, the Seſia, the Adda, the Po, the Oglio, the Lombro, Serio, &c. and alſo by ſeveral canals and lakes. Of the latter, the Lago Maggiore is between 30 and 40 miles in length, and in ſome places ſix or ſeven miles broad. In it lie the *Boromean iſlands*, as they are called, viz. Iſola Bella and Iſola Madre, the beauty of which almoſt exceeds imagination: art and nature ſeem to have vied with one another in embelliſhing them. In each of them is a palace with delicious gardens, belonging to the Boromean family. The water of the lake is clear and of a greeniſh colour, and abounds with fiſh. The hills with which it is ſurrounded preſent a moſt charming landſcape, being planted with vines and cheſnut trees, interſperſed with ſummer houſes. There is a canal running from it towards Switzerland, with which the city of Milan has a communication. It was anciently called *Lacus Verbanus.* The Lago de Como, which was called by the Latin poets *Lacus Larius*, but had its modern name from the city near which it lies, extends itſelf about 30 miles northward from Como, but its greateſt breadth is not above five miles. From the Lago Maggiore iſſues the Teſſino; and from that of Como the Adda. Of the other lakes, that of Lugano and Guarda are the chief: that of Guarda was anciently called *Benacus.*

Milan.

The trade and manufactures of this duchy conſiſt principally in ſilk ſtuffs, ſtockings, gloves, and handkerchiefs, linen and woollen cloth, hardware, curious works of cryſtal, agate, hyacinths, and other gems; but their exports are uſually far ſhort of their imports.

As to the revenue of the duchy, it muſt without doubt be very conſiderable. It is ſaid to have amounted to 2,000,000 of dollars while the duchy was in the hands of the Spaniards.

In the year 1767, the Auſtrian government of Milan publiſhed a law, by which all the rights which the pope or the biſhops had till then exerciſed over eccleſiaſtics, either with regard to their effects or perſons, was transferred to a council eſtabliſhed for that purpoſe at Milan. By the ſame edict, all eccleſiaſtics were obliged to ſell the eſtates which they had become poſſeſſed of ſince the year 1722; and no ſubject, whether eccleſiaſtic or ſecular, was to go to Rome to ſolicit any favour, except letters of indulgence, without the conſent of the ſaid council.

This duchy was ſubdued by the French in the year 1796, when it was regarded as a conſtituent part of the Ciſalpine republic. When hoſtilities recommenced in 1799, it was again taken by the allies, but afterwards reconquered by the army of Dijon under Bonaparte, who entered the metropolis on the 2d of June 1800. It now forms part of the kingdom of Italy.

Milan, the capital of the duchy of that name, in Latin *Mediolanum*, is a very large city, and has a wall and rampart round it, with a citadel; yet is thought to be incapable of making any great reſiſtance. The gardens within the city take up a great deal of ground. In the citadel is a foundery for cannon, and an arſenal furniſhed with arms for 12,000 men. The governor of it is quite independent of the governor general of the Milaneſe, who reſides in the city, in a large but old and ill contrived palace. The yearly income of the governor of Milan is ſaid to be 200,000 guilders. The council belonging to the city is compoſed of a preſident and 60 doctors of law, who are all nobles, and independent of the governor general. Milan hath experienced a great variety of fortune, having been ſubject ſometimes to the French, ſometimes to the Spaniards, and ſometimes to the Germans.

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Milan. A great number of persons of rank and fortune live in it, especially during the winter. The ladies in France are not allowed more liberty than those of this city: even the austerities of the monastic life are so far mitigated here, that gentlemen have not only the liberty of talking with the nuns, and of rallying and laughing at the grate, but also of joining with them in concerts of music, and of spending whole afternoons in their company. The place where the *beau monde* take the air, either in their coaches or on foot, is the rampart betwixt the Porta Orientale and the Porta Tosa, where it is straight and broad, and extremely pleasant, being planted with white mulberry trees, and commanding a prospect on one side of the open country, and on the other of the gardens and vineyards between the ramparts and the city. Milan, which is said to have been built by the Gauls about 200 years after the foundation of Rome, contains a great number of stately edifices, as churches, convents, palaces, and hospitals. The cathedral is a vast pile, all of marble; and though something has been doing for near 400 years towards the outward or inward ornament thereof, it is not yet finished. Of the great number of statues about it, that of St Bartholomew, just flead alive, with his skin hanging over his shoulders; and of Adam and Eve, over the main portal, are the finest. The pillars supporting the roof of the church are all of marble, and the windows finely painted. This church contains a treasure of great value, particularly a shrine of rock crystal, in which the body of St Charles Borromæo is deposited. The other churches most worthy a stranger's notice are those of St Alexander, St Jerome, St Giovanni di Casarotti della Passione, that of the Jesuits, and of St Ambrose, in which lie the bodies of the saint and of the kings Pepin and Bernard. In the Ambrosian college, founded by Frederic Borromæo, 16 professors teach gratis. In the same college is also an academy of painting, with a museum, and a library containing about 45,000 printed books and manuscripts; among the last of which is a translation of Josephus's History of the Jews, done by Rufinus about 1200 years ago, and written on the bark of a tree; St Ambrose's works on vellum, finely illuminated; the orations of Gregory Nazianzen, and the works of Virgil, in folio, with Petrarch's notes. In the museum are Leonardi da Vinci's mathematical and mechanical drawings, in 12 large volumes. The seminary for sciences, the college of the nobles, the Helvetian college, and the mathematical academy, are noble foundations, and stately buildings. Of the hospitals, the most remarkable are the Lazaretto, and that called the *great hospital;* the latter of which receives sick persons, foundlings, and lunatics, and has six smaller hospitals depending on it, with a revenue of 100,000 rix dollars.

The number of the inhabitants of this city is said to be about 250,000. It has been 40 times besieged, taken 20 times, and four times almost entirely demolished; yet it hath always recovered itself. It is said that gunpowder is sold here only by one person, and in one place. The court of inquisition is held in the Dominican convent, near the church of Madonna della Gratia. The houses of entertainment, and the ordinaries here, are represented as very indifferent.—Mr Keysler says, it is not unusual for young travellers, when they go to any of the taverns in Milan, to be asked, "whether they choose a *letto fornito*, or female bedfellow," who continues masked till she enters the bedchamber. Milan is described as inferior to Turin both in beauty and conveniency, many of the streets being crooked and narrow, and paper windows much more frequent than in that city; even in grand palaces, the windows are often composed promiscuously of glass and paper. Two large canals extend from hence, the one to the Tessino, and the other to the Adda; the Tessino having a communication with the Lago Maggiore, and, by a canal, with the Sesia; and the Adda issuing from the Lago di Como, and having a communication by canals with the Lombro and Serio. In a void space in one of the streets of Milan, where stood the house of a barber who had conspired with the commissary of health to poison his fellow citizens, is erected a pillar called *Colonna Infame*, with an inscription to perpetuate the memory of the execrable design. The environs of this city are very pleasant, being adorned with beautiful seats, gardens, orchards, &c. About two Italian miles from it, at the seat of the Simonetti family, is a building, that would have been a masterpiece of its kind had the architect designed it for an artificial echo. It will return or repeat the report of a pistol above 60 times; and any single musical instrument well touched will have the same effect as a great number of instruments, and produce a most surprising and delightful concert.

According to Dr Moore, "there is no place in Italy, perhaps in Europe, where strangers are received in such an easy hospitable manner as at Milan. Formerly the Milanese nobility displayed a degree of splendour and magnificence, not only in their entertainments, but in their usual style of living, unknown in any other country of Europe. They are under a necessity at present of living at less expence, but they still show the same obliging and hospitable disposition. This country having, not very long since, been possessed by the French, from whom it devolved to the Spaniards, and from them to the Germans, the troops of those nations have, at different periods, had their residence here, and in the course of these vicissitudes, produced a style of manners, and stamped a character on the inhabitants of this duchy, different from what prevails in any other part of Italy; and nice observers imagine they perceive in Milanese manners the politeness, formality, and honesty imputed to those three nations, blended with the ingenuity natural to Italians. The great theatre having been burnt to the ground last year, there are no dramatic entertainments, except at a small temporary play-house, which is little frequented; but the company assemble every evening in their carriages on the ramparts, and drive about, in the same manner as at Naples, till it is pretty late. In Italy, the ladies have no notion of quitting their carriages at the public walks, and using their own legs, as in England and France. On seeing the number of servants, and the splendour of the equipages which appear every evening at the Corso on the ramparts, one would not suspect that degree of depopulation, and diminution of wealth, which we are assured has taken place within these few years all over the Milanese; and which proceeds from the burdensome nature of some late taxes, and the insolent and oppressive manner in which they are gathered."—E. Long. 9. 61. N. Lat. 45. 28.

MILBORN-PORT, a town of Somersetshire in England, seated on a branch of the river Parret, 115 miles from London. Though represented in parliament, it is no market town nor corporation; but it appears in Domesday-book to have had a market once, and 56 burgesses. It is in a manner surrounded by Dorsetshire. Here are nine capital burgesses, who yearly choose two bailiffs, that have the government of the borough under them, and jointly return the members to parliament with the two stewards, who are chosen yearly out of nine commonalty stewards, and have the custody of the corporation-seal. These two stewards also distribute the profits of the lands given to the poor here, of which the said commonalty stewards are trustees. The inhabitants are about 1100, the houses not much above 200. There are two fairs, June 6. and October 28.

MILBROOK, a town of Cornwall, on the west side of Plymouth haven. It has a good fishing trade, and has formerly furnished our fleet with many able hands.

MILDENHALL, a town of Suffolk, seven miles from Newmarket, 12 from Bury, and 70 from London. It it a large populous town on the river Lark, a branch of the Ouse, with a harbour for boats. It has a well frequented market on Fridays, especially for fish and wild-fowl. Its church has a tower or steeple 120 feet high. E. Long. 0. 26. N. Lat. 52. 29.

MILDEW, is said to be a kind of thick, clammy, sweet juice, exhaled from, or falling down upon, the leaves and blossoms of plants. By its thickness and clamminess it prevents perspiration, and hinders the growth of the plant. It sometimes rests on the leaves of trees in form of a fatty juice, and sometimes on the ears of corn. It is naturally very tough and viscous, and becomes still more so by the sun's heat exhaling its more fluid parts; by which means the young ears of corn are so daubed over, that they can never arrive at their full growth. Bearded wheat is less subject to the mildew than the common sort; and it is observed that newly dunged lands are more liable to mildew than others. The best remedy is a smart shower of rain, and immediately afterwards a brisk wind. If the mildew is seen before the sun has much power, it has been recommended to send two men into the field with a long cord, each holding one end; and drawing this along the field through the ears, the dew will be dislodged from them, before the heat of the sun is able to dry it to that viscous state in which it does the mischief. Some also say, that lands which have for many years been subject to mildews, have been cured of it by sowing soot along with the corn, or immediately after it.

Mr J. S. Segar, the author of a treatise upon this subject, observes, that the mildew is of such a sharp corrosive nature, that it raises blisters on the feet of the shepherds who go barefoot, and even consumes the hoofs of the cattle. He suspects that it possesses some arsenical qualities, though he does not pretend to affirm this positively. Its pernicious influence, according to him, is rendered still more powerful by a variety of circumstances; such as sending the cattle into the fields too early in the spring; their drinking water mixed with ice, or but lately thawed; their being kept in stables that are too close and filthy, and which are not sufficiently aired. The same author considers the mildew as a principal cause of epidemical distempers among the cattle. The mildew producing these diseases, he says, is that which dries and burns the grass and leaves. It falls usually in the morning, particularly after a thunder storm. Its poisonous quality (which does not continue above 24 hours) never operates but when it has been swallowed immediately after its falling. The disorder attacks the stomach, is accompanied with pimples on the tongue, loss of appetite, a deficcation of the aliments in the stomach, a cough, and difficulty of respiration. As a preservative, the author prescribes purging in spring and in winter. The medicine he advises is composed of 30 grains of sulphur of antimony, and 60 grains of resin of jalap. He is against vomiting, and every thing that is of a heating nature.

MILE, a measure of length or distance, containing eight furlongs. The English statute mile is 80 chains, or 1760 yards; that is, 5280 feet.

We shall here give a table of the miles in use among the principal nations of Europe, in geometrical paces, 60,000 of which make a degree of the equator.

	Geometrical paces.
Mile of Russia	750
of Italy	1000
of England	1200
of Scotland and Ireland	1500
Old league of France	1500
The small league, *ibid.*	2000
The mean league, *ibid.*	2500
The great league, *ibid.*	3000
Mile of Poland	3000
of Spain	3428
of Germany	4000
of Sweden	5000
of Denmark	5000
of Hungary	6000

MILETUS, in *Ancient Geography*, a town of Crete mentioned by Homer; but where situated does not appear. It is said to be the mother town of Miletus in Caria, whither a colony was led by Sarpedon, Minos's brother, (Ephorus, quoted by Strabo). *Milesii*, the people, (Ovid).

MILETUS, in *Ancient Geography*, a celebrated town of Asia Minor, on the confines of Ionia and Caria. It was the capital city of all Ionia, and famous both for the arts of war and peace. It was situated about 10 stadia south of the mouth of the river Mæander, near the sea coast. It was founded by a Cretan colony under Miletus, the companion of Bacchus; or (according to others) by Neleus the son of Codrus; or by Sarpedon a son of Jupiter. It has successively been called *Lelegeis*, *Pithyusa*, and *Anactoria*. The inhabitants, called *Milesii*, were very powerful, and long maintained an obstinate war against the kings of Lydia. They early applied themselves to navigation; and planted no less than 80 colonies, or (according to Seneca) 380, in different parts of the world. It was the only town that made head against Alexander, and was with much difficulty taken. It gave birth to Thales,

Thales, one of the ſeven wiſe men, and the firſt who applied himſelf to the ſtudy of nature. It was alſo the country of Anaximander, the ſcholar and ſucceſſor of Thales, the inventor of ſun dials and the gnomon, and the firſt that publiſhed a geographical map; of Anaximenes, ſcholar and ſucceſſor to the foregoing; and of other great men. It was noted for its excellent wool, according to Virgil; and was alſo celebrated for a temple and oracle of Apollo Didymæus. This famous people, from being powerful, becoming afterwards opulent and abandoned to pleaſures, loſt both their riches and their power.—At preſent it is called by the Turks *Melas*, and not far diſtant from it runs the river Mæander. St Paul going from Corinth to Jeruſalem paſſed by Miletus, and as he went by ſea, and could not take Epheſus in his way, he cauſed the biſhops and prieſts of the church of Epheſus to come to Miletus (Acts xx. 15. &c.), which was about 12 leagues from them.

MILFOIL, or YARROW. See ACHILLEA, BOTANY *Index*.

MILFORD, a town of Suſſex county, in the Delaware ſtate, is ſituated at the ſource of a ſmall river, 15 miles from Delaware bay, and 150 ſouthward of Philadelphia. This town, which contains about 80 houſes, has been built, except one houſe, ſince the revolution. It is laid out with much taſte, and is by no means diſagreeable. The inhabitants are Epiſcopalians, Quakers, and Methodiſts.

MILFORD Haven, one of the fineſt harbours in Europe, and indiſputably the beſt in Britain, is ſituated in Pembrokeſhire in South Wales, and lies on the north ſide of the Briſtol channel. It is very large, ſafe, and deep; there is no danger of going in or out with the tide, or almoſt with any wind. If a ſhip comes in without a cable or anchor ſhe may run aſhore on the ooze, and there lie ſafe till ſhe is refitted; and in an hour's time ſhe may get out of the harbour into the open ſea. It lies extremely convenient for ſhips bound from the Engliſh or Briſtol channels to Ireland, or farther weſt, and from thence to the channels. It is ſaid, that 1000 ſail of any ſize may ride ſecure in this haven. It has 16 deep and ſafe creeks, five bays, and 13 roads, all diſtinguiſhed by their ſeveral names. The ſpring tide riſes 36 feet, ſo that ſhips may at any time be laid aſhore. Dale harbour is a ready outlet for ſmall veſſels, where they may ride in two or three fathoms at low water.—In the reign of Queen Elizabeth, before the Spaniſh invaſion, two forts were begun at the entrance of Milford Haven, one on each ſide, called *Nangle* and *Dale* blockhouſes; but they were not then finiſhed.—The Stack-rock riſes here above water, lying near the middle of the entrance between Nangle and Dale. Penermouth is the opening of that branch of the haven on which the town of Pembroke is ſeated, and where the cuſtomhouſe of Milford is kept. The breadth of the entrance between rock and rock is but 200 yards at high water, and 112 at low water. There is a ridge of rocky ground that has the name of *Carrs*, which runs almoſt acroſs Milford Haven, from Peter church towards Llandſtadwell, where it renders the landing place difficult to ſtrangers, from its not appearing at low water. The great convenience of this harbour is, that in a hour's time a ſhip may be in or out of it, and in the way between the Land's End and Ireland. As it lies near the mouth of the Severn, a ſhip in eight or ten hours may be over on the coaſt of Ireland, or off the Land's End in the Engliſh Channel; and a veſſel may get out hence to the weſt much ſooner than from either Plymouth or Falmouth. This harbour has been greatly improved by new works, at the expence of the government. The parliament on April 14. 1759 granted 10,000l. for fortifying the harbour of Milford, all of which was expended on the fort at Neyland, which, however, ſtill remains unfiniſhed.

MILIARY, in general, ſomething reſembling millet ſeed.

MILIARY Fever. See MEDICINE *Index*.

MILITANT, or CHURCH-MILITANT, denotes the body of Chriſtians while here on earth.

MILITARY, ſomething belonging to the ſoldiery or militia.

MILITARY Diſcipline, the training of ſoldiers, and the due enforcement of the laws and regulations inſtituted by authority for their conduct.

Next to the forming of troops, military diſcipline is the firſt object that preſents itſelf to our notice; it is the ſoul of all armies; and unleſs it be eſtabliſhed amongſt them with great prudence, and ſupported with unſhaken reſolution, they are no better than ſo many contemptible heaps of rabble, which are more dangerous to the very ſtate that maintains them than even its declared enemies.

MILITARY Execution, the ravaging or deſtroying of a country, or town, that refuſes to pay the contribution inflicted upon them.

MILITARY Exerciſe. See EXERCISE and WORDS *of Command*.

MILITARY State, in Britiſh polity, one of the three diviſions of the laity. See LAITY.

This ſtate includes the whole of the ſoldiery, or ſuch perſons as are peculiarly appointed among the reſt of the people for the ſafeguard and defence of the realm.

In a land of liberty, it is extremely dangerous to make a diſtinct order of the profeſſion of arms. In abſolute monarchies, this is neceſſary for the ſafety of the prince; and ariſes from the main principle of their conſtitution, which is that of governing by fear; but, in free ſtates, the profeſſion of a ſoldier, taken ſingly and merely as a profeſſion, is juſtly an object of jealouſy. In theſe no man ſhould take up arms but with a view to defend his country and its laws: he puts not off the citizen when he enters the camp; but it is becauſe he is a citizen, and would wiſh to continue ſo, that he makes himſelf for a while a ſoldier. The laws therefore, and conſtitution of theſe kingdoms, know no ſuch ſtate as that of a perpetual ſtanding ſoldier, bred up to no other profeſſion than that of war; and it was not till the reign of Henry VII. that the kings of England had ſo much as a guard about their perſons.

In the time of the Anglo-Saxons, as appears from Edward the Confeſſor's laws, the military force of England was in the hands of the dukes or heretochs, who were conſtituted through every province and county in the kingdom; being taken out of the principal nobility, and ſuch as were moſt remarkable for being

Military. ing *ſapientes, fideles, et animoſi.* Their duty was to lead and regulate the Engliſh armies with a very unlimited power; *prout eis viſum fuerit, ad honorem coronæ et utilitatem regni.* And becauſe of this great power they were elected by the people in their full aſſembly, or folkmote, in the ſame manner as ſheriffs were elected: following ſtill that old fundamental maxim of the Saxon conſtitution, that where any officer was intruſted with ſuch power, as, if abuſed, might tend to the oppreſſion of the people, that power was delegated to him by the vote of the people themſelves. So too, among the ancient Germans, the anceſtors of our Saxon forefathers, they had their dukes, as well as kings, with an independent power over the military, as the kings had over the civil ſtate. The dukes were elective, the kings hereditary: for ſo only can be conſiſtently underſtood that paſſage of Tacitus, *Reges ex nobilitate, duces ex virtute ſumunt.* In conſtituting their kings, the family or blood royal was regarded; in chooſing their dukes or leaders, warlike merit: juſt as Cæſar relates of their anceſtors in his time, that whenever they went to war, by way either of attack or defence, they elected leaders to command them. This large ſhare of power, thus conferred by the people, though intended to preſerve the liberty of the ſubject, was perhaps unreaſonably detrimental to the prerogative of the crown: and accordingly we find a very ill uſe made of it by Edric duke of Mercia, in the reign of King Edmund Ironſide; who, by his office of duke or heretoch, was entitled to a large command in the king's army, and by his repeated treacheries at laſt transferred the crown to Canute the Dane.

It ſeems univerſally agreed by all hiſtorians, that King Alfred firſt ſettled a national militia in this kingdom, and by his prudent diſcipline made all the ſubjects of his dominions ſoldiers: but we are unfortunately left in the dark as to the particulars of this his ſo celebrated regulation; though, from what was laſt obſerved, the dukes ſeem to have been left in poſſeſſion of too large and independent a power: which enabled Duke Harold, on the death of Edward the Confeſſor, though a ſtranger to the royal blood, to mount for a ſhort ſpace the throne of this kingdom, in prejudice of Edgar Etheling the rightful heir.

Upon the Norman conqueſt, the feodal law was introduced here in all its rigour, the whole of which is built on a military plan. In conſequence thereof, all the lands in the kingdom were divided into what were call *knight's fees*, in number above 60,000; and for every knight's fee, a knight or ſoldier, *miles*, was bound to attend the king in his wars, for 40 days in a year; in which ſpace of time, before war was reduced to a ſcience, the campaign was generally finiſhed, and a kingdom either conquered or victorious. By this means the king had, without any expence, an army of 60,000 men always ready at his command. And accordingly we find one, among the laws of William the Conqueror, which in the king's name commands and firmly enjoins the perſonal attendance of all knights and others; *quod habeant et teneant ſe ſemper in armis et equis, ut decet et oportet: et quod ſemper ſint prompti et parati ad ſervitium ſuum integrum nobis explendum et peragendum, cum opus adfuerit, ſecundum quod debent de feodis et tenementis ſuis de jure nobis facere.* This perſonal ſervice in proceſs of time degenerated into pecuniary commutations or aids; and at laſt the military part of the feodal ſyſtem was aboliſhed at the Reſtoration, by ſtat. 12 Car. II. c. 24. See *Feodal Syſtem.* Military.

In the mean time, we are not to imagine that the kingdom was left wholly without defence in caſe of domeſtic inſurrections, or the proſpect of foreign invaſions. Beſides thoſe who by their military tenures were bound to perform 40 days ſervice in the field, firſt the aſſize of arms, enacted 27 Hen. II. and afterwards the ſtatute of Wincheſter, under Edward I. obliged every man, according to his eſtate and degree, to provide a determinate quantity of ſuch arms as were then in uſe, in order to keep the peace; and conſtables were appointed in all hundreds by the latter ſtatute, to ſee that ſuch arms were provided. Theſe weapons were changed, by the ſtatute 4 and 5 Ph. and M. c. 2. into others of more modern ſervice; but both this and the former proviſions were repealed in the reign of James I. While theſe continued in force, it was uſual from time to time for our princes to iſſue commiſſions of array, and ſend into every county officers in whom they could confide, to muſter and array (or ſet in military order) the inhabitants of every diſtrict; and the form of the commiſſion of array was ſettled in parliament in the 5 Hen. IV. But at the ſame time it was provided, that no man ſhould be compelled to go out of the kingdom at any rate, nor out of his ſhire, but in caſes of urgent neceſſity; nor ſhould provide ſoldiers unleſs by conſent of parliament. About the reign of King Henry VIII. and his children, lord-lieutenants began to be introduced, as ſtanding repreſentatives of the crown, to keep the counties in military order; for we find them mentioned as known officers in the ſtatute 4 and 5 Ph. and M. c. 3. though they had not been then long in uſe; for Camden ſpeaks of them in the time of Queen Elizabeth as extraordinary magiſtrates, conſtituted only in times of difficulty and danger.

In this ſtate things continued till the repeal of the ſtatutes of armour in the reign of King James I.; after which, when King Charles I. had, during his northern expeditions, iſſued commiſſions of lieutenancy, and exerted ſome military powers which, having been long exerciſed, were thought to belong to the crown, it became a queſtion in the long parliament, how far the power of the militia did inherently reſide in the king; being now unſupported by any ſtatute, and founded only upon immemorial uſage. This queſtion, long agitated with great heat and reſentment on both ſides, became at length the immediate cauſe of the fatal rupture between the king and his parliament: the two houſes not only denying this prerogative of the crown, the legality of which claim perhaps might be ſomewhat doubtful; but alſo ſeizing into their hands the entire power of the militia, the illegality of which ſtep could never be any doubt at all.

Soon after the reſtoration of King Charles II. when the military tenures were aboliſhed, it was thought proper to aſcertain the power of the militia, to recognize the ſole right of the crown to govern and command them, and to put the whole into a more regular method of military ſubordination: and the order in which the militia now ſtands by law, is principally built upon the ſtatutes which were then enacted. It is true, the two laſt of them are apparently repealed; but many of their proviſions

provisions are re-enacted, with the addition of some new regulations, by the present militia laws; the general scheme of which is to discipline a certain number of the inhabitants of every county, chosen by lot for three years, and officered by the lord lieutenant, the deputy lieutenants, and other principal landholders, under a commission from the crown. They are not compellable to march out of their counties, unless in case of invasion or actual rebellion, nor in any case compellable to march out of the kingdom. They are to be exercised at stated times: and their discipline in general is liberal and easy; but, when drawn out into actual service, they are subject to the rigours of martial law, as necessary to keep them in order. This is the constitutional security which our laws have provided for the public peace, and for protecting the realm against foreign or domestic violence; and which the statutes declare as essentially necessary to the safety and prosperity of the kingdom.

When the nation was engaged in war, more veteran troops and more regular discipline were esteemed to be necessary, than could be expected from a mere militia; and therefore at such times more rigorous methods were put in use for the raising of armies and the due regulation and discipline of the soldiery, which are to be looked upon only as temporary excrescences bred out of the distemper of the state, and not as any part of the permanent and perpetual laws of the kingdom. For martial law, which is built upon no settled principles, but is entirely arbitrary in its decisions, is, as Sir Matthew Hale observes, in truth and reality no law, but something indulged rather than allowed as a law. The necessity of order and discipline in an army is the only thing which can give it countenance; and therefore it ought not to be permitted in time of peace, when the king's courts are open for all persons to receive justice according to the laws of the land. Wherefore, Thomas earl of Lancaster being convicted at Pontefract, 15 Edward II. by martial law, his attainder was reversed 1 Edward III. because it was done in time of peace. And it is laid down, that if a lieutenant, or other, that hath commission of martial authority, doth in time of peace hang or otherwise execute any man by colour of martial law, this is murder; for it is against *magna charta*. And the petition of right enacts, that no soldier shall be quartered on the subject without his own consent; and that no commission shall issue to proceed within this land according to martial law. And whereas, after the Restoration, King Charles II. kept up about 5000 regular troops, by his own authority, for guards and garrisons, which King James II. by degrees increased to no less than 30,000, all paid from his own civil list; it was made one of the articles of the bill of rights, that the raising or keeping a standing army within the kingdom in time of peace, unless it be with consent of parliament, is against law.

But as the fashion of keeping standing armies (which was first introduced by Charles VII. in France 1445) has of late years universally prevailed over Europe (though some of its potentates, being unable themselves to maintain them, are obliged to have recourse to richer powers, and receive subsidiary pensions for that purpose), it has also for many years past been annually judged necessary by our legislature for the safety of the kingdom, the defence of the possessions of the crown of Great Britain, and the preservation of the balance of power in Europe, to maintain even in time of peace a standing body of troops, under the command of the crown; who are however *ipso facto* disbanded at the expiration of every year, unless continued by parliament. And it was enacted by statute 10 William III. c. 1. that not more than 12,000 regular forces should be kept on foot in Ireland, though paid at the charge of that kingdom: which permission is extended by statute 8 Geo. III. c. 13. to 16,235 men in time of peace.

To prevent the executive power from being able to oppress, says Baron Montesquieu, it is requisite that the armies with which it is intrusted should consist of the people, and have the same spirit with the people: as was the case at Rome, till Marius new-modelled the legions by enlisting the rabble of Italy, and laid the foundation of all the military tyranny that ensued. Nothing then, according to these principles, ought to be more guarded against in a free state, than making the military power, when such a one is necessary to be kept on foot, a body too distinct from the people. Like ours, therefore, it should wholly be composed of natural subjects; it ought only to be enlisted for a short and limited time; the soldiers also should live intermixed with the people; no separate camp, no barracks, no inland fortresses should be allowed. And perhaps it might be still better, if, by dismissing a stated number, and enlisting others at every renewal of their term, a circulation could be kept up between the army and the people, and the citizen and the soldier be more intimately connected together.

To keep this body of troops in order, an annual act of parliament likewise passes, "to punish mutiny and desertion, and for the better payment of the army and their quarters." This regulates the manner in which they are to be dispersed among the several inn-keepers and victuallers throughout the kingdom; and establishes a law-martial for their government. By this, among other things, it is enacted, that if any officer or soldier shall excite, or join any mutiny, or, knowing of it, shall not give notice to the commanding officer, or shall desert, or list in any other regiment, or sleep upon his post, or leave it before he is relieved, or hold correspondence with a rebel or enemy, or strike or use violence to his superior officer, or shall disobey his lawful commands; such offender shall suffer such punishment as a court martial shall inflict, though it extend to death itself.

However expedient the most strict regulations may be in time of actual war, yet in times of profound peace, a little relaxation of military rigour would not, one should hope, be productive of much inconvenience. And, upon this principle, though by our standing laws (still remaining in force, though not attended to) desertion in time of war is made felony without benefit of clergy, and the offence is triable by a jury, and before the judges of the common law; yet, by our militia laws before mentioned, a much lighter punishment is inflicted for desertion in time of peace. So, by the Roman law also, desertion in time of war was punished with death, but more mildly in time of tranquillity. But our mutiny act makes no such distinction: for any of the faults above mentioned are, equally at all all times, punishable with death itself, if a court martial shall think proper. This discretionary power of the

Military. the court martial is indeed to be guided by the directions of the crown: which, with regard to military offences, has almoſt an abſolute legiſlative power. "His Majeſty (ſays the act) may form articles of war, and conſtitute courts martial, with power to try any crime by ſuch articles, and inflict ſuch penalties as the articles direct." A vaſt and moſt important truſt! an unlimited power to create crimes, and annex to them any puniſhments not extending to life or limb! Theſe are indeed forbidden to be inflicted, except for crimes declared to be ſo puniſhable by this act; which crimes we have juſt enumerated, and among which, we may obſerve, that any diſobedience to lawful commands is one. Perhaps in ſome future reviſion of this act, which is in many reſpects haſtily penned, it may be thought worthy the wiſdom of parliament to aſcertain the limits of military ſubjection, and to enact expreſs articles of war for the government of the army, as is done for the government of the navy; eſpecially as, by our preſent conſtitution, the nobility and gentry of the kingdom, who ſerve their country as militia officers, are annually ſubjected to the ſame arbitrary rule during their time of exerciſe.

One of the greateſt advantages of our law is, that not only the crimes themſelves which it puniſhes, but alſo the penalties which it inflicts, are aſcertained and notorious: nothing is left to arbitrary diſcretion: the king by his judges diſpenſes what the law has previouſly ordained, but is not himſelf the legiſlator. How much, therefore, is it to be regretted, that a ſet of men, whoſe bravery has ſo often preſerved the liberties of their country, ſhould be reduced to a ſtate of ſervitude in the midſt of a nation of freemen; for Sir Edward Coke will inform us, that it is one of the genuine marks of ſervitude, to have the law, which is our rule of action, either concealed or precarious; *Miſera eſt ſervitus, ubi jus eſt vagum aut incognitum.* Nor is this ſtate of ſervitude quite conſiſtent with the maxims of ſound policy obſerved by other free nations. For the greater the general liberty is which any ſtate enjoys, the more cautious has it uſually been in introducing ſlavery in any particular order or profeſſion. Theſe men, as Baron Monteſquieu obſerves, ſeeing the liberty which others poſſeſs, and which they themſelves are excluded from, are apt (like eunuchs in the eaſtern ſeraglios) to live in a ſtate of perpetual envy and hatred towards the reſt of the community, and indulge a malignant pleaſure in contributing to deſtroy thoſe privileges to which they can never be admitted. Hence have many free ſtates, by departing from this rule, been endangered by the revolt of their ſlaves; while, in abſolute and deſpotic governments, where no real liberty exiſts, and conſequently no invidious compariſons can be formed, ſuch incidents are extremely rare. Two precautions are therefore adviſed to be obſerved in all prudent and free governments: 1. To prevent the introduction of ſlavery at all: or, 2. If it be already introduced, not to intruſt thoſe ſlaves with arms, who will then find themſelves an overmatch for the freemen. Much leſs ought the ſoldiery to be an exception to the people in general, and the only ſtate of ſervitude in the nation.

Blackſt. Comment.

But as ſoldiers, by this annual act, are thus put in a worſe condition than any other ſubjects; ſo, by the humanity of our ſtanding laws, they are in ſome caſes put in a much better. By ſtatute 43 Eliz. c. 3. a weekly allowance is to be raiſed in every county for the relief of ſoldiers that are ſick, hurt, and maimed: not forgetting the royal hoſpital at Chelſea for ſuch as are worn out in their duty. Officers and ſoldiers, that have been in the king's ſervice, are by ſeveral ſtatutes, enacted at the cloſe of ſeveral wars, at liberty to uſe any trade or occupation they are fit for, in any town in the kingdom (except the two univerſities), notwithſtanding any ſtatute, cuſtom, or charter to the contrary. And ſoldiers in actual military ſervice may make nuncupative wills, and diſpoſe of their goods, wages, and other perſonal chattels, without theſe forms, ſolemnities, and expences, which the law requires in other caſes. Our law does not indeed extend this privilege ſo far as the civil law, which carried it to an extreme that borders upon the ridiculous: for if a ſoldier, in the article of death, wrote any thing in bloody letters on his ſhield, or in the duſt of the field with his ſword, it was a very good military teſtament.

Military || Milk.

Military Court. See Chivalry, *Court of.*

Military Tenures. See Tenure, Feodal System, and Knight.

Military Ways, (viæ militares), are the large Roman roads which Agrippa procured to be made through the empire in the time of Auguſtus, for the more convenient marching of troops and conveyance of carriages. N. Bergier has written the hiſtory of the origin, progreſs, and amazing extent, of theſe military roads, which were paved from the gates of Rome to the extreme parts of the empire. See Way.

MILITIA, in general, denotes the body of ſoldiers, or thoſe who make profeſſion of arms.

In a more reſtrained ſenſe, militia denotes the trained bands of a town or country, who arm themſelves, upon a ſhort warning, for their own defence. So that, in this ſenſe, militia is oppoſed to regular or ſtated troops. See *Military State*, and *Feodal System.*

MILIUM, millet, a genus of plants, belonging to the triandria claſs; and in the natural method ranking under the 4th order, *Gramina.* See Botany *Index.*

MILK, a well known fluid, prepared by nature in the breaſts of women, and the udders of other animals, for the nouriſhment of their young.—According to Dr Cullen *, milk is a connecting and intermediate ſubſtance between animals and vegetables. It ſeems immediately to be ſecreted from the chyle, both being a white liquor of the ſame conſiſtence: it is moſt copiouſly ſecreted after meals, and of an aceſcent nature. In moſt animals who live on vegetables, the milk is aceſcent; and it is uncertain, though at the ſame time no obſervation proves the contrary, whether it is not ſo likewiſe in carnivorous animals. But, whatever be in this, it is certain, that the milk of all animals who live on vegetables is aceſcent. Milk being derived from the chyle, we thence conclude its vegetable nature; for in thoſe who live on both promiſcuouſly, more milk is got, and more quickly, from the vegetable than the animal food. Milk, however, is not purely vegetable; though we have a vegetable liquor that reſembles its taſte, conſiſtence, colour, aceſcency, and the ſeparability of the oily part, viz. an emulſion of the nuces oleoſæ and farinaceous ſubſtances. But theſe want the coagulable part of milk, which ſeems to

* *Lect. on Mat. Med.*

Milk.

to be of animal nature, approaching to that of the coagulable lymph of the blood. Milk, then, feems to be of an intermediate nature, between chyle taken up from the inteftines and the fully elaborated animal fluid.

Its contents are of three kinds: 1ft, An oily part, which, whatever may be faid concerning the origin of other oils in the body, is certainly immediately derived from the oil of the vegetables taken in; as with thefe it agrees very exactly in its nature, and would entirely, if we could feparate it fully from the coagulable part. Another mark of their agreement is the feparability, which proves that the mixture has been lately attempted, but not fully performed. 2dly, Befides this oily, there is a proper coagulable part: And, 3dly, Much water accompanies both, in which there is diffolved a faline faccharine fubftance. Thefe three can be got feparate in cheefe, butter, and whey; but never perfectly fo, a part of each being always blended with every other part.

Nothing is more common, from what has been faid of its immediate nature, than to fuppofe that it requires no affimilation; and hence has been deduced the reafon of its exhibition in the moft weakly ftate of the human body. But wherever we can examine milk, we always find that it coagulates, fuffers a decompofition, and becomes acefcent. Again, Infants, who feed entirely on milk, are always troubled with eructations, which every body obferves are not of the fame quality with the food taken; and therefore it appears, that, like all other food, milk turns naturally acefcent in the ftomach, and only enters the chyle and blood in confequence of a new recompofition. It approaches then to the nature of vegetable aliment, but is not capable of its noxious vinous fermentation, and therefore has an advantage over it; neither from this quality, like animal food, is it heating in the ftomach, and productive of fever; though at the fame time, from its quantity of coagulable matter, it is more nourifhing than vegetables.

Milk is the food moft univerfally fuited to all ages and ftates of the body; but it feems chiefly defigned by nature as the food of infants. When animals are in the fœtus ftate, their folids are a perfect jelly, incapable of an affimilatory power. In fuch ftate nature has perfectly affimilated food, as the albumen ovi in the oviparous, and in the viviparous animals certainly fomewhat of the fame kind, as it was neceffary the veffels fhould be filled with fuch a fluid as would make way for an after affimilation. When the infant has attained a confiderable degree of firmnefs, as when it is feparated from the mother, yet fuch a degree of weaknefs ftill remains as makes fomewhat of the fame indication neceffary; it behoves the infant to have an alkalefcent food ready prepared, and at the fame time its noxious tendency to be avoided. Milk then is given, which is alkalefcent, and, at the fame time, has a fufficient quantity of acidity to correct that alkalefcency. As the body advances in growth, and the alkalefcent tendency is greater, the animal, to obviate that tendency, is led to take vegetable food, as more fuited to its ftrength of affimilation.

Dr Cullen obferves, that milk is fuited to almoft all temperaments; and it is even fo to ftomachs difpofed to acefcency, more than thofe fubftances which have undergone the vinous fermentation; nay, it even cures the heartburn, checks vinous fermentation, and precipitates the lees, when, by renewal of fermentation, the wine happens to be fouled. It therefore very properly accompanies a great deal of vegetable aliment: although fometimes its acefcency is troublefome, either from a large proportion taken in, or from the degree of it; for, according to certain unaccountable circumftances, different acids are formed in the ftomach in different ftates of the body; in a healthy body, *e. g.* a mild one; in the hypochondriac difeafe fometimes, one of a very acrid quality. When the acidity of milk is carried to a great degree, it may prove remarkably refrigerant, and occafion cold crudities, and the recurrence of intermittent fevers. To take the common notion of its paffing unchanged into the blood, it can fuffer no folution. But if we admit its coagulum in the ftomach, then it may be reckoned among foluble or infoluble foods, according as that coagulum is more or lefs tenacious. Formerly rennet, which is employed to coagulate milk, was thought an acid; but, from late obfervations, it appears, that, if it be an acid, it is very different from other acids, and that its coagulum is ftronger than that produced by acids. It has been imagined, that a rennet is to be found in the ftomachs of all animals, which caufes coagulation of milk; but according to Dr Cullen the coagulation of milk feems to be owing to a weak acid in the ftomach, the relicks of our vegetable food, inducing, in healthy perfons, a weak and foluble coagulum: but in different ftomachs this may be very different, in thefe becoming heavy and lefs foluble food, and fometimes even evacuated in a coagulated undiffolved ftate both by ftomach and ftool.

As milk is acefcent, it may be rendered fometimes purgative by mixing with the bile; and fome examples of this have been remarked. More commonly, however, it is reckoned among thofe foods which occafion coftivenefs.

Hoffman, in his experiments on milk, found that all kinds of it contained much water; and when this was diffipated, found the refiduums very different in their folubility. But we muft not thence conclude, that the fame infolubility takes place in the ftomach; for extracts made from vegetables with water are often very infoluble fubftances, and hardly diffufible through water itfelf: therefore, in Hoffman's extracts, if we may fo call them, of milk, fomewhat of the fame kind might have appeared; and thefe fubftances, which in their natural ftate were not fo, might appear very infoluble. However, we may allow that milk is always fomehow infoluble in the inteftines, as it is of a drying nature, and as cheefe, &c. is very coftive. And this effect fhows that milk is always coagulated in the ftomach; for if it remained fluid, no fæces would be produced, whereas fometimes very hard ones are obferved. In the blood veffels, from its animal nature, it may be confidered as nutritious; but when we confider its vegetable contents, and acefcency in the primæ viæ, we find that, like animal food, it does not excite that degree of fever in the time of digeftion, and that from its acefcency it will refift putrefaction. Hence its ufe in hectic fevers, which, whatever be their caufe, appear

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appear only to be exacerbations of natural feverish paroxyſms, which occur twice every day, commonly after meals, and at night. To obviate theſe, therefore, we give ſuch an aliment as produces the leaſt exacerbation of theſe fevers: and of this nature is milk, on account of its aceſcent vegetable nature.

There appears alſo ſomewhat peculiar to milk, which requires only a ſmall exertion of the animal powers in order to its aſſimilation; and beſides, in hectic complaints there is wanted an oily, bland food, approaching to the animal nature; ſo that on all theſe accounts milk is a diet peculiarly adapted to them, and, in general, to moſt convaleſcents, and to thoſe of inflammatory temperaments. So far of milk in general. We ſhall now ſpeak of the particular kinds which are in common uſe.

The milks of women, mares, and aſſes, agree very much in their qualities, being very dilute, having little ſolid contents, and, when evaporated to dryneſs, having theſe very ſoluble, containing much ſaccharine matter, of a very ready aceſcency, and, when coagulated, their coagulum being tender and eaſily broke down. From this view they have leſs oil, and ſeem to have leſs coagulable matter than the reſt.

The milks of cows, ſheep, and goats, agree in oppoſite qualities to the three juſt mentioned; but here there is ſomewhat more of gradation. Cows milk comes neareſt to the former milk: goats milk is leſs fluid, leſs ſweet, leſs flatulent, has the largeſt proportion of inſoluble part after coagulation, and indeed the largeſt proportion of coagulable part; its oily and coagulable parts are not ſpontaneouſly ſeparable, never throwing out a cream, or allowing butter to be readily extracted from it. Hence the virtues of theſe milks are obvious, being more nouriſhing, though at the ſame time leſs eaſily ſoluble in weak ſtomachs, than the three firſt, leſs aceſcent than theſe, and ſo more rarely laxative, and peculiarly fitted for the diet of convaleſcents without fever. The three firſt again are leſs nouriſhing, more ſoluble, more laxative, as more aceſcent, and adapted to the convaleſcents with fever.

Theſe qualities, in particular milks, are conſiderably diverſified by different circumſtances. Firſt, Different animals, living on the ſame diet, give a conſiderably different milk; for there ſeems to be ſomething in the conſtitution, abſtracting from the aliment, which conſtitutes a conſiderable diverſity of milk, not only in the ſame ſpecies of animals, but alſo in the ſame animal, at different ages, and at different diſtances after delivery: this applies to the choice of nurſes. Secondly, Milk follows the nature of the aliment more than any other juice in the human body, being more or leſs fluid and dilute, more or leſs ſolid and nouriſhing, in proportion as theſe qualities are more or leſs in the aliment. The nature of the aliment differs according to its time of growth, *e. g.* old graſs being always found more nouriſhing than young. Aliment, too, is always varied according to the ſeaſon, as that is warm or dry, moiſt or cloudy.

The milk of each particular kind of animal is fitter for particular purpoſes, when fed on proper food.—Thus the cow delights in the ſucculent herbage of the vale: if the ſheep be fed there he certainly rots, but on the higher and more dry ſide of the mountain he feeds pleaſantly and healthy; while the goat never ſtops near the bottom, but aſcends to the craggy ſummit: and certainly the milks of theſe animals are always beſt on their proper ſoil, and that of goats is beſt on a mountainous country. From a diſſertation of Linnæus, we have many obſervations concerning the diverſity of plants on which each animal chooſes to feed. All the Swediſh plants which could be collected together, were preſented alternately to domeſtic animals, and then it appeared that the goat lived on the greateſt variety, and even on many which were poiſonous to the reſt; that the cow choſe the firſt ſucculent ſhoots of the plant, and neglected the fructification; which laſt was preferred by the goat. Hence may be deduced rules concerning the paſturage of different animals; *e. g.* Farmers find, that, in a paſture which was only fit to feed a certain number of ſheep, an equal number of goats may be introduced, while the ſheep are no leſs nouriſhed than before.

It is not eaſy to aſſign the difference between milk freſh drawn and that detained in the open air for ſome time: but certainly there is ſome material one, otherwiſe nature univerſally would not have directed infants to ſucking; and indeed it ſeems, better than the other, fitted for digeſtion and nouriſhment. Phyſicians have ſuppoſed that this depended on the evaporation of ſome *ſpt. rector:* but our author cannot conceive any ſuch, except common water here; and beſides, theſe volatile parts can hardly be nutritious. A more plauſible account ſeems deducible from mixture: milk new drawn has been but lately mixed, and is expoſed to ſpontaneous ſeparation, a circumſtance hurtful to digeſtion; none of the parts being, by themſelves, ſo eaſily aſſimilated as when they are all taken together. Hence, then, milk new drawn is more intimately blended, and therefore then is moſt proper to the weakly and infants.

Another difference in the uſe of milk expoſed for ſome time to the air, is taking it boiled or unboiled. Phyſicians have generally recommended the former; but the reaſon is not eaſily aſſigned. Perhaps it is this: Milk kept for ſome time expoſed to the air has gone ſo far to a ſpontaneous ſeparation; whereas the heat thoroughly blends the whole, and hence its reſolution is not ſo eaſy in the ſtomach; and thus boiled milk is more coſtive than raw, and gives more fæces. Again, When milk is boiled, a conſiderable quantity of air is detached, as appears from the froth on the ſurface; and air is the chief inſtrument of fermentation in bodies; ſo that after this proceſs it is not liable to aceſcency: for theſe reaſons it is proper for the robuſt and vigorous.

Another difference of milk is, according as it is fluid or coagulated. The coagulated is of two kinds, as induced by rennet, or the natural aceſcency of the milk. The former preparation makes the firmer and leſs eaſily ſoluble coagulum; though, when taken with the whey unſeparated, it is leſs difficult of ſolution, though more ſo than any other coagulum in the ſame caſe. Many nations uſe the latter form, which is eaſier ſoluble, but very much aceſcent, and therefore, in point of ſolution, ſhould be confined to the vigorous, in point of aceſcency, to thoſe who like on alkaleſcent food; and in the laſt caſe, the Laplanders uſe it as their chief aceſcent

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acefcent condiment. From the fame confiderations it is more cooling, and in its other effects like all other acefcent vegetables.

Milk by evaporation yields a fweet faline matter, of which Dr Lewis gives the following proportion:

Twelve ounces of	Left of dry matter	From which water extracted a fweet faline fubftance amounting to
Cows milk	13 drachms.	$1\frac{1}{2}$ drachms.
Goats milk	$12\frac{1}{2}$	$1\frac{1}{2}$
Human milk	8	6
Affes milk	8	6

The faline fubftance extracted from affes milk was white, and fweet as fugar; thofe of the others brown or yellow, and confiderably lefs fweet; that from cows milk had the leaft fweetnefs of any.

On diftilling 12 quarts of milk *in balneo mariæ*, at leaft nine quarts of pure phlegm were obtained; the liquor which afterwards arofe was acidulous, and by degrees grew fenfibly more and more acid as the diftillation was continued. After this came over a little fpirit, and at laft, an empyreumatic oil. The remaining folid matter adhered to the bottom of the retort, in the form of elegant fhining black flowers, which being calcined and elixated yielded a portion of fixed alkaline falt.

Milk fet in a warm place, throws up to the furface an unctuous cream, from which, by agitation, the butter is eafily feparated. The addition of alkaline falts prevents this feparation, not (as fome have fuppofed) by abforbing an acid from the milk, but by virtue of their property of intimately uniting oily bodies with watery liquors. Sugar, another grand intermedium betwixt oils and water, has this effect in a greater degree, though that concrete is by no means alkaline, or an abforbent of acids.

The fweet faccharine part of the milk remains diffolved in the whey after the feparation of the curd or cheefy matter, and may be collected from it in a white cryftalline form, by boiling the whey till all remains of the curdled fubftance have fallen to the bottom; then filtering, evaporating it to a due confiftence, fetting it to fhoot, and purifying the cryftals by folution in water and a fecond cryftallization. Much has been faid of the medicinal virtues of this fugar of milk, but it does not feem to have any confiderable ones: It is from cows milk that it has been generally prepared; and the cryftals obtained from this kind of milk have but little fweetnefs.

When milk is fuffered to coagulate fpontaneoufly, the whey proves acid, and on ftanding grows more and more fo till the putrefactive ftate commences. Sour whey is ufed as an acid, preferably to the directly vegetable or the mineral acids, in fome of the chemical arts; as for diffolving iron in order to the ftaining of linen and leather. This acid was commonly made ufe of in the bleaching of linen, for diffolving and extracting the earthy particles left in the cloth by the alkaline falts and lime employed for cleanfing and whitening it. Butter milk is preferred to plain four milk or four whey: This laft is fuppofed to give the cloth a yellow colour. Dr Home, in his ingenious treatife on this fubject, recommends water acidulated with fulphuric acid (in the proportion of about half an ounce, or at moft three quarters of an ounce, to a gallon), as preferable in many refpects to the acid of milk, or of the more directly vegetable fubftances.

He obferves, that the latter are often difficultly procurable, abound with oleaginous particles, and haften to corruption; whilft the vitriolic acid is cheap, and pure, and indifpofed to putrefy: That milk takes five days to perform its office, whilft the vitriolic acid does it in as many hours, perhaps in as many minutes: That this acid contributes alfo to whiten the cloth, and does not make it weaker though the cloth be kept in it for months. He finds, that acids as well as alkalies, extract an oily matter from the cloth, and lofe their acidity and alkalicity. Since this treatife appeared, the ufe of four milk is very generally fuperfeded by oil of vitriol.

It is obfervable, that affes milk is greatly difpofed, on ftanding for a little time, to become thick and ropy. In the Breflaw collection for the year 1720, there is a remarkable account of milk (which probably was that of the afs) grown fo thick and tenacious as to be drawn out into long ftrings, which, when dried, were quite brittle.

New cows milk, fuffered to ftand for fome days on the leaves of butterwort or fun-dew, becomes uniformly thick, flippery, and coherent, and of an agreeable fweet tafte, without any feparation of its parts. Frefh milk, added to this, is thickened in the fame manner, and this fucceffively. In fome parts of Sweden, as we are informed in the Swedifh Memoirs, milk is thus prepared for food.

New milk has a degree of glutinous quality, fo as to be ufed for joining broken ftone ware. There is a far greater tenacity in cheefe properly prepared.

Milk, when examined by a microfcope, appears compofed of numerous globules fwimming in a tranfparent fluid. It boils in nearly the fame degree of heat with common water; fome forts rather fooner, and fome a little later: after boiling, it is lefs difpofed to grow four than in its natural ftate. It is coagulated by acids both mineral and vegetable, and by alkalies both fixed and volatile. The coagulum made by acids falls to the bottom of the ferum; that made by alkalies fwims on the furface, commonly forming (efpecially with volatile alkalies) a thick coriaceous fkin. The ferum, with alkalies, proves green or fanious; with acids, it differs little in appearance from the whey that feparates fpontaneoufly. The coagulum formed by acids is diffolved by alkalies, and that formed by alkalies is rediffolved by acids; but the milk does not in either cafe refume its original properties. It is coagulated by moft of the middle falts, whofe bafis is an earth or a metallic body; as folution of alum, fixed fal ammoniac, fugar of lead, green and blue vitriol; but not by the chalybeate or purging mineral waters, nor by the bitter falt extracted from the purging waters. Among the neutral falts that have been tried, there is not one that produces any coagulation. They all dilute the milk, and make it lefs difpofed to coagulate with acids or alkalies: Nitre feems to have this effect in a greater degree than the other neutral falts. It is inftantly coagulated by highly

Milk. rectified spirit of wine, but scarcely by a phlegmatic spirit. It does not mingle with expressed oils. All the coagula are dissolved by gall.

It has generally been supposed by medical authors, that the milk of animals is of the same nature with chyle, and that the human milk always coagulates in the stomach of infants; but in a late dissertation upon the subject by Mr Clarke, member of the Royal Irish Academy, we find both these positions controverted. According to him, women's milk, in a healthy state, contains no coagulable, mucilaginous, or cheesy principle, in its composition; or it contains so little, that it cannot admit of any sensible proof. Dr Rutty states, that it does not afford even a sixth part of the curd which is yielded by cows milk; and Dr Young denies that it is at all coagulable either by rennets or acids. This is confirmed by Dr Ferris, who in 1782 gained the Harveian prize medal at Edinburgh by a dissertation upon milk. Mr Clarke informs us, that he has made a vast number of experiments upon women's milk with a view to determine this point. He made use of ardent spirits, all the different acids, infusions of infants stomachs, and procured the milk of a great many different women; but in no instance, excepting one or two, did he perceive any thing like curd. This took place in consequence of a spontaneous acescency; and only a small quantity of soft flaky matter was formed, which floated in the serum. This he looked upon to be a morbid appearance.

Irish Transf. for 1788.

The general opinion that women's milk is coagulable has arisen from a single circumstance, viz. that infants frequently vomit the milk they suck in a state of apparent coagulation. This greatly perplexed Dr Young; who, after having tried in vain to coagulate human milk artificially, concluded, that the process took place spontaneously in the stomach; and that it would always do so if the milk were allowed to remain in a degree of heat equal to about 96 degrees of Fahrenheit. Mr Clarke took equal quantities of three different kinds of milk, and put them into bottles slightly corked, and these bottles into water, the temperature of which was kept up by a spirit of wine lamp as near as possible to 96° of Fahrenheit: but after frequently examining each bottle during the course of the experiment, at the expiration of several hours there was not the smallest tendency towards coagulation to be perceived in any of them; the cream was only thrown to the surface in a thick and adhesive form, and entirely separated from the fluid below, which had something of a gray and wheyish appearance. As the matter vomited by infants is sometimes more adhesive than we can suppose cream to be, Mr Clarke supposed that the curd might be so entangled with the cream, as to be with difficulty separated from it; but having collected a quantity of rich cream from the milk of different women, he repeated the experiment with precisely the same event, not being able in any one instance to produce the smallest quantity of curd. To determine, however, what effects might be produced upon milk by the stomach of an infant, Mr Clarke made the following experiment: Having taken out the stomach of a fœtus which had been deprived of life by the use of instruments, he infused it in a small quantity of hot water, so as to make a strong infusion. He added a tea-spoonful of this infusion to equal quantities of cows and human milk; the consequence of which was, that the cow's milk was firmly coagulated in a short time, but the human milk was not altered in the least; neither was the least coagulation produced by adding a second and third spoonful to the human milk. "Upon the whole, then, (says Mr Clarke), I am persuaded it will be found, that human milk, in an healthy state, contains little or no curd, and that the general opinion of its nature and properties is founded upon fallacious analogy and superficial observations made on the matter vomited by infants. We may presume, that the cream of women's milk, by its inferior specific gravity, will swim on the surface of the contents of the stomach; and being of an oily nature, that it will be of more difficult digestion than any other constituent part of milk. When an infant then sucks very plentifully, so as to over-distend the stomach, or labours under any weakness in the powers of digestion, it cannot appear unreasonable to suppose, that the cream shall be first rejected by vomiting. Analogous to this, we know that adults affected with dyspepsia often bring up greasy fluids from the stomach by eructation, and this especially after eating fat meat. We have, in some instances, known this to blaze when thrown into the fire like spirit of wine or oil." Our author derives a confirmation of his opinion from the following observation, viz. that curds vomited by infants of a few days old are yellow, while they become white in a fortnight or three weeks. This he accounts for from the yellow colour of the cream thrown up by the milk of women during the first four or five days after delivery.

Mr Clarke likewise controverts that common opinion of the human milk being so prone to acidity, that a great number of the diseases of children are to be accounted for from that principle. "Whoever (says he) takes the trouble of attentively comparing human milk with that of ruminant animals, will soon find it to be much less prone to run into the acescent or acid process. I have very often exposed equal quantities of human and cows milk in degrees of temperature, varying from the common summer heat, or 65°, to 100°; and I have constantly found that cows milk acquires a greater degree of acidity in 36 hours than the human did in many days: cows milk becomes offensively putrid in four or five days; a change which healthy human milk, exposed in the same manner, will not undergo in many weeks, nay, sometimes in many months. I once kept a few ounces of a nurse's milk, delivered about six or seven days, for more than two years in a bottle moderately corked. It stood on the chimney-piece, and was frequently opened to be examined. At the end of this period it showed evident marks of moderate acidity, whether examined by the taste, smell, or paper stained with vegetable blues or purples; the latter it changed to a florid red colour, whereas cows milk kept a few days changed the colour of the same paper to a green, thereby clearly showing its putrescent tendency."

Our author next goes on to consider of the probability there is of milk becoming so frequently and strongly acid as to occasion most of the diseases of infants. He begins with an attempt to show that the phenomena commonly looked upon to be indications of acrimony are by no means certain. Curdled milk

has

Milk. has already been ſhown to be no ſign of acidity; and the other appearance, which has commonly been thought to be ſo certain, viz. green fæces, is, in the opinion of Mr Clarke, equally fallacious. In ſupport of this he quotes a letter from Dr Sydenham to Dr Cole; in which he ſays, that the green matter vomited by hyſterical women is not any proof of acrid humours being the cauſe of that diſeaſe, for ſea-ſick people do the ſame. The opinion of green fæces being an effect of acidity, proceeds upon the ſuppoſition that a mixture of bile with an acid produces a green colour; but it is found, that the vegetable acid, which only can exiſt in the human body, is unable to produce this change of colour, though it can be effected by the ſtrong mineral acids. As nothing equivalent to any of theſe acids can be ſuppoſed to exiſt in the bowels of infants, we muſt therefore take ſome other method of accounting for the green fæces frequently evacuated by them. "Why ſhould four milk, granting its exiſtence, give riſe to them in infants and not in adults? Have butter milk, ſummer fruits of the moſt aceſcent kind, lemon or orange juice, always this effect in adults by their admixture with bile? This is a queſtion which, I believe, cannot be anſwered in the affirmative."

On the whole, Dr Clarke conſiders the diſeaſe of acidity in the bowels, though ſo frequently mentioned, to be by no means common. He owns indeed, that it may ſometimes occur in infancy as well as in adults, from weakneſs of the ſtomach, coſtiveneſs, or improper food; and an indubitable evidence is afforded by fæces which ſtain the blue or purple colour of vegetables to a red, though nothing can be inferred with certainty from the colour or ſmell.

The doctor next proceeds to ſtate ſereral reaſons for his opinion, that the greater number of infantile diſeaſes are not owing to acidity; 1. Women's milk in a healthy ſtate contains little or no coagulable matter or curd. 2. It ſhows leſs tendency out of the body to become aceſcent than many other kinds of milk. 3. The appearances which have been generally ſuppoſed to characterize its acidity do not afford ſatiſfactory evidence of ſuch a morbid cauſe. 4. Granting this to be the caſe, we have plenty of mild abſorbents, capable of deſtroying all the acid which can be ſuppoſed to be generated in the bowels of an infant; yet many children are obſerved to die in conſequence of theſe diſeaſes ſuppoſed to ariſe from acidity. 5. Though the milk of all ruminant animals is of a much more aceſcent nature than that of the human ſpecies, yet the young of theſe animals never ſuffer any thing like the diſeaſes attributed to acidity in infants. 6. Hiſtory informs us that whole nations uſe four curdled milk as a conſiderable part of their food, without feeling any inconvenience; which, however, muſt have been the caſe, if acidity in the ſtomach were productive of ſuch deleterious effect as has been ſuppoſed.

The reaſoning of Dr Clarke ſeems here to be very plauſible, and nothing has as yet been offered to contradict it. The reviewers in taking notice of the treatiſe only obſerve, that the doctor's poſitions are ſupported by great probability; yet "they have ſeen them, or think they have ſeen them, contradicted by the appearance of diſeaſes and the effects of medicines;" ſo that they muſt leave the ſubject to farther examination. Milk.

In a memoir by Meſſrs Parmentier and Deyeux, members of the royal college of pharmacy, &c. in Paris, we have a great number of experiments on the milk of aſſes, cows, goats, ſheep, and mares, as well as women. The experiments on cows milk, were made with a view to determine whether any change was made in the milk by the different kinds of food eaten by the animal. For this purpoſe ſome were fed with the leaves of *maize* or Turkey wheat; ſome with cabbage; others with ſmall potatoes; and others with common graſs. The milk of thoſe fed with the *maize* or Turkey wheat was extremely ſweet; that from the potatoes and common graſs much more ſerous and inſipid; and that from the cabbages the moſt diſagreeable of all. By diſtillation only eight ounces of a colourleſs fluid were obtained from as many pounds of each of theſe milks; which from thoſe who fed upon graſs had an aromatic flavour; a diſagreeable one from cabbage; and none at all from the potatoes and Turkey wheat. This liquid became fetid in the ſpace of a month, whatever ſubſtance the animal had been fed with, acquiring at the ſame time a viſcidity and becoming turbid; that from cabbage generally, but not always, becoming firſt putrid. All of them ſeparated a filamentous matter, and became clear on being expoſed to the heat of 25° of Reaumur's thermometer. In the reſiduums of the diſtillation no difference whatever could be perceived. As the only difference therefore exiſting in cows milk lies in the volatile part, our authors conclude, that it is improper to boil milk either for common or medicinal purpoſes. They obſerved alſo that any ſudden change of food, even from a worſe to a better kind was attended by a very remarkable diminution in the quantity of milk. All the reſiduums of the diſtillations yielded, in a ſtrong fire, a yellow oil and acid, a thick and black empyreumatic oil, a volatile alkali, and towards the end a quantity of inflammable air, and at laſt a coal remained containing ſome fixed alkali with muriatic acid.

On agitating in long bottles the creams from the milk of cows fed with different ſubſtances, all of them were formed into a kind of half-made butter; of which that formed from the milk from maize was white, firm, and inſipid; that from potatoes was ſofter and more pinguedinous; but that from common graſs was the beſt of all. Cabbage, as in other caſes, gave a ſtrong taſte.

In the courſe of their experiments, it was endeavoured to determine whether butter is actually contained in the cream, or whether it be a chemical production of the operation of churning. They could not find any reaſon abſolutely ſatisfactory on either ſide, but incline to the latter opinion; becauſe when cream is allowed to remain among the milk, and the whole curdled promiſcuouſly, only fat cheeſe, without any butter, is produced. The oily parts cannot be ſeparated into butter either by acids or any other means than churning: even the artificial mixture of oil with the cream is inſufficient for the purpoſe.

The ſerum of milk was reduced by filtration to a clear and pellucid liquor; and, by mixture with fixed alkali, depoſited a portion of cheeſy matter which had been

Milk. been diffolved in the whey. The fugar of milk was alfo found in this liquor.

In their experiments upon the milk of various animals, it was found that the milk of affes yielded by diftillation an infipid liquor, and depofited a liquor fimilar to the lymph of cows milk. It is coagulated by all the acids, but not into an uniform mafs; exhibiting only the appearance of diftinct flocculi. It affords but little cream, which is converted with difficulty into a foft butter that foon becomes rancid. It has but a fmall quantity of faccharine particles, and thefe are often mixed with muriatic felenite and common falt. Goats milk has a thick cream, and agreeable to the ftate; and the milk itfelf may be preferved longer in a found ftate than any other fpecies, the fcum on its furface being naturally convertible into palatable cheefe. It is eafily made into firm butter, which does not foon become rancid, and has a good flavour. The butter milk contains a large quantity of cheefy matter, which readily coagulates; but has ftill lefs faccharine matter than that of affes. Sheeps milk can fcarce be diftinguifhed from that of a cow, and eafily parts with its cream by ftanding. It is of a yellow colour, an agreeable flavour, and yields a great proportion of butter; but this is not folid, and foon becomes rancid. Mares milk is the moft infipid and leaft nutritious of any; notwithftanding which it has been much recommended for weak and confumptive patients: in which cafes it is probable that it proves efficacious by being more confonant than any other to the debilitated powers of digeftion. It boils with a fmaller fire than any other kind of milk, is eafily coagulated, and the diftilled water does not foon change its nature. It has but a fmall quantity of cheefy matter, and very few oily particles: the cream cannot be made into butter; and the whey contains about as much fugar as cows or goats milk.

In this memoir our authors remark, that in order to augment the quantity, as well as to improve the quality, of the milk of animals, they fhould be well fed, their ftalls kept clean, and their litter frequently renewed: they fhould be milked at ftated hours, but not drained: great attention fhould alfo be paid to the breed; becaufe inferior cattle are maintained at as great expence as the moft valuable kinds. No change ought to be made in the food; though if the milk be employed for medicinal purpofes, it may be improved by a proper mixture of herbs, &c.

In their experiments on women's milk, Meffrs Parmentier and Deyeux differ fomewhat from Dr Clarke. They firft tried the milk of a woman who had been delivered four months; and obferved, that after the cream had been feparated the other part appeared of a more perfect white, and that it could not be coagulated either by vinegar or mineral acids; which they attributed to a fuperabundance of ferum. But they found that in proportion to the age of the milk it was found to be more eafily coagulable; and this was confirmed by experiments made upon the milk of 20 nurfes. Its coagulability was not increafed by heat. The cream, by agitation, formed a vifcid unctuous matter, but could not be changed into perfect butter: but they found that it was extremely difficult to determine the proportions of the various component parts in human milk, as it differs remarkably, not only in different fubjects, but in the fame fubject at different times. In a nurfe aged about 32 years, who was extremely fubject to nervous affections, the milk was one day found almoft quite colourlefs and tranfparent. In two hours after, a fecond quantity drawn from the breaft was vifcid like the white of an egg. It became whiter in a fhort time, but did not recover its natural colour before the evening. It was afterwards found that thefe changes were occafioned by her having fome violent hyfteric fits in the mean time.

Sugar of Milk. Different methods have been propofed for obtaining the fugar of milk. The following is an account of a method ufed by fome of the Tartar nations of preferving their milk by means of froft: in which operation great quantities of the fugar of milk are accidentally formed. The account was given by Mr Fahrig of Peterfburgh, who undertook a journey, by order of the academy of Peterfburgh, among the Mogul tribes who inhabit the country beyond the lake Baikal, on the banks of the river Salenga. Thefe people allow their milk to freeze in large quantity in iron kettles; and, when it is perfectly congealed, they place them over a gentle fire to foften the edges of the cake, after which it may be taken out with a wooden fpatula. They commence thefe operations at the beginning of the cold, when they have milk in the greateft abundance; after which it may be preferved with great eafe throughout the whole winter. Mr Fahrig having frequent opportunities of feeing thefe cakes, foon obferved, that the furface of them was covered to a confiderable depth with a farinaceous powder; and having eftablifhed a dairy upon the fame plan with thofe of the Moguls, he found the fame thing take place with himfelf. This powder was extremely fweet, and he received platefuls of it from the natives, who ufed it in their food, and fweetened their other victuals with it. Having caufed a number of cakes of frozen milk to be conveyed to the top of his houfe, where they were directly expofed to the violent cold, he found that the feparation of the faccharine powder was greatly promoted by this means. He fcraped the cakes every week to the depth of two inches, and afterwards fpread out the powder upon an earthen plate in order to deftroy the remains of moifture which might have prevented it from keeping for any length of time. When expofed in this manner it had a very agreeable and ftrong faccharine tafte; diffolved in warm water; and when ftrongly ftirred by means of a chocolate ftick, would at all times produce an excellent and well tafted milk. Raw milk affords a much larger quantity of this faccharine matter than fuch as has been boiled, or which has had the cream taken off it. Neither muft the milk be fuddenly expofed to the cold before it has loft its natural heat; for the fudden contact of the cold drives all the cheefy and fat part towards the middle, while the external parts confift of little elfe than water. In order to allow the parts of the milk to be all properly mixed together, Mr Fahrig allowed the milk when newly taken from the cows to cool, and then poured it out into fhallow kettles.

Our author is of opinion that this method of making milk would be of great fervice to navigators to fupply themfelves with milk during long fea voyages: and he he aſſures us, from his own experience, that it will always ſucceed, if proper attention be paid to it. He is of opinion, however, that all countries are not equally proper for the preparation of this ſaccharine matter: and indeed this ſeems very evidently to be the caſe, as the proceſs appears to be a cryſtallization of the ſaccharine parts of the milk, and a ſeparation of them from the aqueous ones by means of extreme cold. The country in which he made the experiments is one of the moſt elevated in all Aſia; and ſo cold, that, though it lies only in the 50th degree of north latitude, its rivers are frozen up for ſix months of the year. A very dry cold wind alſo prevails throughout almoſt the whole year; and the dry winds generally come from the north, being almoſt always preceded by a warm wind from the ſouth, which blows for ſome time. The dry rarefied air increaſes the evaporation from the ice cakes, and leaves nothing but the ſaccharine or pure conſtituent parts of the milk, which with the addition of water can always recompoſe the fluid.

Milk, in the wine trade. The coopers know very well the uſe of ſkimmed milk, which makes an innocent and efficacious forcing for the fining down of all white wines, arracks, and ſmall ſpirits; but is by no means to be uſed for red wines, becauſe it diſcharges their colour. Thus, if a few quarts of well ſkimmed milk be put into a hogſhead of red wine, it will ſoon precipitate the greater part of the colour, and leave the whole nearly white: and this is of known uſe in the turning of red wines, when pricked, into white; in which a ſmall degree of acidity is not ſo much perceived.

Milk is, from this quality of diſcharging colour from wines, of uſe alſo to the wine coopers, for the whitening of wines that have acquired a brown colour from the caſk, or from having been haſtily boiled before fermenting; for the addition of a little ſkimmed milk, in theſe caſes, precipitates the brown colour, and leaves the wines almoſt limpid, or of what they call a *water whiteneſs*, which is much coveted abroad in wines as well as in brandies.

Milk of Lime; Milk of Sulphur. The name of *milk* is given to ſubſtances very different from *milk* properly ſo called, and which reſemble milk only in colour. Such is water in which quicklime has been ſlaked, which acquires a whiteneſs from the ſmall particles of the lime being ſuſpended in it, and has hence been called the milk of *lime*. Such alſo is the ſolution of liver of *ſulphur*, when an acid is mixed with it, by which white particles of ſulphur are made to float in the liquor.

Milk of Vegetables. For the ſame reaſon that milk of animals may be conſidered as a true animal emulſion, the emulſive liquors of vegetables may be called *vegetable milks*. Accordingly emulſions made with almonds are commonly called *milk of almonds*. But beſides this vegetable milk, which is in ſome meaſure artificial, many plants and trees contain naturally a large quantity of emulſive or milky juices. Such are lettuce, ſpurge, fig tree, and the tree which furniſhes the elaſtic American reſin. The milky juices obtained from all theſe vegetables derive their whiteneſs from an oily matter, mixed and undiſſolved in a watery or mucilaginous liquor. Moſt reſinous gums were originally ſuch milky juices, which afterwards become ſolid by the evaporation of their more fluid and volatile parts.

Milk-Fever. See Medicine *Index*.

Milky-Hedge, the Engliſh name of a ſhrub growing on the coaſt of Coromandel, where it is uſed for hedging. The whole ſhrub grows very buſhy, with numerous erect branches, which are compoſed of cylindrical joints as thick as a tobacco pipe, of a green colour, and from three to ſix inches long: the joints are thicker than the other parts, but always give way firſt on any accidental violence offered to the plant. When broken it yields a milk of an exceſſively cauſtic quality, which bliſters any part of the ſkin it touches. When the joints are broken off at each end, the tube then contains but very little milk. In this ſtate Mr Ives ventured to touch it with his tongue, and found it a little ſweet. In the hedges it is ſeldom very woody; but when it is, the wood is very ſolid, and the bark gray and cracked. This plant, he informs us, has acquired great reputation in curing the venereal diſeaſe, on the following account: A poor Portugueſe woman, the eldeſt female of her family, had wrought ſurpriſing cures in the moſt inveterate venereal diſorders, even ſuch as the European phyſicians had pronounced incurable. Theſe facts became ſo notorious, that the ſervants of the Company, and eſpecially their ſurgeons, were induced to offer her a very conſiderable premium for a diſcovery of the medicine; but ſhe always refuſed to comply, giving for a reaſon, that while it remained a ſecret, it was a certain proviſion for the maintenance of the family in the preſent as well as in future generations. On account of this denial the Engliſh ſurgeons were ſometimes at the pains to have her motions without doors carefully watched; and as they were not able to diſcover that ſhe ever gathered of any other plant or tree but this, they conjectured that the milk of this tree was the ſpecific employed. Mr Ives inquired at the black doctors concerning the virtues of this plant; who all agreed, that it will cure the lues venerea, but differed as to the manner of adminiſtering it; ſome ſaying that a joint of it ſhould be eaten every morning; others that the milk only ſhould be dropped upon ſugar; and then put into milk, oil, &c. and given daily to the patient.

Milky Way. See Astronomy *Index*.

MILL, a machine for grinding corn, &c. of which there are various kinds, according to the different methods of applying the moving power; as water-mills, wind-mills, mills worked by horſes, &c. See Mechanics *Index*.

The firſt obvious method of reducing corn into flour for bread would be by the ſimple expedient of pounding. And that was for ages the only one which was practiſed by the various deſcendants of Adam, and actually continued in uſe among the Romans below the reign of Veſpaſian. But the proceſs was very early improved by the application of a grinding power, and the introduction of millſtones. This, like moſt of the common refinements in domeſtic life, was probably the invention of the antediluvian world, and certainly practiſed in ſome of the earlieſt ages after it; and, like moſt of them, it was equally known in the eaſt and weſt. Hence the Gauls and Britons appear familiarly acquainted with the uſe of hand-mills before the time of their ſubmiſſion to the Romans; the Britons particularly

Mill.

larly diſtinguiſhing them, as the Highlanders and we diſtinguiſh them at preſent, by the ſimple appellations of *querns*, *carnes*, or *ſtones*. And to theſe the Romans added the very uſeful invention of water mills. For this diſcovery the world is pretty certainly indebted to the genius of Italy; and the machine was not uncommon in the country at the conqueſt of Lancaſhire. This, therefore, the Romans would neceſſarily introduce with their many other refinements among us. And that they actually did, the Britiſh appellation of a *water-mill* fully ſuggeſts of itſelf; the *melin* of the Welſh and Corniſh, the *mull*, *meill*, and *melin* of the Armoricans, and the Iriſh *muilean* and *muilind*, being all evidently derived from the Roman *mola* and *molendinum*. The ſubject Britons univerſally adopted the Roman name, but applied it, as we their ſucceſſors do, only to the Roman *mill*; and one of theſe was probably erected at every ſtationary city in the kingdom. One plainly was at Mancheſter, ſerving equally the purpoſes of the town and the accommodation of the garriſon.—And one alone would be ſufficient, as the uſe of handmills remained very common in both, many having been found about the ſite of the ſtation particularly; and the general practice having deſcended among us nearly to the preſent period. Such it would be peculiarly neceſſary to have in the camp, that the garriſon might be provided againſt a ſiege. And the water-mill at Mancheſter was fixed immediately below the Caſtlefield and the town, and on the channel of the Medlock. There, a little above the ancient ford, the ſluice of it was accidentally diſcovered about 30 years ago. On the margin of Dyer's croft, and oppoſite to ſome new conſtructions, the current of the river, accidentally ſwelled with the rains, and obſtructed by a dam, broke down the northern bank, ſwept away a large oak upon the edge of it, and diſcloſed a long tunnel in the rock below. This has been ſince laid open in part with a ſpade. It appeared entirely uncovered at the top, was about a yard in width, and another in depth, but gradually narrowed to the bottom. The ſides ſhowed everywhere the marks of the tool on the rock, and the courſe of it was parallel with the channel. It was bared by the flood about 25 yards only in length, but was evidently continued for ſeveral further; having originally begun, as the nature of the ground evinces, juſt above the large curve in the channel of the Medlock.

Whitaker's Hiſt. of Mancheſter.

For the firſt five or ſix centuries of the Roman ſtate, there were no public bread bakers in the city of Rome. They were firſt introduced into it from the eaſt, at the concluſion of the war with Perſeus, and about the year 167 before Chriſt. And, towards the cloſe of the firſt century, the Roman families were ſupplied by them every morning with freſh loaves for breakfaſt.—But the ſame cuſtom, which prevailed originally among the Romans and many other nations, has continued nearly to the preſent time among the Mancunians. The providing of bread for every family was left entirely to the atttention of the women in it; and it was baked upon ſtones, which the Welſh denominate *greidiols* and we *gredles*. It appears, however, from the kiln-burnt pottery which has been diſcovered in the Britiſh ſepulchres, and from the Britiſh appellation of an *odyn* or *oven* remaining among us at preſent, that furnaces for baking were generally known among the original Britons. An odyn would therefore, be erected at the manſion of each Britiſh baron, for the uſe of himſelf and his retainers. And, when he and they removed into the vicinity of a Roman ſtation, the oven would be rebuilt with the manſion, and the public bakehouſes of our towns commence at the firſt foundation of them. One bakehouſe would be conſtructed, as we have previouſly ſhown one mill to have been ſet up, for the public ſervice of all the Mancunian families. One oven and one mill appear to have been equally eſtabliſhed in the town. And the inhabitants of it appear immemorially accuſtomed to bake at the one and grind at the other. Both, therefore, were in all probability conſtructed at the firſt introduction of water-mills and ovens into the country. The great ſimilarity of the appointments refers the conſideration directly to one and the ſame origin for them. And the general nature of all ſuch inſtitutions points immediately to the firſt and actual introduction of both. And, as the ſame eſtabliſhments prevailed equally in other parts of the north, and pretty certainly obtained over all the extent of Roman Britain, the ſame erections were as certainly made at every ſtationary town in the kingdom.

Mill, Millſtone.

MILL, John, a very learned divine, was born at Shap in Weſtmorland, about the year 1645; and became a ſervitor of Queen's college, Oxford. On his entering into orders he became an eminent preacher, and was made prebendary of Exeter. In 1681, he was created doctor of divinity; about the ſame time he was made chaplain in ordinary to King Charles II. and in 1685 he was elected principal of St Edmund's hall in Oxford. His edition of the Greek Teſtament, which will ever render his name memorable, was publiſhed about a fortnight before his death, which happened in June 1707. Dr Mills was employed 30 years in preparing this edition.

MILLSTONE, the ſtone by which corn is ground.—The millſtones which we find preſerved from ancient times are all ſmall, and very different from thoſe in uſe at preſent. Thoreſby mentions two or three ſuch found in England, among other Roman antiquities, which were but 20 inches broad; and there is great reaſon to believe that the Romans, as well as the Egyptians of old, and the ancient Jews, did not employ horſes, or wind, or water, as we do, to turn their mills, but made their ſlaves and captives of war do this laborious work: they were in this ſervice placed behind theſe millſtones, and puſhed them on with all their force. Sampſon, when a priſoner to the Philiſtines, was treated no better, but was condemned to the millſtone in his priſon. The runner or looſe millſtone, in this ſort of grinding, was uſually very heavy for its ſize, being as thick as broad. This is the millſtone which is expreſsly prohibited in Scripture to take in pledge, as lying looſe it was more eaſily removed. The Talmudiſts have a ſtory, that the Chaldeans made the young men of the captivity carry millſtones with them to Babylon, where there ſeems to have been a ſcarcity at that time; and hence, probably, their paraphraſe renders the text "have borne the mills or millſtones;" which might thus be true in a literal ſenſe. They have alſo a proverbial expreſſion of a man with a millſtone about his neck; which they uſe to expreſs a man under the ſevereſt weight

weight of affliction. This alfo plainly refers to this fmall fort of ftones.

Rheniſh MILLSTONE, a ftone which has been claffed among volcanic products, on account of its appearance, which is a blackifh gray, porous, and very much refembling a lava of Mount Vefuvius.

MILLENARIANS, or CHILIASTS, a name given to thofe in the primitive ages, who believed that the faints will reign on earth with Chrift 1000 years. See MILLENNIUM.

MILLENER, or MILLINER, one who fells ribbands and dreffes, particularly head dreffes for women; and who makes up thofe dreffes.

Of this word different etymologies have been given. It is not derived from the French. The French cannot exprefs the notion of *milliner*, otherwife than by the circumlocution *marchand* or *marchande des modes*.

Neither is it derived from the Low Dutch language, the great, but neglected, magazine of the Anglo-Saxon. For Sewell, in his Dictionary Englifh and Dutch, 1708, defcribes *millener* to be "en kraamer van lint en andere optonifelon, Franfche kraamer;" that is, "a pedlar who fells ribbands and other trimmings or ornaments; a French pedlar."

Littleton, in his Englifh and Latin dictionary, publifhed 1677, defines millener, "a jack of all trades;" q. d. *millenarius*, or *mille mercium venditor;* that is, "one who fells a thoufand different forts of things." This etymology feems fanciful: But, if he rightly underftood the vulgar meaning of the word *millener* in his time, we muft hold that it then implied what is now termed "a haberdafher of fmall wares," one who dealt in various articles of petty merchandife, and who did not *make up* the goods which he fold.

Before Littleton's time, however, a fomewhat nicer characteriftic than feems compatible with his notion, appears to have belonged to them; for Shakefpeare, in his Henry IV. makes Hotfpur, when complaining of the daintinefs of a courtier, fay,

"He was *perfumed* like a milliner."

The fact feems to be, that there were milleners of feveral kinds: as, *horſe milleners*, (for fo thofe perfons were called who make ornaments of coloured worfted for horfes); haberdafhers of fmall wares, the *milleners* of Littleton; and *milleners* fuch as thofe now peculiarly known by that name, whether male or female, and to whom Shakefpeare's allufion feems moft appropriate.

Laftly, Dr Johnfon, in his dictionary, derives the word from *milaner*, an inhabitant of *Milan*, from whence people of this profeffion firft came, as a *Lombard* is a banker.

MILLE PASSUS, or *Millia Paſſuum;* a very common expreffion among the ancient Romans for a meafure of diftance, commonly called a *mile. Milliarium*, rarely ufed. Which Hefychius made to confift of feven ftadia; Plutarch, little fhort of eight; but many others, as Strabo and Polybius, make it juft eight ftadia. The reafon of this difference feems to be, that the former had a regard to the Grecian foot, which is greater than the Roman or Italic. This diftance is oftentimes called *lapis*, which fee. Each paffus confifted of five feet (Columella).

MILLENNIUM, "a thoufand years;" generally employed to denote the thoufand years, during which, according to an ancient tradition in the church, grounded on fome doubtful texts in the Apocalypfe and other Scriptures, our bleffed Saviour fhall reign with the faithful upon earth after the firft refurrection, before the final completion of beatitude.

Though there has been no age of the church in which the millennium was not admitted by individual divines of the firft eminence, it is yet evident from the writings of Eufebius, Irenæus, Origen, and others among the ancients, as well as from the hiftories of Dupin, Mofheim, and all the moderns, that it was never adopted by the whole church, or made an article of the eftablifhed creed in any nation.

About the middle of the fourth century the Millennians held the following tenets:

1ft, That the city of Jerufalem fhould be rebuilt, and that the land of Judea fhould be the habitation of thofe who were to reign on earth 1000 years.

2dly, That the firft refurrection was not to be confined to the martyrs; but that after the fall of Antichrift all the juft were to rife, and all that were on the earth were to continue for that fpace of time.

3dly, That Chrift fhall then come down from heaven, and be feen on earth, and reign there with his fervants.

4thly, That the faints during this period fhall enjoy all the delights of a terreftrial paradife.

Thefe opinions were founded upon feveral paffages of Scripture, which the Millenarians among the fathers underftood in no other than a literal fenfe, but which the moderns, who hold that opinion, confider as partly literal and partly metaphorical. Of thefe paffages, that upon which the greateft ftrefs has been laid, we believe to be the following:—"And I faw an angel come down from heaven, having the key of the bottomlefs pit, and a great chain in his hand. And he laid hold on the dragon, that old ferpent, which is the devil and Satan, and bound him a *thouſand years*, and caft him into the bottomlefs pit, and fhut him up, and fet a feal upon him, that he fhould deceive the nations no more till *the thouſand years* fhould be fulfilled; and after that he muft be loofed a little feafon. And I faw thrones, and they fat upon them, and judgement was given unto them: and I faw the fouls of them that were beheaded for the witnefs of Jefus, and for the word of God, and which had not worfhipped the beaft, neither his image, neither had received his mark upon their foreheads, or in their hands; and they lived and reigned with Chrift a *thouſand years*. But the reft of the dead lived not again till *the thouſand years were finiſhed*. This is the firft refurrection *." This paffage all the ancient Millenarians took in a fenfe grofsly literal; and taught, that during the millennium the faints on earth were to enjoy every bodily delight. The moderns, on the other hand, confider the power and pleafure of this kingdom as wholly fpiritual; and they reprefent them as not to commence till after the conflagration of the prefent earth. But that this laft fuppofition is a miftake, the very next verfe except one affures us: for we are there told, that "when the thoufand years are expired, Satan fhall be loofed out of his prifon, and fhall go out to deceive the nations which are in the four quarters of *the earth;*" and we have no reafon to believe

* Rom. xx. 1—6.

Millennium believe that he will have ſuch power or ſuch liberty in "the new heavens and the *new earth* wherein dwelleth righteouſneſs."

For this and other reaſons, which our limits will not permit us to enumerate, the moſt judicious critics contend, that the prophecies of the millennium point, not to a reſurrection of martyrs and other juſt men to reign with Chriſt a thouſand years in a viſible kingdom upon earth, but to that ſtate of the Chriſtian church, which, for a thouſand years before the general judgement, will be ſo pure and ſo widely extended, that, when compared with the ſtate of the world in the ages preceding, it may, in the language of Scripture, be called a reſurrection from the dead. In ſupport of this interpretation they quote two paſſages from St Paul, in which a converſion from Paganiſm to Chriſtianity, and a reformation of life, is called a reſurrection from the dead:—"Neither yield ye your members as inſtruments of unrighteouſneſs unto ſin; but yield yourſelves unto God as thoſe that are *alive from the dead* *:" And again, "Wherefore he ſaith, Awake thou that ſleepeſt, and *ariſe from the dead*, and Chriſt ſhall give thee light †." It is likewiſe to be obſerved, that in all the deſcriptions of the reſurrection and future judgement which are given us at ſuch length in the goſpels and epiſtles, there is no mention made of a *firſt* and *ſecond* reſurrection at the diſtance of a thouſand years from each other. There is indeed an order in the reſurrection: for we are told ‡, that "every man ſhall riſe in his own order; Chriſt the firſt fruits, afterwards they that are Chriſt's at his coming, &c." But were the millennarian hypotheſis well founded, the words ſhould rather have run thus: "Chriſt the firſt fruits, then the martyrs at his coming, and a thouſand years afterwards the reſidue of mankind. Then cometh the end, &c."

* Rom. vi. 13.

† Eph. v. 14.

‡ 1 Cor. xv. 23.

Theſe arguments ſtrongly incline us to believe, that by the reign of Chriſt and the ſaints for a thouſand years upon earth, nothing more is meant, than that before the general judgement the Jews ſhould be converted, genuine Chriſtianity be diffuſed through all nations, and mankind enjoy that peace and happineſs which the faith and precepts of the goſpel are calculated to confer on all by whom they are ſincerely embraced.

Our Saviour's own account of his religion is, that from a ſmall beginning it will increaſe to the full harveſt. The millennium therefore is to be conſidered as the full effect of the Chriſtian principles in the hearts of men, and over the whole world; and the divines who have treated of this ſubject endeavour to prove, that this is to be expected from the facts which have already exiſted, and from the importance of the Chriſtian doctrine.

1. The gradual progreſs of Chriſtianity is no objection to this fact. This is ſimilar to the progreſs and advancement from leſs to greater perfection in every thing which poſſeſſes vegetable or animal life. The ſame thing is obſerved in the arts, in civilization, in ſocieties, and in individuals—and why ſhould it not be admitted to have place in religion? There is indeed a general principle on which a gradual progreſſion, both in the natural and moral world, is founded. The Almighty never employs ſupernatural means where the thing can be accompliſhed by thoſe which are natural. This idea is of the moſt general extent through the whole of the preſent ſyſtem of nature. The poſſibility of another plan could eaſily be admitted; but in this caſe there would be a total alteration of every part of the works of God or of man that we are acquainted with. In the ſame manner, if the religion of Chriſt had been irreſiſtible, it would have totally altered its natural conſequences. It was neceſſary, therefore, from the preſent condition of man, as an active, intelligent, and accountable being, that means ſhould be employed; and wherever means are employed, the effects produced muſt be gradual, and not inſtantaneous.

2. Though the progreſs of a divine revelation be gradual, yet it is to be expected, from the wiſdom and compaſſion of God, that it will ſtill be advancing in the hearts of men, and over the world. In the firſt age of the church, the word of God, ſupported by miracles, and by the animated zeal of men who ſpake what they ſaw and heard, grew and prevailed. In this caſe ſupernatural means were neceſſary, becauſe the prejudices of the world could not be ſubdued without them. It was the firſt watering of a plant which you afterwards leave to the dew of heaven. Miracles at the ſame time were employed only as the means of conviction; and they were not continued, becauſe in this caſe they would have become a conſtant and irreſiſtible principle, incompatible with the condition of man as a reaſonable agent. After this power was withdrawn, there were many ages of ignorance and ſuperſtition in the Chriſtian church. But what is neceſſary to be eſtabliſhed on this ſubject is, not that the progreſs of Chriſtianity has never been interrupted, but that on the whole it has been advancing. The effects of this religion on mankind, in proportion as it was received, were immediate and viſible: It deſtroyed the groſs ſuperſtition of idol worſhip: it aboliſhed the practice, which was general in the heathen world, of reducing to the loweſt ſtate of ſervitude the greateſt part of our brethren: it ſoftened the horrors of war, even when the vices of mankind made defence neceſſary: it entered into ſocial and private life; and taught men benevolence, humanity and mercy. It is in theſe bleſſed effects that we can obſerve the progreſs of Chriſtianity even to this day. Superſtition and idolatry were ſoon engrafted on the ſtem which our Saviour planted in the world; but the ſimplicity of the goſpel has been gradually undermining the fabric of ſuperſtition; and the men who are moſt nearly intereſted in the deceit are now almoſt aſhamed to ſhow their faces in the cauſe. The practice of ſlavery has, generally ſpeaking, been extinguiſhed in the Chriſtian world; yet the remains of it have been a diſgrace to the Chriſtian name, and the profeſſors of that religion have now begun to ſee the inconſiſtency. War is not only carried on with leſs animoſity, and leſs havock of the human ſpecies; but men begin to cultivate more generally, and to delight in, the arts of peace. The increaſing ſpirit of charity and benevolence, of which it were eaſy to give unexampled inſtances in the preſent age, is a decided proof of the increaſing influence of Chriſtianity. At the ſame time, if, inſtead of theſe general principles, we were to deſcend to private examples of infidelity or of wickedneſs, it would be eaſy to bring proofs in ſupport of an oppoſite opinion: but the reaſoning would by no means be equally concluſive; for if the general principles by which ſociety is regulated be more liberal and merciful, it

Millennium || Millepora.

it is evident that there is more goodneſs in a greater number of the human race. Society is nothing more than a collection of individuals; and the general tone, eſpecially when it is on the ſide of virtue, which almoſt in every inſtance oppoſes the deſigns of leading and intereſted men, is a certain evidence of the private ſpirit. To ſhow that this reformation is connected with Chriſtianity, it is unneceſſary to ſtate any compariſon between the influence of heathen, and the influence of Chriſtian principles: between civilization as depending on the powers of the human underſtanding, and on the efficacy of the word of God. The whole of this controverſy may be appealed to an obvious fact, viz. that as any nation has come nearer to the ſimplicity of the goſpel in the ſtandard of its worſhip, it has been more poſſeſſed of thoſe national virtues which we have aſcribed to the influence of Chriſtianity. This fact is worth a thouſand volumes of ſpeculation on this ſubject.

3. A revelation ſanctioned by God, for a benevolent purpoſe, will be expected to produce effects correſponding to the wiſdom which gave it, and to the purpoſe for which it is employed. It may be gradual; but it will be increaſing, and it muſt increaſe, to the full harveſt. He that has begun the good work will alſo finiſh it. It is reaſonable to expect this illuſtrious ſucceſs of the goſpel, both from the nature of the thing, and from the prophecies contained in the ſacred ſcriptures. The precepts of the goſpel, in their genuine ſenſe, are admirably calculated for the peace and welfare both of individuals and ſociety. The greateſt liberality of mind, the greateſt generoſity of temper, the moſt unbounded love, and the greateſt indifference to the accumulation of this world's property, if they glowed from breaſt to breaſt, and operated with equal force on all men, would be productive of equal good and happineſs to all. We are ſcarcely able to perceive the force of this at firſt view, becauſe the deceit and impoſition which yet exiſt in the world, prevent the operation of the beſt principles even in the beſt hearts. But in proportion to the improvement of mankind, what is their real intereſt, and what are the real objects of happineſs, will gradually unfold. The contempt of vice will be greater in proportion to the ſcarcity of it: for one villain gives countenance and ſupport to another, juſt as iron ſharpeneth iron. This opens to our view another fact connected with the practice of Chriſtianity, namely, that the nearer it arrives to its perfect ſtate, it will be the more rapid in its progreſs. The beauty of holineſs will be more viſible; and, in the ſtrong language of the prophet, "the earth ſhall bring forth in one day, and a nation ſhall be born at once *." This future perfection of the goſpel is conſiſtent with its nature and importance.—We can ſcarcely believe that means ſo admirably adapted to the reformation of mankind ſhould be without their effect; and if the moſt difficult part be already accompliſhed, we have no reaſon to apprehend that the ſcheme will not be completed. This fact is alſo clearly the ſubject of ancient prophecy. For "thus ſaith the Lord †, I will extend peace to her like a river, and the glory of the Gentiles like a flowing ſtream. And it ſhall come to paſs, from one ſabbath to another, and from one new moon to another, ſhall all fleſh come to worſhip before me, ſaith the Lord."—"Violence ſhall be no more heard in thy land, waſting nor deſtruction within thy border; but thou ſhalt call thy walls ſalvation, and thy gates praiſe." (Iſ. lx. 18.).

* Iſ. lxvi. 8.

† Ver. 12. 23.

Without entering more minutely on the prophecy already quoted from chap. xx. of the book of the Revelation, it is ſufficient to obſerve, that Dr Whitby, in his treatiſe on the millennium at the end of his commentary, proves, in the cleareſt manner, from the ſpirit of the paſſage and the ſimilarity of the expreſſions with thoſe of other prophets, that it refers to a ſtate of the church for a thouſand years, which ſhall be like life from the dead. The commencement of this period is connected with two events: the fall of antichriſt, and the converſion of the Jews. The latter of theſe events muſt be conſidered as a key to all the prophecies concerning the millennium. As the Jews were the ancient people of God, and as their converſion is to be the previous ſtep to the general knowledge of Chriſtianity, the prophecies of the millennium have a chief relation to this important event. We have already obſerved, that God never interpoſes with miraculous power to produce what can be effected by natural means; and from what we know of human nature, we cannot but perceive that the converſion of the Jews will powerfully operate to the general converſion of mankind. Freed from thoſe prejudices which now make them the objects of hatred in all nations, and fired with that zeal by which new converts are always actuated, they will preach the goſpel with a fervour of which we, who have long been bleſſed with its rays, can hardly form a conception; and, by their preſent diſperſion over the whole earth, they will be enabled to adapt their inſtructions to every individual of the human race in the language of his fathers. Indeed, if they are not at ſome future period to be employed by Providence for this purpoſe, it is difficult, if not impoſſible, to give any reaſon for their diſperſed ſtate and political exiſtence. Juſt now it muſt be confeſſed that they are the moſt implacable enemies of the Chriſtian name; but their converſion is not on that account more unlikely or improbable than were events which have taken place of nearly equal importance a very few years ago. On the whole, the perfection of Chriſtianity is a doctrine of reaſonable expectation to the church; and it is impoſſible for the advocates for natural religion to deny, that unlimited obedience to its precepts is conſiſtent with the pureſt ſtate of liberty and of happineſs. This is the only millennium which the prophets and apoſtles, as we underſtand them, promiſe to the ſaints; but as men figuring in the very firſt ranks of learning have thought otherwiſe, we would not be too confident that our interpretation is juſt.—Such of our readers as wiſh for further information, will find it in the works of Mr Mede, Biſhop Newton, Dr Whitby and Dr Gill; and to thoſe maſterly writers we refer them for that ſatisfaction which in ſuch an article as this cannot be given.

MILLEPES, or WOOD LOUSE; a ſpecies of ONISCUS. See ENTOMOLOGY *Index*.

MILLEPORA, in *Natural Hiſtory*, a name by which Linnæus diſtinguiſhes that genus of lithophytes, of a hard ſtructure and full of holes, which are not ſtellated or radiated, and whoſe animal is the hydra, in which it differs from the madrepora, and comprehending 14 different ſpecies.

In the millepora, the animal which forms and inhabits it occupies the ſubſtance; and it is obſerved that

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the milleporæ grow upon one another; their little animals produce their ſpawn; which attaching itſelf either to the extremity of the body already formed, or underneath it, gives a different form to this production. Hence the various ſhapes of the millepora, which is compoſed of an infinite number of the cells of thoſe little inſects, which all together exhibit different figures, though every particular cellula has its eſſential form, and the ſame dimenſions, according to its own ſpecies.

MILLET. See MILIUM, BOTANY *Index*.

MILLIARE, or MILLIARIUM, a Roman mile, which conſiſted of 1000 paces, *mille paſſus*, whence the name.

MILLIARIUM AUREUM, was a gilded pillar in the forum of Rome, at which all the highways of Italy met, as one common centre. From this pillar the miles were counted, and at the end of every mile a ſtone was put down. The milliary column was erected by Auguſtus Cæſar, and, as we are informed by travellers, is ſtill to be ſeen.

MILLING of CLOTH. See FULLING.

MILLION, in *Arithmetic*, the ſum of ten hundred thouſand, or a thouſand times a thouſand. See ARITHMETIC.

MILLO, a part of Mount Zion at its extremity; and therefore called *Millo* of the city of David (2 Chron. xxxii.), taken in with the wall that encompaſſed Mount Zion. Uncertain whether *Beth Millo*, (Judges ix. 20.) denotes a place; if it did, it lay near Sechem.

MILLOT, CLAUDE FRANCIS XAVIER, of the French academy, was born at Beſançon, March 1726, and was for ſome time a Jeſuit. He was conſecrated for the pulpit, and continued to preach after he left the ſociety: But the weakneſs of his voice, his timidity, and the awkwardneſs of his manner, not permitting him to continue in this profeſſion, he relinquiſhed it, although he had preached Advent ſermons at Verſailles, and Lent ſermons at Luneville. The marquis de Felino, miniſter of Parma, inſtituted an hiſtorical claſs for the benefit of the young nobility; and, at the deſire of M. le Duc de Nivernois, he gave the charge of it to the abbé Millot. The miniſter having occaſioned a kind of rebellion among the people by ſome innovations which he had made in the ſtate, the abbé continued attached to the intereſts of his patron, and would not deſert him till the ſtorm was blown over. When he was told that he would loſe his place by this conduct, he replied, "My place is with a virtuous perſecuted man who has been my benefactor; and that I ſhall never loſe." At length, having filled the hiſtorical chair with great approbation, he returned to France, and was appointed preceptor to M. le Duc d'Enghien. In this ſituation he died, A. D. 1785, aged 59. The abbé Millot did not ſhine in company; he was cold and reſerved in his manner; but every thing he ſaid was judicious, and exactly in point.—D'Alembert ſaid, that of all his acquaintance the abbé Millot had the feweſt prejudices and the leaſt pretenſion. He compoſed ſeveral works, which are digeſted with great care, and written in a pure, ſimple, and natural ſtyle. The principal are, 1. *Elemens de l'Hiſtoire de France, depuis Clovis juſqu' à Louis XIV.* 3 vols. in 12mo. The author, ſelecting the moſt curious and important facts, has ſuppreſſed every thing foreign to the ſubject; and has not only arranged the materials in their proper order, but choſen them with the greateſt judgement. Querlon thought this the beſt abridgement which we have of the hiſtory of France, and preferred it to that of the preſident Henault. 2. *Elemens de l'Hiſtoire d'Angleterre, depuis ſon origine ſous les Romains, juſqu' à George II.* 3 vols. 12mo. In this valuable abridgement, the author ſatisfies, without tiring, his readers. It is all that is neceſſary for thoſe who wiſh to gain a general knowledge of the Engliſh hiſtory, without entering minutely into its particular parts.—3. *Elemens de l'Hiſtoire Univerſelle*, 9 vols. 12mo. A certain critic maintains, that this work is merely a counterfeit of Voltaire's general hiſtory. But this cenſure is altogether unjuſt. The ancient hiſtory in this work is wholly compoſed by the abbé Millot; and, no leſs than the modern part, diſcovers his abilities in the choice of facts, in diveſting them of uſeleſs circumſtances, in relating them without prejudice, and in adorning them with judicious reflections. 4. *L'Hiſtoire des Troubadours*, 3 vols. 12mo, compiled from the manuſcripts of M. de Saint Palaie. This work appears rather tedious, becauſe it treats of men almoſt unknown, and moſt of them deſerving to be ſo. What is there quoted from the Provençal poets is not at all intereſting; and, according to the obſervation of a man of wit, "it ſerves no purpoſe to ſearch curiouſly into a heap of old ruins while we have modern palaces to engage our attention." 5. *Memoires Politiques et Militaires, pour ſervir à l'Hiſtoire de Louis XIV. et de Louis XV.* compoſed from original papers collected by Adrian Maurice duc de Noailles, marſhal of France, in 6 vols. 12mo. 6. The abbé Millot publiſhed alſo ſeveral Diſcourſes, in which he diſcuſſes a variety of philoſophical queſtions, with more ingenuity of argument than fire of expreſſion; and a tranſlation of the moſt ſelect harangues in the Latin hiſtorians; of which it has been remarked, as well as of the orations of the abbé d'Olivet, that they are coldly correct, and elegantly inſipid. The character of the author, more prudent and circumſpect than lively and animated, ſeldom elevated his imagination above a noble ſimplicity without warmth, and a pure ſtyle without oſtentation. Some of the critics, however, have accuſed him of declamation in ſome parts of his hiſtories, particularly in thoſe parts which concern the clergy. But, in our opinion, the word declamation is totally inapplicable to the writings of the abbé Millot. He flatters, it is true, neither prieſts nor ſtateſmen; and he relates more inſtances of vicious than of virtuous actions, becauſe the one are infinitely more common than the other: But he relates them coldly; and he appears to be guided more by ſincerity and a love of truth, than by that partial philoſophy which blames the Chriſtian religion for thoſe evils which it condemns.

MILO, a celebrated athlete of Crotona in Italy. His father's name was Diotimus. He early accuſtomed himſelf to carry the greateſt burdens, and by degrees became a prodigy of ſtrength. It is ſaid that he carried on his ſhoulders a young bullock, four years old, for above forty yards; and afterwards killed it with one blow of his fiſt, and eat it up in one day. He was ſeven times crowned at the Pythian games, and ſix at the Olympian. He preſented himſelf a ſeventh time; but no one had the courage or boldneſs to enter the liſts againſt

Milo.

against him. He was one of the difciples of Pythagoras; and to his uncommon ftrength, it is faid, the learned preceptor and his pupils owed their life: The pillar which fupported the roof of the fchool fuddenly gave way; but Milo fupported the whole weight of the building, and gave the philofopher and his auditors time to efcape. In his old age, Milo attempted to pull up a tree by the roots, and break it. He partly effected it; but his ftrength being gradually exhaufted, the tree when half cleft re-united, and his hands remained pinched in the body of the tree. He was then alone; and, being unable to difentangle himfelf, he was devoured by the wild beafts of the place, about 500 years before the Chriftian era.

Milo, *T. Annius*, a native of Lanuvium, who attempted to obtain the confulfhip at Rome by intrigue and feditious tumults. Clodius the tribune oppofed his views; yet Milo would have fucceeded but for the following event: As he was going into the country, attended by his wife and a numerous retinue of gladiators and fervants, he met on the Appian road his enemy Clodius, who was returning to Rome with three of his friends and fome domeftics completely armed.—A quarrel arofe between the fervants. Milo fupported his attendants, and the difpute became general.—Clodius received many fevere wounds, and was obliged to retire to a neighbouring cottage. Milo purfued his enemy in his retreat, and ordered his fervants to defpatch him. The body of the murdered tribune was carried to Rome, and expofed to public view. The enemies of Milo inveighed bitterly againft the violence and barbarity with which the facred perfon of a tribune had been treated. Cicero undertook the defence of Milo; but the continual clamours of the friends of Clodius, and the fight of an armed foldiery, which furrounded the feat of judgement, fo terrified the orator, that he forgot the greateft part of his arguments, and the defence he made was weak and injudicious.—Milo was condemned, and banifhed to Maffilia. Cicero foon after fent his exiled friend a copy of the oration which he had prepared for his defence, in the form in which we have it now; and Milo, after he had read it, exclaimed, *O Cicero, hadft thou fpoken before my accufers in thefe terms, Milo would not be now eating figs at Marfeilles.* The friendfhip and cordiality of Cicero and Milo were the fruits of long intimacy and familiar intercourfe. It was to the fuccefsful labours of Milo that the orator was recalled from banifhment, and reftored to his friends.

Milo, (anciently *Melos*), an ifland in the Archipelago, about 50 miles in circumference, with a harbour, which is one of the largeft in the Mediterranean. The principal town is of the fame name as the ifland, and was prettily built, but abominably nafty: the houfes are two ftories high, with flat roofs; and are built with a fort of pumice ftone, which is hard, blackifh, and yet very light.

This ifland was formerly rich and populous. From the earlieft times of antiquity it enjoyed pure liberty. The Athenians, not being able to perfuade the Melians to declare in their favour in the Peloponnefian war, made a defcent upon the ifland, and attacked them vigoroufly. In two different expeditions they failed of their purpofe: but returning with more numerous forces, they laid fiege to Melos; and obliging the befieged to furrender at difcretion, put to the fword all the men who were able to bear arms. They fpared only the women and children, and thefe they carried into captivity. This act of cruelty puts humanity to the blufh, and difgraces the Athenian name. But war was then carried on with a degree of wild rage, unexampled in the prefent times. Republics know not how to pardon, and always carry their vengeance to an extravagant height. When Lyfander, the Lacedemonian general, came to give law to the Athenians, he expelled the colony which they had fent to Melos, and re-eftablifhed the unfortunate remains of its original inhabitants.

This ifland loft its liberty when Rome, afpiring to the empire of the world, conquered all the ifles of the Archipelago. In the partition of the empire, it fell to the fhare of the eaftern emperors, was governed by particular dukes, and was at laft conquered by Soliman II. Since that period, it has groaned under the yoke of Turkifh defpotifm, and has loft its opulence and fplendour. At the commencement of the prefent century, it boafted of 17 churches and 11 chapels, and contained more than 20,000 inhabitants. It was very fertile in corn, wine, and fruits; and the whole fpace from the town to the harbour, which is nearly two miles, was laid out in beautiful gardens. M. Tournefort, who vifited it in the year 1700, gives a fine defcription of it. "The earth, being conftantly warmed by fubterraneous fires, produced almoft without interruption plenteous crops of corn, barley, cotton, exquifite wines, and delicious melons. St Elias, the fineft monaftery in the ifland, and fituated on the moft elevated fpot, is encircled with orange, citron, cedar, and fig trees. Its gardens are watered by a copious fpring. Olive trees, of which there are but few in the other parts of the ifland, grow in great numbers around this monaftery. The adjacent vineyards afford excellent wine. In a word, all the productions of the ifland are the very beft of their kinds; its partridges, quails, kids, and lambs, are highly valued, and yet may be bought at a very cheap price."

Were M. Tournefort to return to Milo, M. Savary * affures us, he would no longer fee the fine ifland which he has defcribed. "He might ftill fee alum, in the form of feathers, and fringed with filver thread, hanging from the arches of the caverns; pieces of pure fulphur filling the cliffs of the rocks; a variety of mineral fprings; hot baths (though thefe are now only a fet of fmall dirty caves); the fame fubterraneous fires which in his days warmed the bofom of the earth, and were the caufe of its extraordinary fertility: but inftead of 5000 Greeks, all paying the capitation tax (A), he would now find no more than about 700 inhabitants

* *Letters on Greece*, Let. xlii.

(A) Grown up men are the only perfons who pay the capitation tax. Therefore, by adding to the number of 5000 who paid the tax, the women, boys, and girls, we find that Melos, in the days of Tournefort, contained at leaft 20,000 fouls.

Milo.

inhabitants on an iſland 18 leagues in circumference. He would ſigh to behold the fineſt lands lying uncultivated, and the moſt fertile valleys converted into moraſſes; of the gardens ſcarcely a veſtige left; three-fourths of the town in ruins, and the inhabitants daily decreaſing. In ſhort, during the laſt 50 years, Melos has aſſumed a quite different appearance. The plague, which the Turks propagate everywhere, has cut off one part of its inhabitants; the injudicious adminiſtration of the Porte, and the oppreſſive extortions of the captain pacha, have deſtroyed the reſt. At preſent, for want of hands, they cannot cut out a free channel for their waters, which ſtagnate in the valleys, corrupt, and infect the air with their putrid exhalations. The ſalt marſhes, of which there are numbers in the iſland, being equally neglected, produce the ſame effects. Add to theſe inconveniences, thoſe ſulphureous exhalations which ariſe all over the iſland, and by which the inhabitants of Melos are afflicted with dangerous fevers during three-fourths of the year. Perhaps they may be obliged to forſake their country. Every countenance is yellow, pale, and livid; and none bears any marks of good health. The prudent traveller will be careful to ſpend but a very ſhort time in this unwholeſome country, unleſs he chooſes to expoſe himſelf to the danger of catching a fever. To ſleep over night, or to ſpend but one day in the iſland, is often enough to occaſion his being attacked with that diſtemper.

"Yet (continues our author) a judicious and enlightened government might expel thoſe evils which ravage Melos. Its firſt care would be to eſtabliſh a lazaret, and to prohibit veſſels whoſe crews or cargoes are infected with the plague from landing. Canals might next be cut, to drain the marſhes, whoſe exhalations are ſo pernicious. The iſland would then be repeopled. The ſulphureous vapours are not the moſt noxious. Theſe prevailed equally in ancient times, yet the iſland was then very populous. M. Tournefort, who travelled through it at a time leſs diſtant from the period when it was conquered by the Turks, and when they had not yet had time to lay it waſte, reckons the number of its inhabitants (as we have ſaid) at about 20,000. The depopulation of Melos is therefore to be aſcribed to the deſpotiſm of the Porte, and is deteſtable police."

Sutherland's Tour up the Straits, p. 146.

The women of Milo, once ſo celebrated for their beauty, are now ſallow, unhealthy, and diſguſtingly ugly; and render themſelves ſtill more hideous by their dreſs, which is a kind of looſe jacket, with a white coat and petticoat, that ſcarcely covers two-thirds of their thighs, barely meeting the ſtocking above the knee. Their hind hair hangs down the back in a number of plaits; that on the fore part of the head is combed down each ſide of the face, and terminated by a ſmall ſtiff curl, which is even with the lower part of the cheek. All the inhabitants are Greeks, for the Turks are not fond of truſting themſelves in the ſmall iſlands; but every ſummer the captain baſhaw goes round with a ſquadron to keep them in ſubjection, and to collect the revenue. When the Ruſſians made themſelves maſters of the Archipelago, many of the iſlands declared in their favour; but being abandoned by the peace, they were ſo ſeverely mulcted by the grand ſignior, that they have profeſſed a determination to remain perfectly quiet in future. As the Turks, however, do not think them worth a garriſon, and will not truſt them with arms and ammunition, all thoſe which the Ruſſians may chooſe to invade will be obliged to ſubmit. The two points which form the entrance of the harbour, croſſing each other, render it imperceptible until you are cloſe to it. Thus, while you are perfectly ſecure within it, you find great difficulty in getting out, particularly in a northerly wind; and as no trade is carried on except a little in corn and ſalt, Milo would ſcarcely ever be viſited, were it not that, being the firſt iſland which one makes in the Archipelago, the pilots have choſen it for their reſidence. They live in a little town on the top of a high rock, which, from its ſituation and appearance, is called the *Caſtle*.—Partridges ſtill abound in this iſland; and are ſo cheap, that you may buy one for a charge of powder only. The peaſants get them by ſtanding behind a portable ſcreen, with a ſmall aperture in the centre, in which they place the muzzle of their piece, and then draw the partridges by a call. When a ſufficient number are collected, they fire among them, and generally kill from four to ſeven at a ſhot; but even this method of getting them is ſo expenſive, from the ſcarcity of ammunition, that the people can never afford to ſhoot them, except when there are gentlemen in the iſland, from whom they can beg a little powder and ſhot.

Milſtone ‖ Miltiades.

Milo is 60 miles north of Candia; and the town is ſituated in E. Long. 25. 15. N. Lat. 36. 27.

MILSTONE. See MILLSTONE.

MILT, in *Anatomy*, a popular name for the SPLEEN.

MILT, or *Melt*, in *Natural Hiſtory*, the ſoft roe in fiſhes; thus called from its yielding, by expreſſion, a whitiſh juice reſembling milk. See ROE.

The milt is properly the ſeed or ſpermatic part of the male fiſh. The milt of a carp is reckoned a choice bit. It conſiſts of two long whitiſh irregular bodies, each included in a very thin fine membrane. M. Petit conſiders them as the teſticles of the fiſh wherein the ſeed is preſerved; the lower part, next the anus, he ſuppoſes to be the *veſiculæ ſeminales*.

MILTHORP, a port town of Weſtmoreland, at the mouth of the Can, five miles from Kendal. It is the only ſea port in the county; and goods are brought hither in ſmall veſſels from Grange in Lancaſhire. Here are two paper mills. It has a market on Friday, and a fair on Old May day; and there is a good ſtone bridge over the river Betha, which runs through the town.

MILTIADES, an Athenian captain, ſon of Cypſelus. He obtained a victory in a chariot race at the Olympic games. He led a colony of Athenians to the Cherſoneſus. The cauſes of this appointment are ſtriking and ſingular. The Thracian Dolonci, haraſſed by a long war with the Abſynthians, were directed by the oracle of Delphi to take for their king the firſt man they met in their return home, who invited them to come under his roof and partake his entertainments. This was Miltiades, whom the appearance of the Dolonci, with their ſtrange arms and garments, had ſtruck. He invited them to his houſe, and was made acquainted with the commands of the oracle. He obeyed; and when the oracle of Delphi had approved a ſecond time the choice of the Dolonci, Miltiades. lonci, he departed for the Cherfonefus, and was invefted by the inhabitants with fovereign power. The firft meafures he took were to ftop the further incurfions of the Abfynthians, by building a ftrong wall acrofs the ifthmus. When he had eftablifhed himfelf at home, and fortified his dominions againft foreign invafion, he turned his arms againft Lampfacus. His expedition was unfuccefsful; he was taken in an ambufcade, and made prifoner. His friend Crœfus king of Lydia was informed of his captivity, and procured his releafe. He lived few years after he had recovered his liberty. As he had no iffue, he left his kingdom and poffeffions to Stefagoras the fon of Cimon, who was his brother by the fame mother. The memory of Miltiades was greatly honoured by the Dolonci, and they regularly celebrated feftivals and exhibited fhows in commemoration of a man to whom they owed their greatnefs and prefervation.

Miltiades, the fon of Cimon, and brother of Stefagoras mentioned in the preceding article, was fome time after the death of the latter, who died without iffue, fent by the Athenians with one fhip to take poffeffion of the Cherfonefus. At his arrival Miltiades appeared mournful, as if lamenting the recent death of his brother. The principal inhabitants of the country vifited the new governor to condole with him; but their confidence in his fincerity proved fatal to them. Miltiades feized their perfons, and made himfelf abfolute in Cherfonefus. To ftrengthen himfelf, he married Hegefipyla, the daughter of Olorus the king of the Thracians. His triumph was fhort. In the third year of his government, his dominions were threatened by an invafion of the Scythian Nomades, whom Darius had fome time before irritated by entering their country. He fled before them; but as their hoftilities were of fhort duration, he was foon reftored to his kingdom. Three years after, he left Cherfonefus; and fet fail for Athens, where he was received with great applaufe. He was prefent at the celebrated battle of Marathon; in which all the chief officers ceded their power to him, and left the event of the battle to depend upon his fuperior abilities. He obtained an important victory over the more numerous forces of his adverfaries. Some time after, Miltiades was intrufted with a fleet of 70 fhips, and ordered to punifh thofe iflands which had revolted to the Perfians. He was fuccefsful at firft, but a fudden report that the Perfian fleet was coming to attack him, changed his operations as he was befieging Paros. He raifed the fiege, and returned to Athens. He was accufed of treafon, and particularly of holding correfpondence with the enemy. The falfity of thefe accufations might have appeared, if Miltiades had been able to come into the affembly. But a wound which he had received before Paros detained him at home; and his enemies, taking advantage of his abfence, became more eager in their accufations, and louder in their clamours. He was condemned to death; but the rigour of his fentence was retracted on the recollection of his great fervices to the Athenians, and he was put into prifon till he had paid a fine of 50 talents to the ftate. His inability to difcharge fo a great a fum detained him in confinement; and his wounds becoming incurable, he died a prifoner about 489 years before the Chriftian era. His body was ranfomed by his fon Cimon; who was obliged to borrow and pay the 50 talents, to give his father a decent burial.—The accufations againft Miltiades were probably the more readily believed by his countrymen, when they remembered how he made himfelf abfolute in Cherfonefus; and in condemning the barbarity of the Athenians towards a general, who was the fource of their military profperity, we muft remember the jealoufy which ever reigns among a free and independent people, and how watchful they are in defence of the natural rights which they fee wrefted from others by violence. Cornelius Nepos has written the life of Miltiades the fon of Cimon; but his hiftory is incongruous and unintelligible, from his confounding the actions of the fon of Cimon with thofe of the fon of Cypfelus. Greater reliance is to be placed on the narration of Herodotus, whofe veracity is confirmed, and who was indifputably better informed and more capable of giving an account of the life and exploits of men who flourifhed in his age, and of which he could fee the living monuments. Herodotus was born about fix years after the famous battle of Marathon: and C. Nepos, as a writer of the Auguftan age, flourifhed about 450 years after the age of the father of hiftory.

Milton. MILTON, John, the moft illuftrious of the Englifh poets, was defcended of a genteel family, feated at a place of their own name, viz. *Milton*, in Oxfordfhire. He was born December 9. 1608, and received his firft rudiments of education under the care of his parents, affifted by a private tutor. He afterwards paffed fome time at St Paul's fchool, London; in which city his father had fettled, being engaged in the bufinefs of a fcrivener. At the age of 17, he was fent to Chrift's college, Cambridge; where he made great progrefs in all parts of academical learning; but his chief delight was in poetry. In 1628, he proceeded bachelor of arts, having performed his exercife for it with great applaufe. His father defigned him for the church; but the young gentleman's attachment to the Mufes was fo ftrong, that it became impoffible to engage him in any other purfuits. In 1632, he took the degree of mafter of arts; and having now fpent as much time in the univerfity as became a perfon who determined not to engage in any of the three profeffions, he left the college, greatly regretted by his acquaintance, but highly difpleafed with the ufual method of training up youth there for the ftudy of divinity; and being much out of humour with the public adminiftration of ecclefiaftical affairs, he grew diffatisfied with the eftablifhed form of church government, and difliked the whole plan of education practifed in the univerfity. His parents who now dwelt at Horton, near Colnbrook, in Buckinghamfhire, received him with unabated affection, notwithftanding he had thwarted their views of providing for him in the church, and they amply indulged him in his love of retirement; wherein he enriched his mind with the choiceft ftores of Grecian and Roman literature; and his poems of *Comus*, *l'Allegro*, *Il Penferofo*, and *Lycidas*, all wrote at this time, would have been fufficient, had he never produced any thing more confiderable, to have tranfmitted his fame to the lateft pofterity. However, he was not fo abforbed in his ftudies as not to make frequent excurfions to London; neither did fo much excellence

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Milton.

paſs unnoticed among his neighbours in the country, with the moſt diſtinguiſhed of whom he ſometimes choſe to relax his mind, and improve his acquaintance with the world as well as with books.—After five years ſpent in this manner, he obtained his father's permiſſion to travel for farther improvement. At Paris he became acquainted with the celebrated Hugo Grotius; and from thence travelling into Italy, he was everywhere careſſed by perſons of the moſt eminent quality and learning.

Upon his return home, he ſet up a genteel academy in Alderſgate ſtreet.—In 1641, he began to draw his pen in defence of the Preſbyterian party; and the next year he married the daughter of Richard Powell, Eſq. of Foreſt Hill in Oxfordſhire. This lady, however, whether from a difference on account of party, her father being a zealous royaliſt, or ſome other cauſe, ſoon thought proper to return to her relations; which ſo incenſed her huſband, that he reſolved never to take her again, and wrote and publiſhed ſeveral tracts in defence of the doctrine and diſcipline of divorce. He even made his addreſſes to another lady; but this incident proved the means of a reconciliation with Mrs Milton.

In 1644, he wrote his Tract upon Education; and the reſtraint on the liberty of the preſs being continued by act of parliament, he wrote boldly and nobly againſt that reſtraint. In 1645, he publiſhed his juvenile poems; and about two years after, on the death of his father, he took a ſmaller houſe in High Holborn, the back of which opened into Lincoln's-Inn Fields.—Here he quietly proſecuted his ſtudies, till the fatal cataſtrophe and death of Charles I.; on which occaſion he publiſhed his Tenure of Kings and Magiſtrates, in juſtification of the fact. He was now taken into the ſervice of the commonwealth, and made Latin ſecretary to the council of ſtate, who reſolved neither to write to others abroad, nor to receive any anſwers, except in the Latin tongue, which was common to them all. The famous Εικων Βασιλικη coming out about the ſame time, our author, by command, wrote and publiſhed his *Iconoclaſtes* the ſame year. It was alſo by order of his maſters, backed by the reward of 1000l. that in 1651 he publiſhed his celebrated piece, entitled *Pro Populo Anglicano Defenſio*; " A Defence of the People of England, in anſwer to Salmaſius's Defence of the King; which performance ſpread his fame over all Europe. He now dwelt in a pleaſant houſe with a garden in Petty France, Weſtminſter, opening into St James's Park. In 1652 he buried his wife, who died not long after the delivery of her fourth child; and about the ſame time he alſo loſt his eye-ſight, by a *gutta ſerena*, which had been growing upon him many years.

Cromwell took the reigns of government into his own hand in the year 1653; but Milton ſtill held his office. His leiſure hours he employed in proſecuting his ſtudies; wherein he was ſo far from being diſcouraged by the loſs of his ſight, that he even conceived hopes this misfortune would add new vigour to his genius; which in fact ſeems to have been the caſe.—Thus animated, he again ventured upon matrimony: his ſecond lady was the daughter of Captain Woodſtock of Hackney: ſhe died in childbed about a year after. On the depoſition of the protector, Richard Cromwell, and on the return of the long parliament, Milton being ſtill continued ſecretary, he appeared again in print; pleading for a farther reformation of the laws relating to religion; and, during the anarchy that enſued, he drew up ſeveral ſchemes for re-eſtabliſhing the commonwealth, exerting all his faculties to prevent the return of Charles II. England's deſtiny, however, and Charles's good fortune, prevailing, our author choſe to conſult his ſafety, and retired to a friend's houſe in Bartholomew-Cloſe. A particular proſecution was intended againſt him; but the juſt eſteem to which his admirable genius and extraordinary accompliſhments entitled him, had raiſed him ſo many friends, even among thoſe of the oppoſite party, that he was included in the general amneſty.

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This ſtorm being over, he married a third wife, Elizabeth, daughter of Mr Minſhall a Cheſhire gentleman; and not long after he took a houſe in the Artillery Walk, leading to Bunhill Fields. This was his laſt ſtage: here he ſat down for a longer continuance than he had been able to do anywhere; and though he had loſt his fortune (for every thing belonging to him went to wreck at the Reſtoration), he did not loſe his taſte for literature, but continued his ſtudies with almoſt as much ardour as ever; and applied himſelf particularly to the finiſhing his grand work, the *Paradiſe Loſt*; one of the nobleſt poems that ever was produced by human genius. —It was publiſhed in 1667, and his *Paradiſe Regained* came out in 1670.—This latter work fell ſhort of the excellence of the former production; although, were it not for the tranſcendent merit of Paradiſe Loſt, the ſecond compoſition would doubtleſs have ſtood foremoſt in the rank of Engliſh epic poems. After this he publiſhed many pieces in proſe; for which we refer our readers to the edition of his Hiſtorical, Poetical, and Miſcellaneous Works, printed by Millar, in 2 vols. 4to, in 1753.

In 1674, this great man paid the laſt debt to nature at his houſe in Bunhill Fields, in the 66th year of his age; and was interred on the 12th of November, in the chancel of St Giles's, Cripplegate.—A decent monument was erected to his memory, in 1737, in Weſtminſter Abbey, by Mr Benſon, one of the auditors of the impreſt.—Milton was remarkably handſome in his perſon; but his conſtitution was tender, and by no means equal to his inceſſant application to his ſtudies.—Though greatly reduced in his circumſtances, yet he died worth 1500l. in money, beſides his houſehold goods.—He had no ſon: but left behind him three daughters, whom he had by his firſt wife.

Milton, the name of ſeveral places in England; particularly,

Milton, or *Middleton*, in Dorſetſhire, ſouth-weſt of Blandford, near the road to Dorcheſter, 114 miles from London. It is chiefly noted for its abbey, built by King Athelſtan. The church ſtands near the ſouth ſide of the abbey. It is a large and magnificent pile of Gothic architecture, and contains ſeveral ancient monuments. Here is an almhouſe for ſix people, who have 12s. a-week, and three yards of cloth for a gown, one pair of ſhoes and ſtockings, and 10s. each on St Thomas's day yearly. Here is a free ſchool, and a market on Tueſdays.

Milton, in Kent, near Sittingbourn and the iſle of Sheppey, 6 miles north-weſt of Feverſham, and 40 from

Milton || Mimnermus.

from London. It is alſo called *Middleton* from its ſituation near the middle of the county, i. e. from Deptford to the Downs. The kings of Kent had a palace here, which was caſtellated, and ſtood below the church; but was burnt down in Edward the Confeſſor's time by Earl Goodwin, &c. Its church ſtands near a mile off. On approaching the town up the Thames, by the Eaſt Swale, it ſeems hid among the creeks: yet it is a large town; and has a conſiderable market on Saturdays, and a fair on July 24. The oyſters taken here are the moſt famous of any in Kent. This town is governed by a portreeve, choſen yearly on St James's day, who ſupervifes the weights and meaſures all over the hundred of Milton.

MILTON, in Kent, a mile on the eaſt ſide of Graveſend, was incorporated with it in the reign of Queen Elizabeth, by the name of the portreeve, jurats, and inhabitants of the towns of Graveſend and Milton. King Henry VIII. raiſed a platform or blockhouſe here, for the defence both of this town and Graveſend, and the command of the river. It has a fair January 25.

MILVIUS, MOLVIUS, or MULVIUS, *Pons;* a bridge on the Tiber, built by Æmilius Scaurus the cenſor, in the time of Sylla, at two miles diſtance from the city, on the Via Flaminia, and repaired by Auguſtus. From this bridge the ambaſſadors of the Allobroges were brought back to Rome, by Cicero's management, and made a diſcovery of Catiline's conſpiracy (Salluſt). Near it Maxentius was defeated by Conſtantine (Eutropius). Now called *Ponte Molle.*

MILVIUS, a ſpecies of FALCO. See FALCO, ORNITHOLOGY *Index.*

MIMI, MIMES, in the ancient comedy, were buffoons or mimics, who entertained the people by taking off certain characters, uſing ſuch geſtures as ſuited the perſons or ſubjects they repreſented. There were on the Roman ſtage female performers of this kind called *mimæ.* The word is derived from μιμεομαι, *I imitate.* Some of the *mimi* acted their parts to the ſound of the *tibia;* theſe they called *mimauli.*

MIMI were alſo a kind of farces or ludicrous comedies, generally performed by one perſon. They had no acts, nor any *exordium.*—The *mimi* were introduced upon the Roman ſtage long after comedy and tragedy had arrived at their full perfection. The actor wore no maſk, but ſmeared his face with ſoot, was dreſſed in lambſkin, wore garlands of ivy, and carried a baſket of flowers and herbs, in honour of Bacchus, and diverted the audience with apiſh tricks and ridiculous dances. This was the ſtate of the *mimi* ſoon after their firſt introduction; but they underwent many alterations, which it would take up too much room to relate, and which are not of ſufficient importance to juſtify a detailed account. See PANTOMIMES.

MIMESIS, in *Rhetoric*, the imitating the voice and geſtures of another perſon.

MIMNERMUS, an ancient poet and muſician, flouriſhed about the beginning of the ſixth century B. C. He was of Smyrna, and cotemporary with Solon. Athenæus gives him the invention of pentameter verſe. His elegies, of which only a few fragments are preſerved, were ſo much admired in antiquity, that Horace preferred them to thoſe of Callimachus. He compoſed a poem of this kind, as we learn from Pauſanias, upon the battle fought between the people of Smyrna, and the Lydians under Gyges. He likewiſe was author of a poem in elegiac verſe, quoted by Strabo, which he entitled *Nanno,* and in which we may ſuppoſe he chiefly celebrated a young and beautiful girl of that name, who, according to Athenæus, was a player on the flute, with whom he was enamoured in his old age. With reſpect to love matters, according to Propertius, his verſes were more valuable than all the writings of Homer.

Mimoſa || Minagnghinim.

> *Plus in amore valet Mimnermi verſus Homero.*
> Lib. I. Eleg. ix. v. 11.

And Horace bears teſtimony to his abilities in deſcribing that ſeducing paſſion:

> *Si Mimnernus uti cenſet, ſine amore jociſque*
> *Nil eſt jucundum, vivas in amore jociſque.*
> Lib. I. Epiſt. vi. v. 65.

> If, as wiſe Mimnermus ſaid,
> Life unbleſt with love and joy
> Ranks us with the ſenſeleſs dead,
> Let theſe gifts each hour employ.

Alluding to ſome much admired lines of the Greek poet, which have been preſerved by Stobæus.

> Τις δε βιος, τι δε τερπνον ατης χρυσης Ἀφροδιτης, &c.

> What is life and all its pride,
> If love and pleaſure be denied?
> Snatch, ſnatch me hence, ye Fates, whene'er
> The am'rous bliſs I ceaſe to ſhare.
> Oh let us crop each fragrant flow'r
> While youth and vigour give us pow'r:
> For frozen age will ſoon deſtroy
> The force to give or take a joy;
> And then, a prey to pain and care,
> Deteſted by the young and fair,
> The ſun's bleſt beams will hateful grow,
> And only ſhine on ſcenes of wo.

MIMOSA, the SENSITIVE PLANT, a genus of plants belonging to the monœcia claſs; and in the natural method ranking under the 33d order, *Lomentaceæ.* See BOTANY and MATERIA MEDICA *Index.*

The name *mimoſa*, ſignifying "mimic," is given to this genus on account of the ſenſibility of the leaves, which, by their motion, mimic or imitate, as it were, the motion of animals.

MINA, or MANEH, a ſpecies of money which properly ſignifies *one part* or *ounce.* It is obſerved that this word occurs only in the books of Kings, Chronicles, Ezra, and Ezekiel. This prophet (xlv. 12.) tells us, that the minah or maneh was valued at 60 ſhekels, which in gold make of our Engliſh money about $54\frac{3}{4}$ pounds, and in ſilver almoſt ſeven pounds. Thus for the Hebrew maneh. But the Greek or Attic mina, which is probably that mentioned in the books of the Maccabees and in the New Teſtament, is valued at 100 drachmæ, or about 2l. 17s. ſterling. There was alſo a leſſer mina, which was valued at 75 drachmæ.

MINAGNGHINIM, a pulſative inſtrument of muſic, among the Hebrews, which was a ſquare table of wood, fitted with a handle; over this table was ſtretched

ſtretched an iron chain, or hempen cord, paſſing through balls of wood or braſs, which ſtruck againſt the table, when the inſtrument was ſhaken, and occaſioned a clear ſound, which might be heard at a great diſtance.

MINCHA, in the Jewiſh cuſtoms, offerings of meal, cakes, or biſcuits, made in the temple of the Lord. The Seventy have ſometimes preſerved this word in their tranſlation; but inſtead of *mincha* they read *manaa*, which doubtleſs was the received pronunciation in their time. We find *manaa* in the ſame ſenſe, in Baruch i. 10. Levit. ii. 3. &c. See the Greek of Jerem. xvii. 26. Dan. ii. 46. 2 Kings viii. 5, 9. xvii. 7. xx. 12. 2 Chron. vii. 7. Nehem. xiii. 5. 9. &c.

MINCHING-HAMPTON, a town of Glouceſterſhire, 20 miles from Bath and Briſtol, and near 90 from London, with a market on Tueſdays, and two fairs. The pariſh is pretty large, being bounded on the north by the Stroud, and on the ſouth by the brook Avening; and has 12 hamlets belonging to it, with a common called Amberley. Here is a good large rectory church, built in form of a croſs, and worth 200l. a-year. Near it are very large camps, with deep trenches; and near Dunkirk in this pariſh are fulling mills.

MINCIUS, a river of the Tranſpadana in Italy; running from, or rather tranſmitted through, the Lacus Benacus, from north to ſouth, into the Padus; but originally riſing in the Rhetian Alps. Now Mincio or Menzo, running through the duchy of Mantua into the Po.

MIND, a thinking intelligent being, otherwiſe called *ſpirit*, in oppoſition to matter or body. See METAPHYSICS, Part III.

MINDANAO, or MAGINDANAO, a large iſland of Aſia in the Eaſt Indies, and one of the Philippines; 160 miles in length, and 120 in breadth. The interior parts contain ſeveral chains of lofty mountains, between which are extenſive plains, where vaſt herds of cattle roam at large in the moſt delicious paſtures. Several deep valleys alſo interſect, as it were, certain parts of the country, through which, during the rainy ſeaſons, vaſt torrents pour from the mountains, and force their impetuous way to the ſea. The rains and vapours which lodge in the plains diffuſe themſelves into meandering rivulets, and, collecting a variety of ſmall ſtreams in their courſe, approach the ſea in the form of conſiderable rivers.—The ſovereign of Magindanao is a powerful prince, and has ſeveral inferior chiefs, who acknowledge him as their head. Nevertheleſs, there are others of them who refuſe ſubmiſſion to him, and are conſequently in a continual ſtate of war; ſo that peace, at leaſt, does not appear to be one of the bleſſings of this iſland. The Spaniards, indeed, aſſert their right to the entire dominion of Magindanao; but it is mere aſſertion; for though they have forts, &c. on the iſland, it is by no means in a ſtate of ſubjection to their nation.

The air is eſteemed ſalubrious, particularly in the vicinity of the ſea. The heat there is not, in any degree, ſo intenſe as might be expected in a country which is ſituated on the very verge of the torrid zone. The prevalence of the eaſterly winds, in that part of the coaſts which is waſhed by the Pacific ocean, renders the air cool and pleaſant, the trade wind blowing inceſſantly on its ſhores. It acts, indeed, with ſo much power as to ſweep the whole breadth of the iſland; and though in its paſſage it loſes much of its ſtrength, it retains a ſufficient degree of force to afford refreſhing breezes to the inhabitants of the weſtern ſhore. The interior parts are much colder, from a very cloudy atmoſphere, which frequently hangs over the ſummits of the mountains in thick and humid vapours. The ſoil, which is very exuberant, is ſuited to the cultivation of the whole vegetable tribes. Rice is produced in the greateſt abundance; a pecul, or 133 pounds, may be purchaſed for a Spaniſh dollar. Every part of the iſland abounds with buffaloes, cows, hogs, goats, &c. It affords alſo great variety of fowls, and a ſpecies of duck, whoſe head is of a fine ſcarlet colour. Here is alſo a ſmall breed of horſes, remarkable for their ſpirit. The natives, however, principally employ buffaloes in the various branches of huſbandry and agriculture.

The city of Magindanao is ſituated on the ſouth-eaſt ſide of the iſland, has a river capable of admitting ſmall veſſels, and carries on a conſiderable trade with Manilla, Sooloo, Borneo and the Moluccas. Their exports are rice, tobacco, bees wax, and ſpices; in return for which they receive coarſe cloths of Coromandel, China ware, and opium. The village or town of Samboingan is ſituated on the banks of a ſmall rivulet, which empties itſelf immediately into the ſea, and is agreeably ſhaded by groves of cocoa trees. The number of its inhabitants is about 1000, among which are included the officers, ſoldiers, and their reſpective families. In its environs there are ſeveral ſmall look-out houſes, erected on poſts of twelve feet high, in all of which a conſtant guard is kept; ſo that it appears as if the Spaniards were in a continual ſtate of enmity with the natives. The houſes are built of thoſe ſimple materials which are of very general uſe in the eaſtern ſeas. They are erected on poſts, and built of bamboo, covered with mats; the lower apartments ſerve for their hogs, cattle, and poultry, and the upper ones are occupied by the family."

MINDELHEIM, a town of Germany, in the circle of Suabia, and in Algow, with a caſtle. It is capital of a ſmall territory between the rivers Iller and Lech, ſubject to the houſe of Bavaria. It was taken by the Imperialiſts after the battle of Hochſtet, who erected it into a principality in favour of the duke of Marlborough; but it returned back to the houſe of Bavaria by the treaty of Raſtadt. It is 33 miles ſouth-eaſt of Ulm. E. Long. 10. 40. N. Lat. 48. 5.

MINDELHEIM, a diſtrict of Germany, in Suabia, lying between the biſhoprick of Augſburg and the abbacy of Kempten, which is 20 miles in length and 16 in breadth.

MINDEN, a conſiderable town of Germany, in the circle of Weſtphalia; and capital of a territory of the ſame name; ſeated on the river Weſer, which renders it a trading place. It formerly belonged to the king of Pruſſia, who ſecularized the biſhopric. It is 27 miles eaſt by ſouth of Oſnaburg, and 37 weſt of Hanover. E. Long. 9. 5. N. Lat. 52 22.

MINDEN (the principality of), in Germany, lies in the circle of Weſtphalia, to the north of the county of Ravenſburg, and along each ſide of the river Weſer.

Mindora, Mine.

It is about 22 miles ſquare, and Minden and Peterſhagen are the principal places. It was formerly a biſhopric, but is now ſecularized: and was ceded to the elector of Brandenburg by the treaty of Weſtphalia.

MINDORA, an iſland of Aſia, in the Eaſt Indies, and one of the Philippines, 50 miles in circumference, and ſeparated from Luconia by a narrow channel. It is full of mountains, which abound in palm trees and all ſorts of fruits. The inhabitants are idolaters, and pay tribute to the Spaniards, to whom this iſland belongs.

MINE, in *Natural Hiſtory*, a deep pit under ground, from whence various kinds of minerals are dug out; but the term is more particularly applied to thoſe which yield metals. Where ſtones only are procured, the appellation of *quarries* is univerſally beſtowed upon the places from which they are dug out, however deep they may be.

The internal parts of the earth, as far as they have been yet inveſtigated, do not conſiſt of one uniform ſubſtance, but of various *ſtrata* or beds of ſubſtances, extremely different in their appearances, ſpecific gravities, and chemical qualities, from one another. Neither are theſe ſtrata ſimilar to one another either in their nature or appearance in different countries; ſo that even in the ſhort extent of half a mile, the ſtrata will be found quite different from what they are in another place. As little are they the ſame either in depth or ſolidity. Innumerable cracks and fiſſures, by the miners called *lodes*, are found in every one of them; but theſe are ſo entirely different in ſize and ſhape, that it is impoſſible to form any inference from their ſize in one place to that in another. In theſe lodes or fiſſures the metallic ore is met with; and, conſidering the great uncertainty of the dimenſions of the lodes, it is evident that the buſineſs of mining, which depends on that ſize, muſt in like manner be quite uncertain and precarious. Mr Price, in his treatiſe on the Corniſh mines, obſerves, that "the comparative ſmallneſs of the largeſt fiſſures to the bulk of the whole earth is really wonderful. In the fineſt pottery we can make, by a microſcopic view, we may diſcover numerous cracks and fiſſures, ſo ſmall as to be impenetrable by any fluid, and impervious to the naked eye; as, by the laws of nature originally impoſed by the Creator, it happens that matter cannot contract itſelf into ſolid large maſſes, without leaving fiſſures between them, and yet the very fiſſures are as neceſſary and uſeful as the ſtrata through which they paſs. They are the drains that carry off the redundant moiſture from the earth; which, but for them, would be too full of fens and bogs for animals to live or plants to thrive on. In theſe fiſſures, the ſeveral ingredients which form *lodes*, by the continual paſſing of waters, and the menſtrua of metals, are brought out of the adjacent ſtrata, collected and conveniently lodged in a narrow channel, much to the advantage of thoſe who ſearch for and purſue them; for if metals and minerals were more diſperſed, and ſcattered thinly in the body of the ſtrata, the trouble of finding and getting at them would be endleſs; and the expence of procuring them exceed the value of the acquiſition.

The inſides of the fiſſures are commonly coated over with a hard, cryſtalline, earthy ſubſtance or rind, which very often, in the breaking of hard ore, comes off along with it, and is commonly called the *capels* or *walls* of the lode: but Mr Price is of opinion, that the proper walls of the lode are the ſides of the fiſſure itſelf, and not the coat juſt mentioned, which is the natural plaſter upon thoſe walls, furniſhed perhaps by the contents of the fiſſures, or from oozings of the ſurrounding ſtrata.

Mine.

The breadth of a lode is eaſily known by the diſtance betwixt the two incruſted ſides of the ſtones of ore; and if a lode yields any kind of ore, it is a better ſign that the walls be regular and ſmooth, or at leaſt that one of them be ſo, than otherwiſe; but there are not many of theſe fiſſures which have regular walls until they have been ſunk down ſome fathoms.

Thus the inner part of the fiſſure in which the ore lies, is all the way bounded by two walls of ſtone, which are generally parallel to one another, and include the breadth of the vein or lode. Whatever angle of inclination ſome fiſſures make in the ſolid ſtrata at their beginning, they generally continue to do the ſame all along. Some are very uncertain in their breadth, as they may be ſmall at their upper part and wide underneath, and *vice verſa*. Their regular breadth, as well as their depth, is ſubject to great variation; for though a fiſſure may be many fathoms wide in one particular place, yet a little further eaſt or weſt it may not perhaps be one inch wide. This exceſſive variation happens generally in very compact ſtrata, when the vein or fiſſure is ſqueezed, as it were, through hard rocks which ſeem to compreſs and ſtraiten it. A true vein or fiſſure, however, is never entirely obliterated, but always ſhows a ſtring of metallic ore or of a veiny ſubſtance; which often ſerves as a leader for the miners to follow until it ſometimes leads them to a large and richly impregnated part. Their length is in a great meaſure unlimited, though not the ſpace beſt fitted for yielding metal. The richeſt ſtate for copper, according to Mr Price, is from 40 to 80 fathoms deep; for tin, from 20 to 60: and though a great quantity of either may be raiſed at 80 or 100 fathoms, yet, "the quality (ſays our author) is often too much decayed and dry for metal."

Mr Price informs us, that the fiſſures or veins of the Corniſh mines extend from eaſt to weſt; or, more properly, one end of the fiſſure points weſt and by ſouth, or weſt and by north; while the other tends eaſt and by ſouth, or eaſt and by north. Thus they frequently paſs through a conſiderable tract of country with very few variations in their directions, unleſs they be interrupted by ſome intervening cauſe.—But, beſides this eaſt and weſt direction, we are to conſider what the miners call the *underlying* or *hade* of the vein or lode; viz. the deflection or deviation of the fiſſure from its perpendicular line, as it is followed in depth like the ſlope of the roof of a houſe, or the deſcent of the ſteep ſide of a hill. This ſlope is generally to the north or ſouth; but varies much in different veins, or ſometimes even in the ſame vein; for it will frequently ſlope or underlie a ſmall ſpace in different ways, as it may appear to be forced by hard ſtrata on either ſide.—Some of the fiſſures do not vary much from a perpendicular, while some deviate more than a fathom; that is, for every fathom they descend in perpendicular height, they deviate likewise as much to the south or north. Others differ so much from the perpendicular, that they assume a position almost horizontal; whence they are also called *horizontal* or *flat lodes*, and sometimes *lode plots*. Another kind of these has an irregular position with regard to the rest; widening horizontally for a little way, and then descending perpendicularly almost like stairs, with only a small string or leader to follow after; and thus they alternately vary and yield ore in several flat or horizontal fissures. This, by the Cornish tinners, is called (but in Mr Price's opinion erroneously) a *floor* or *squat;* which, properly speaking, is a hole or chasm impregnated with metal, making no continued line of direction or regular walls. Neither does a floor of ore descend to any considerable depth; for underneath it there appears no sign of a vein or fissure, either leading directly down or any other way. This kind of vein is very rare in Britain. The fissures most common in Britain are the perpendicular and inclined, whether their direction be north or south, east or west.

The perpendicular and horizontal fissures (according to our author) probably remain little altered from their first position, when they were formed at the induration of the strata immediately after the waters left the land. The perpendicular fissures are found more commonly situated in level ground, at a distance from hills, and from the sea shore; but with regard to the latter, we find that the upper and under masses of strata differ in their solidity and other properties. "Hence, (says our author) it is very plain, that inclined fissures owe their deflection or underlie to some secondary cause, violence, or subsidence, of the earth: for though perpendicular fissures are seldom to be seen, yet such as are inclined at very considerable depths, become more and more perpendicular, as the more central strata, by reason of the vast superincumbent weight, do not seem so likely to be driven out of their position as those which lie nearer the surface."

The fissures are often met with fractured as well as inclined; the reason of which, in Mr Price's opinion, has been a subsidence of the earth from some extraordinary cause. "The original position (says he) must have been horizontal, or parallel to the surface of the earth: but we often find these strata very sensibly declined from that first position; nay, sometimes quite reversed, and changed into perpendicular. When we see a wall lean, we immediately conclude that the foundation has given way, according to the angles which the walls make with the horizon; and when we find the like declination in strata, we may conclude, by parity of reason, that there has been a like failure of what supported them, in proportion to that declination; or that whatever made the strata to fall so much awry, must also cause every thing included in those strata to fall proportionally. Wherever the greatest subsidence is to the north, the top of the lode or fissure will point to the north, and of consequence underlie to the south, and *vice versa:* the slide or heave of the lode manifests the greater subsidence of the strata; but the same lode is frequently fractured and heaved in several places, all of which, by due observation, will show us they were occasioned by so many several shocks or subsidencies, and that the strata were not unfooted, shaken, or brought to fall only once or twice, but several times."

Mr Price in the course of his work, observes, that though the metallic veins generally run from east to west, they are frequently intersected by veins or *lodes*, as he calls them, of other matters, which run from north to south. Some of these cross veins contain lead or antimony, but never tin or copper. Sometimes one of these unmetallic veins intersects the true one at right angles, sometimes obliquely; and sometimes the mixture of both is so intimate, that the most expert miners are at a loss to discover the separated part of the true vein. When this last is intercepted at right angles, it is moved either north or south, a very little way, perhaps not more than one fathom; in which case, the miners having worked to a small distance in one of these directions, if they find themselves disappointed, turn to the other hand, and seldom fail of meeting with what they expected. Sometimes they are directed in their search by the pointing of a rib or string of the true vein; but when the interruption happens in an oblique direction, the difficulty of finding the vein again is much greater.

When two metallic veins in the neighbourhood of each other run in an oblique direction, and of consequence meet together, they commonly produce a body of ore at the place where they intersect; and if both are rich, the quantity will be considerable; but if one be poor and the other rich, then both are either enriched or impoverished by the meeting. After some time they separate again, and each will continue its former direction near to the other; but sometimes, though rarely, they continue united.

It is a sign of a poor vein when it separates or diverges into strings; but on the contrary, when several of them are found running into one, it is accounted a promising sign. Sometimes there are branches without the walls of the vein in the adjacent strata, which often come either obliquely or transversely into it. If these branches are impregnated with ore, or if they underlie faster than the true vein, that is, if they dip deeper into the ground, then they are said to overtake or come into the lode, and to enrich it; or if they do not, then they are said to go off from it, and to impoverish it. But neither these nor any other marks either of the richness or poverty of a mine are to be entirely depended upon; for many mines, which have a very bad appearance at first, do nevertheless turn out extremely well afterwards; while others, which in the beginning seemed very rich, turn gradually worse and worse: but in general, where a vein has a bad appearance at first, it will be imprudent to be at much expence with it.

Veins of metal, as has been already observed, are frequently, as it were, so compressed betwixt hard strata, that they are not an inch wide; nevertheless, if they have a string of good ore, it will generally be worth while to pursue them: and they frequently turn out well at last, after they have come into softer ground. In like manner, it is an encouragement to go on if the branches or leaders of ore enlarge either in width or depth as they are worked; but it is a bad sign if they continue horizontal without inclining downwards; though it is not proper always to discontinue the work-

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Mine.

ing of a vein which has an unfavourable aſpect at firſt. Veins of tin are worth working when only three inches wide, provided the ore be good; and copper ores when ſix inches wide will pay very well for the working. Some of the great mines, however, have very large veins, with a number of other ſmall ones very near each other. There are alſo veins, croſſing one another ſometimes met with, which are called *contras*, vulgarly *caunters*. Sometimes two veins run down into the ground in ſuch a manner that they meet in the direction of their depth; in which caſe, the ſame obſervations apply to them which are applicable to thoſe that meet in a horizontal direction. Sometimes a vein will ſuddenly diſappear without giving any warning, by becoming narrower, or of worſe quality; which by the miners is called a *ſtart* or *leap*, and is very common in the mines of Cornwall. In one day's time they may thus be diſappointed in the working of a rich vein of tin, and have no further ſign of any thing to work upon. At the fractured extremity of their vein they perceive a body of clay or other matter; and the method of recovering their vein is to drive on the work in the direction of the former part, ſo that their new work ſhall make the ſame angle with the clay that the other part of the vein does. Sometimes they ſink a ſhaft down from the ſurface; but it is generally a matter of difficulty to recover a vein when thus loſt.

The method of diſcovering mines is a matter of ſo much difficulty, that it ſeems ſurpriſing how thoſe who were totally unacquainted with the nature of metals firſt came to think of digging them out of the earth. According to Lucretius, the diſcovery was made by the conflagration of certain woods, which melted the veins of metal in the earth beneath them; but this ſeems rather to be improbable. Ariſtotle, however, is of the ſame opinion with Lucretius, and tells us, that ſome ſhepherds of Spain having ſet fire to the woods, the earth was thus heated to ſuch a degree that the ſilver near the ſurface of it melted and flowed into a maſs; and that in a ſhort time the metallic maſs was diſcovered by the rending of the earth in the time of an earthquake: and the ſame ſtory is told by Strabo, who aſcribes the diſcovery of the mines of Andaluſia to this accident. Cadmus is ſaid by ſome to have been the firſt who diſcovered gold: while others aſcribe this to Thoas the Thracian, to Mercury the ſon of Jupiter, or to Piſus king of Italy; who having left his own country, went into Egypt, where he was elected king after the death of Mizraim the ſon of Ham; and, on account of his diſcovery, was called the *Golden God*. Others ſay, that *Eaclis* or Cæacus the ſon of Jupiter, or Sol the ſon of Oceanus, was the firſt diſcoverer; but Æſchylus attributes the diſcovery not only of gold, but of all other metals, to Prometheus. The braſs and copper mines in Cyprus were firſt diſcovered by Cinyra the ſon of Agryopa; and Heſiod aſcribes the diſcovery of the iron mines of Crete to the Cretan Dactyli Idæi. The extraction of lead or tin from its ore in the iſland of Caſſiteris, according to ſeveral ancient authors, was diſcovered by Midacritus.—The Scripture, however, aſcribes the invention of braſs and iron, or at leaſt of the methods of working them, to Tubal Cain before the flood.

In more modern times, we know that mines have been frequently diſcovered by accident; as in ſea cliffs, among broken craggy rocks, by the waſhing of the tide or floods, alſo by irruptions and torrents of water iſſuing out of hills and mountains, and ſometimes by the wearing of high roads. Mr Price mentions another way by which mines have been diſcovered, viz. by fiery coruſcations; which, he ſays, he has heard from perſons whoſe veracity he is unwilling to queſtion. "The tinners (ſays he) generally compare theſe effluvia to blazing ſtars or other whimſical likeneſſes, as their fears or hopes ſuggeſt; and ſearch with uncommon eagerneſs the ground over which theſe jack-a-lanterns have appeared and pointed out. We have heard but little of theſe phenomena for many years; whether it be, that the preſent age is leſs credulous than the foregoing, or that the ground, being more perforated by innumerable new pits ſunk every year, ſome of which, by the ſtannary laws, are prevented from being filled up, has given theſe vapours a more gradual vent, it is not neceſſary to inquire, as the fact itſelf is not generally believed."

Mines, however, are now moſt commonly diſcovered by inveſtigating the nature of ſuch veins, ores, and ſtones as may ſeem moſt likely to turn to account; but there is a particular ſagacity, or habit of judging from particular ſigns, which can be acquired only by long practice. Mines, eſpecially thoſe of copper, may alſo be diſcovered by the harſh and diſagreeable taſte of the waters which iſſue from them; though it is probable that this only happens when the ore lies above the level of the water which breaks out; for it does not ſeem likely that the taſte of the ore could *aſcend*, unleſs we were to ſuppoſe a pond or lake of water ſtanding above it. The preſence of copper in any water is eaſily diſcovered by immerging in it a bit of poliſhed iron, which will thus inſtantly be turned of a copper colour, by reaſon of the precipitation of the metal upon it. A candle, or piece of tallow put into water of this kind, will in a ſhort time be tinged of a green colour.

Another and ſtill more remarkable method of diſcovering mines is ſaid to be by the *virgula divinatoria*, or "divining rod;" which, however incredible the ſtories related concerning it may be, is ſtill relied on by ſome, and among others by Mr Price. It is not known who was the inventor of this method; but Agricola ſuppoſes that it took its riſe from the magicians, who pretended to diſcover mines by enchantment. No mention is made of it, however, before the 11th century, ſince which time it has been in frequent uſe; and the Corpuſcular Philoſophy has even been called in to account for it. But before we pretend to account for phenomena ſo very extraordinary as thoſe reported of the *virgula divinatoria*, it is neceſſary, in the firſt place, to determine whether or not they exiſt. Mr Price, as has been already hinted, believes in it, though he owns that by reaſon of his conſtitution of mind and body, he is almoſt incapable of co-operating with its influence. The following account, however, he gives from Mr William Cookworthy of Plymouth, a gentleman of known veracity and great chemical abilities.

He had the firſt information concerning this rod from one Captain Ribeira, who deſerted from the Spaniſh ſervice in Queen Anne's reign, and became captain-commandant in the garriſon of Plymouth; in which

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which town he ſatisfied ſeveral intelligent perſons of the virtues of the rod, by many experiments on pieces of metal hid in the earth, and by an actual diſcovery of a copper mine near Oakhampton, which was wrought for ſome years. This captain very readily ſhowed the method of uſing the rod in general, but would not by any means diſcover the ſecret of diſtinguiſhing the different metals by it: though, by a conſtant attention to his practice, Mr Cookworthy diſcovered it. Captain Ribeira was of opinion, that the only proper rods for this purpoſe were thoſe cut from the nut or fruit trees; and that the virtue was confined to certain perſons, and thoſe, comparatively ſpeaking, but few: but Mr Price ſays, that the virtue reſides in all perſons and in all rods under certain circumſtances. "The rod (ſays he) is attracted by all the metals, by coals, limeſtone, and ſprings of water, in the following order: 1. Gold; 2. Copper; 3. Iron; 4. Silver; 5. Tin; 6. Lead; 7. Coals; 8. Limeſtone and ſprings of water. One method of determining the different attractions of the rod is this: Stand, holding the rod with one foot advanced; put a guinea under that foot, and an halfpenny under the other, and the rod will be drawn down; ſhift the pieces of money, and the rod will be drawn towards the face, or backwards to the gold, which proves the gold to have the ſtronger attraction.

"The rods formerly uſed were ſhoots of one year's growth that grew forked; but it is found, that two ſeparate ſhoots tied together with packthread or other vegetable ſubſtance anſwer rather better than ſuch as are naturally forked, as the ſhoots of the latter are ſeldom of an equal ſize. They are to be tied together by the greater ends, the ſmall ones being held in the hands. Hazle rods cut in the winter, ſuch as are uſed for fiſhing rods, and kept till they are dry, do beſt; though, where theſe are not at hand, apple-tree ſuckers, rods from peach trees, currants, or the oak, though green, will anſwer tolerably well."

Our author next proceeds to deſcribe the manner of holding the rod; of which he gives a figure, as he ſays it is difficult to be deſcribed. The ſmall ends being crooked, are to be held in the hands in a poſition flat or parallel to the horizon, and the upper part in an elevation not perpendicular to it, but at an angle of about 70 degrees. "The rod (ſays he) being properly held by thoſe with whom it will anſwer, when the toe of the right foot is within the ſemidiameter of the piece of metal or other ſubject of the rod, it will be repelled towards the face, and continue to be ſo while the foot is kept from touching or being directly over the ſubject; in which caſe it will be ſenſibly and ſtrongly attracted, and be drawn quite down. The rod ſhould be firmly and ſteadily graſped; for if, when it has begun to be attracted, there be the leaſt imaginable jerk or oppoſition to its attraction, it will not move any more till the hands are opened, and a freſh graſp taken. The ſtronger the graſp the livelier the rod moves, provided the graſp be ſteady and of an equal ſtrength. This obſervation is very neceſſary; as the operation of the rod in many hands is defeated purely by a jerk or counteraction: and it is from thence concluded, that there is no real efficacy in the rod, or that the perſon who holds it wants the virtue; whereas, by a proper attention to this circumſtance in uſing it, five perſons in ſix have the virtue, as it is called; that is, the nut or fruit-bearing rod will anſwer in their hands. If a rod, or the leaſt piece of one of the nut-bearing or fruit kind, be put under the arm, it will totally deſtroy the operation of the *virgula divinatoria*, in regard to all the ſubjects of it, except water, in thoſe hands in which the rod naturally operates. If the leaſt animal thread, as ſilk, or worſted, or hair, be tied round or fixed on the top of the rod, it will in like manner hinder its operation; but the ſame rod placed under the arm, or the ſame animal ſubſtances tied round or fixed on the top of the rod, will make it work in thoſe hands, in which without theſe additions it is not attracted."

Such are the accounts of this extraordinary rod, to which it is probable that few will aſſent; and we believe the inſtances of mines having been diſcovered by it are but very rare. Another and very ancient mode of diſcovering mines, leſs uncertain than the divining rod, but extremely difficult and precarious, is that called *ſhoding*; that is, tracing them by looſe ſtones, fragments, or *ſhodes*, which may have been ſeparated or carried off to a conſiderable diſtance from the vein, and are found by chance in running waters, on the ſuperficies of the ground, or a little under.—"When the tinners (ſays Mr Price) meet with a looſe ſingle ſtone of tin ore, either in a valley or in ploughing or hedging, though at 100 fathoms diſtance from the vein it came from, thoſe who are accuſtomed to this work will not fail to find it out. They conſider, that a metallic ſtone muſt originally have appertained to ſome vein, from which it was ſevered and caſt at a diſtance by ſome violent means. The deluge, they ſuppoſe, moved moſt of the looſe earthy coat of the globe, and in many places waſhed it off from the upper towards the lower grounds, with ſuch a force, that moſt of the backs or lodes of veins which protruded themſelves above the faſt were hurried downwards with the common maſs: whence the ſkill in this part of their buſineſs lies much in directing their meaſures according to the ſituation of the ſurface." Afterwards, however, our author complains that this art of *ſhoding*, as he calls it, is in a great meaſure loſt.

The following account of a method of finding ſilver mines by Alonzo Barba ſeems to be ſimilar to that of ſhoding juſt now mentioned. "The veins of metal (ſays he) are ſometimes found by great ſtones above ground; and if the veins be covered, they hunt them out after this manner; viz. taking in their hands a ſort of mattock, which has a ſteel point at one end to dig with, and a blunt head at the other wherewith to break ſtones, they go to the hollows of the mountains, where the current of rain water deſcends, or to ſome other part of the ſkirts of the mountains, and there obſerve what ſtones they meet with, breaking in pieces thoſe that ſeem to have any metal in them; whereof they find many times both middling ſort of ſtones and ſmall ones alſo of metal. Then they conſider the ſituation of that place, and whence theſe ſtones can tumble, which of neceſſity muſt be from higher ground, and follow the track of them up the hill as long as they can find any of them," &c.

"Another way (ſays Mr Price) of diſcovering lodes is is by working drifts acroſs the *country*, as we call it, that is, from north to ſouth, and *vice verſa*. I tried the experiment in an adventure under my management, where I drove all open at graſs about two feet in the ſhelf, very much like a level to convey water upon a mill wheel; by ſo doing I was ſure of cutting all lodes in my way: and I did accordingly diſcover five courſes, one of which has produced above 180 tons of copper ore, but the others were never wrought upon. This method of diſcovering lodes is equally cheap and certain; for 100 fathoms in ſhallow ground may be driven at 50s. expence."

In that kind of ground called by our author *feaſible*, and which he explains by the phraſe *tenderſtanding*, he tells us, that "a very effectual, proving, and conſequential way is, by driving an adit from the loweſt ground, either north or ſouth; whereby there is a certainty to cut all lodes at 20, 30, or 40 fathoms deep, if the level admits of it. In driving adits or levels acroſs, north or ſouth, to unwater mines already found, there are many freſh veins diſcovered, which frequently prove better than thoſe they were driving to."

After the mine is found, the next thing to be conſidered is, whether it may be dug to advantage. In order to determine this, we are duly to weigh the nature of the place, and its ſituation, as to wood, water, carriage, healthineſs, and the like; and compare the reſult with the richneſs of the ore, the charge of digging, ſtamping, waſhing, and ſmelting.

Particularly the form and ſituation of the ſpot ſhould be well conſidered. A mine muſt either happen, 1. In a mountain; 2. In a hill; 3. In a valley; or, 4. In a flat. But mountains and hills are dug with much greater eaſe and convenience, chiefly becauſe the drains and burrows, that is, the adits or avenues, may be here readily cut, both to drain the water and to form gangways for bringing out the lead, &c. In all the four caſes, we are to look out for the veins which the rains or other accidental thing may have laid bare; and if ſuch a vein be found, it may often be proper to open the mine at that place, eſpecially if the vein prove tolerably large and rich: otherwiſe the moſt commodious place for ſituation is to be choſen for the purpoſe, viz. neither on a flat, nor on the tops of mountains, but on the ſides. The beſt ſituation for a mine, is a mountainous, woody, wholeſome ſpot; of a ſafe eaſy aſcent, and bordering on a navigable river. The places abounding with mines are generally healthy; as ſtanding high, and everywhere expoſed to the air; yet ſome places where mines are found prove poiſonous, and can upon no account be dug, though ever ſo rich; the way of examining a ſuſpected place of this kind, is to make experiments upon brutes, by expoſing them to the effluvia or exhalations, to find the effects.

Devonſhire and Cornwall, where there are a great many mines of copper and tin, is a very mountainous country, which gives an opportunity in many places to make adits or ſubterraneous drains to ſome valley at a diſtance, by which to carry off the water from the mine, which otherwiſe would drown them out from getting the ore. Theſe adits are ſometimes carried a mile or two, and dug at a vaſt expence, as from 2000l. to 4000l. eſpecially where the ground is rocky; and yet they find this cheaper than to draw up the water out of the mine quite to the top, when the water runs in plenty, and the mine is deep. Sometimes, indeed, they cannot find a level near enough to which an adit may be carried from the very bottom of the mine; yet they find it worth while to make an adit at half the height to which the water is to be raiſed, thereby ſaving half the expence.

Mr Coſtar, conſidering that ſometimes from ſmall ſtreams, and ſometimes from little ſprings or collections of rain water, one might have a good deal of water above ground, though not a ſufficient quantity to turn an overſhot wheel, thought that if a ſufficient fall might be had, this collection of water might be made uſeful in raiſing the water in a mine to the adit, where it may be carried off.

But now the moſt general method of draining mines is by the ſteam engine. See *Steam-Engine*.

Mine, in the military art, denotes a ſubterraneous canal or paſſage, dug under the wall or rampart of a fortification, intended to be blown up by gunpowder.

The alley or paſſage of a mine is commonly about four feet ſquare; at the end of this is the chamber of the mine, which is a cavity of about five feet in width and in length, and about ſix feet in height; and here the gunpowder is ſtowed. The ſauciſſe of the mine is the train, for which there is always a little aperture left.

Two ounces of powder have been found, by experiment, capable of raiſing two cubic feet of earth; conſequently 200 ounces, that is, 12 pounds 8 ounces, will raiſe 200 cubic feet, which is only 16 feet ſhort of a cubic toiſe, becauſe 200 ounces, joined together, have proportionably a great force than two ounces, as being an united force.

All the turnings a miner uſes to carry on his mines, and through which he conducts the ſauciſſe, ſhould be well filled with earth and dung; and the maſonry in proportion to the earth to be blown up, as 3 to 2. The entrance of the chamber of the mine ought to be firmly ſhut with thick planks, in the form of a St Andrew's croſs, ſo that the encloſure be ſecure, and the void ſpaces ſhut up with dung or tempered earth. If a gallery be made below or on the ſide of the chamber, it muſt abſolutely be filled up with the ſtrongeſt maſonry, half as long again as the height of the earth; for this gallery will not only burſt, but likewiſe obſtruct the effect of the mine. The powder ſhould always be kept in ſacks, which are opened when the mine is charged, and ſome of the powder ſtrewed about: the greater the quantity of earth to be raiſed is, the greater is the effect of the mine, ſuppoſing it to have the due proportion of powder. Powder has the ſame effect upon maſonry as upon earth, that is, it will proportionably raiſe either with the ſame velocity.

The branches which are carried into the ſolidity of walls do not exceed three feet in depth, and two feet ſix inches in width nearly: this ſort of mine is moſt excellent to blow up the ſtrongeſt walls.

The weight of a cubic foot of powder ſhould be 80lb.; 1 foot 1 inch cube will weigh 100lb. and 1 foot 2 inches and $\frac{1}{12}$ 150lb.; and 200lb. of powder will be-

be 1 foot 5 inches cube; however there is a diverſity in this, according to the quantity of ſaltpetre in the gunpowder.

If, when the mines are made, water be found at the bottom of the chamber, planks are laid there, on which the powder is placed either in ſacks or barrels of 100lb. each. The ſauciſſe muſt have a clear paſſage to the powder, and be laid in an auget or wooden trough, through all the branches. When the powder is placed in the chamber, the planks are laid to cover it, and others again acroſs theſe; then one is placed over the top of the chamber, which is ſhaped for that purpoſe; between that and thoſe which cover the powder, props are placed, which ſhore it up; ſome inclining towards the outſide; others to the inſide of the wall; all the void ſpaces being filled with earth, dung, brick, and rough ſtones. Afterwards planks are placed at the entrance of the chamber, with one acroſs the top, whereon they buttreſs three ſtrong props, whoſe other ends are likewiſe propped againſt another plank ſituated on the ſide of the earth in the branch; which props being well fixed between the planks with wedges, the branch ſhould then be filled up to its entrance, with the forementioned materials. The ſauciſſes which paſs through the ſide branches muſt be exactly the ſame length with that in the middle, to which they join: the part which reaches beyond the entrance of the mine is that which conveys the fire to the other three; the ſauciſſes being of equal length, will ſpring together.

From a great number of experiments, it appears 1. That the force of a mine is always towards the weakeſt ſide; ſo that the diſpoſition of the chamber of a mine does not at all contribute to determine this effect. 2. That the quantity of powder muſt be greater or leſs, in proportion to the greater or leſs weight of the bodies to be raiſed, and to their greater or leſs coheſion; ſo that you are to allow for each cubic fathom

Of looſe earth, - -	9 or 10lb.
Firm earth and ſtrong ſand,	11 or 12
Flat clayey earth, -	15 or 16
New maſonry, not ſtrongly bound,	15 or 20
Old maſonry, well bound,	25 or 30

3. That the aperture, entonnoir of a mine, if rightly charged, is a cone, the diameter of whoſe baſe is double the height taken from the centre of the mine. 4. That when the mine has been overcharged, its entonnoir is nearly cylindrical, the diameter of the upper extreme not much exceeding that of the chamber. 5. That beſides the ſhock of the powder againſt the bodies it takes up, it likewiſe cruſhes all the earth that borders upon it, both underneath and ſidewiſe.

To charge a mine ſo as to have the moſt advantageous effect, the weight of the matter to be carried muſt be known; that is, the ſolidity of a right cone, whoſe baſe is double the height of the earth over the centre of the mine: thus, having found the ſolidity of the cone in cubic fathoms, multiply the number of fathoms by the number of pounds of powder neceſſary for raiſing the matter it contains; and if the cone contains matters of different weights, take a mean weight between them all, always having a regard to their degree of coheſion.

As to the diſpoſition of mines, there is but one general rule, which is, That the ſide towards which one would determine the effect be the weakeſt; but this varies according to occaſions and circumſtances.

The calculation of mines is generally built upon this hypotheſis, That the entonnoir of a mine is the fruſtum of an inverted cone, whoſe altitude is equal to the radius of the excavation of the mine, and the diameter of the whole leſſer baſe is equal to the line of leaſt reſiſtance; and though theſe ſuppoſitions are not quite exact, yet the calculations of mines deduced from them have proved ſucceſsful in practice; for which reaſon this calculation ſhould be followed till a better and more ſimple be found out.

M. de Valliere found that the entonnoir of a mine was a paraboloid, which is a ſolid generated by the rotation of a ſemiparabola about its axis; but as the difference between theſe two is very inſignificant in practice, that of the fruſtum of a cone may be uſed.

MINEHEAD, a town of Somerſetſhire, 166 miles from London. It is an ancient borough, with a harbour in the Briſtol channel, near Dunſter caſtle, much frequented by paſſengers to and from Ireland. It was incorporated by Queen Elizabeth, with great privileges, on condition the corporation ſhould keep the quay in repair; but its trade falling off, the quay was neglected, and they loſt their privileges. A ſtatute was obtained in the reign of King William, for recovering the port, and keeping it in repair, by which they were to have the profits of the quay and pier for 36 years, which have been computed at about 200l. a-year; and they were at the expence of new-building the quay. In purſuance of another act, confirming the former; a new head has been built to the quay, the beach cleared, &c. ſo that the biggeſt ſhip may enter, and ride ſafe in the harbour. The town contains about 500 houſes, and 2000 ſouls. It was formerly governed by a portreve, and now by two conſtables choſen yearly at a court leet held by the lord of the manor. Its chief trade is with Ireland, from whence about 40 veſſels uſed to come hither in a year with wool; and about 400 chaldrons of coals are yearly imported at this place, Watchet, and Poriock, from South Wales, which lies directly oppoſite to it about ſeven leagues over, the common breadth of this channel all the way from Holmes to the Land's End. Here are ſeveral rich merchants, who have ſome trade alſo to Virginia and the Weſt Indies; and they correſpond much with the merchants of Barneſtaple and Briſtol in thier foreign commerce. Three or four thouſand barrels of herrings, which come up the Severn in great ſhoals about Michaelmas, are caught, cured, and ſhipped off here every year, for the Mediterranean, &c. The market here is on Wedneſday, and fair on Whitſun-Wedneſday.

MINERAL, in *Natural Hiſtory*, is uſed in general for all foſſil bodies, whether ſimple or compound, dug out of a mine; from whence it takes its denomination. See MINERALOGY.

Mineral Waters. All waters naturally impregnated with any heterogeneous matter which they have diſſolved within the earth may be called *mineral waters*, in

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in the moſt general and extenſive meaning of that name; in which are therefore comprehended almoſt all thoſe that flow within or upon the ſurface of the earth, for almoſt all theſe contain ſome earthy or ſaline matter. But, ſtrictly ſpeaking, thoſe waters only which hold in ſolution ſuch a quantity of foreign ingredients as to give them properties which are eaſily recognized by the taſte or ſmell come under the denomination of mineral waters. For the methods of analyzing mineral waters, see CHEMISTRY *Index*.

Here we ſhall give a tabular view of the more remarkable mineral waters which have been diſcovered and examined.

An ALPHABETICAL TABLE of the moſt noted Mineral Waters in Europe, exhibiting their Medicinal Properties and Contents.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Abcourt,	Near St Germains in France.	A cold chalybeate water, containing beſides the iron a ſmall quantity of foſſil alkali ſaturated with fixed air.	Diuretic and purgative. Internally uſed in dropſies, jaundice, and obſtructions of the viſcera; externally in ſcorbutic eruptions, ulcers, &c.
Aberbrothick,	County of Forfar in Scotland.	A cold chalybeate. Contains iron diſſolved in fixed air.	Diuretic and corroborative. Uſed in indigeſtions, nervous diſorders, &c.
Acton,	Middleſex county, England.	Contains Epſom and ſea ſalt. Cold.	Strongly purgative, and cauſes a ſoreneſs in the fundament.
Aghaloo,	Tyrone, Ireland.	Sulphur, foſſil alkali, and ſome purging ſalt. Cold.	Alterative and corroborant. Uſeful in ſcrofulous diſorders, worms, and cutaneous diſeaſes.
Aix-la-Chapelle,	Juliers in Germany.	Sulphureous and hot. Contain aerated calcareous earth, ſea ſalt, foſſil alkali, and ſulphur.	Diaphoretic, purgative, and diuretic. Uſed as baths as well as taken internally. Uſeful in rheumatiſms, and all diſeaſes proceeding from a debility of the ſyſtem.
Alford or Awford,	Somerſetſhire, England.	A purging ſalt along with ſea ſalt. Cold.	Strongly purgative.
Aſkeron,	Yorkſhire, in England.	Contains Epſom ſalt, aerated calcareous earth, and ſulphur. Cold.	Diuretic. Uſeful when drunk in leproſy, and other cutaneous diſeaſes.
Antrim,	Ireland.		Similar to Borrowdale water, but weaker.
Baden,	Swabia in Germany.	Hot and ſulphureous ſprings and baths, reſembling thoſe of Aix-la-Chapelle.	See AIX-LA-CHAPELLE, and BADEN, in the order of the Alphabet.
Bagnigge,	Middleſex, near London.	Epſom ſalt and muriated magneſia. Cold. Another ſpring contains iron and fixed air.	Strongly purgative, three half pints being a doſe. The chalybeate ſpring alſo proves purgative when the bowels contain any vitiated matter.
Balimore,	Worceſterſhire in England.	A fine cold chalybeate, containing iron rendered ſoluble by fixed air, along with ſome other ſalt ſuppoſed to be foſſil alkali.	Corroborative, and good in obſtructions of the viſcera. Drank from two to three pints in a morning.
Ball, or Baudwell,	Lincolnſhire in England.	A cold petrifying water; contains aerated calcareous earth or magneſia.	Corroborative and aſtringent. Drunk to the quantity of two pints, or two and a half.
Balaruc,	Languedoc in France.	Hot, and contain ſome purging ſalts.	Drank as purgatives, and uſed as hot baths. Uſeful in ſcrofulous and cutaneous diſorders.
Ballycaſtle,	Antrim in Ireland.	Chalybeate and ſulphureous. Cold.	Reſembles that of Balimore in virtue.
Ballynahinch,	Down in Ireland.	Iron, fixed air, and ſulphur. Cold.	Uſeful in ſcorbutic diſorders and diſeaſes of indigeſtion.
Ballyſpellan,	Near Kilkenny in Ireland.	Iron, fixed air, and probably foſſil alkali.	Similar in virtue to that of Balimore.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Bagneres,	Bigorre in France.	Earth and ſulphur. Hot.	The waters uſed in baths, like thoſe of Aix-la-Chapelle. Some of the ſprings purgative, others diuretic.
Bareges,	Bigorre in France.	Sea ſalt, foſſil alkali, calcareous earth, ſelenites, ſulphur, and a fine bituminous oil. Hot.	Diuretic and diaphoretic. Uſeful in nervous as well as cutaneous diſorders, in old wounds and ſome venereal complaints. Uſed as baths, as well as taken internally to the quantity of a quart or three pints.
Barnet and North-hall,	Hertfordſhire in England.	Epſom ſalt, and aerated calcareous earth.	Purgative.
Bath,	Somerſetſhire in England.	Iron, aerated calcareous earth, ſelenite, Glauber's ſalt, and ſea ſalt. Hot.	Powerfully corroborative, and very uſeful in all kinds of weakneſſes. Uſed as a bath, and taken internally.
Bandola,	Italy.	Iron, fixed air, foſſil alkali, and a little ſulphur.—Cold.	Gently laxative, diuretic, and diaphoretic.
Borrowdale,	Cumberland in England.	A great quantity of ſea ſalt, aerated calcareous earth, and ſome bittern. Cold.	Strongly emetic and cathartic. Sometimes uſeful in the jaundice and dropſy, ſcorbutic diſorders, and chronic obſtructions. Uſed likewiſe as a bath in cutaneous diſeaſes. Taken in the doſe of a pint, containing only about ſeven drachms and a half of ſea ſalt; ſo that a great part of the virtue muſt reſide in the aerated calcareous earth.
Brentwood,	Eſſex in England.	Epſom ſalt, and aerated calcareous earth.	Purgative.
Briſtol,	Somerſetſhire in England.	Calcareous earth, ſea ſalt, Epſom ſalt, Glauber's ſalt, and ſelenites. Hot.	Uſed as a bath; and drank from four to eight ounces at a time, to two quarts per day. Uſeful in conſumptions, diabetes, fluor albus, &c.
Bromley,	Kent in England.	Iron and fixed air. Cold.	Diuretic and corroborative.
Broughton,	Yorkſhire in England.	Sulphur, ſea ſalt, Epſom ſalt, and aerated earth. Cold.	Similar to Harrowgate.
Buxton,	Derbyſhire in England.	A ſmall quantity of ſea ſalt, foſſil alkali, Epſom ſalt, and aerated calcareous earth. Hot. Here is alſo a fine cold chalybeate ſpring.	Uſeful in gout, rheumatiſm, and other diſorders in which tepid baths are ſerviceable. Uſed as baths, and drank to the quantity of five or ſix pints per day.
Caroline baths,	Bohemia.	Iron, fixed air, aerated earth, ſea ſalt, foſſil alkali, Epſom ſalt, and Glauber's ſalt. Hot.	Purgative, and uſed as baths. Of ſervice in diſorders of the ſtomach and bowels, ſcrofula, &c.
Carlton,	Nottinghamſhire in England.	Iron diſſolved in fixed air, along with a bituminous oil, which gives it the ſmell of horſe dung.—Cold.	Diuretic and corroborative.
Carrickfergus,	Antrim in Ireland.	Seems from its bluiſh colour to contain a very ſmall quantity of copper. Cold.	Weakly purgative.
Carrickmore,	Cavan in Ireland.	Foſſil alkali, fixed air, and ſome purging ſalt. Cold.	Purgative and diuretic.
Caſhmore,	Waterford in Ireland.	Green vitriol.	Purgative, diuretic, and ſometimes emetic.
Caſtle-Connel,	Limerick in Ireland.	Iron diſſolved in fixed air, &c. Cold.	Reſembles the German Spaw, and is in conſiderable repute.
Caſtle-Leod,	Roſs-ſhire in Scotland.	Aerated earth, ſelenites, Glauber's ſalt, and ſulphur. Cold.	Diuretic, diaphoretic, and corroborant; uſeful in cutaneous diſeaſes.

Caſtlemain,

Names of Springs.	Countries in which they are found.	Contents and Quality of the Water.	Medicinal Virtues.
Caſtlemain,	Kerry in Ireland.	Iron, ſulphur, and fixed air. Cold.	Corroborant and diuretic.
Cawley,	Derbyſhire in England.	Epſom ſalt, aerated calcareous earth, and ſulphur. Cold.	Gently purgative.
Cawthorp,	Lincolnſhire in England.	Iron, fixed air, and probably foſſil alkali. Cold.	Purgative, and corrects acidities.
Chadlington,	Oxfordſhire in England.	Foſſil alkali, ſea ſalt, and ſulphur. Cold.	Purgative.
Chaude Fontaine,	Liege in Germany.	Aerated earth, foſſil alkali, and fixed air. Hot.	Reſembles thoſe of Aix-la-Chapelle and Buxton.
Cheltenham,	Glouceſterſhire in England.	Calcareous earth, iron, Epſom ſalt, and common ſalt. Cold.	Purgative and corroborant; taken in the quantity of from one to three or four pints. It is uſeful in caſes of indigeſtion and ſcorbutic diſorders; alſo in the gravel.
Chippenham,	Wiltſhire in England.	Iron diſſolved in fixed air.	Diuretic and corroborative.
Cleves,	Germany.	Iron, fixed air, and other ingredients of Pyrmont water.	Diuretic and corroborant.
Clifton,	Oxfordſhire in England.	Foſſil alkali, and aerated calcareous earth or ſelenite. Cold.	Gently laxative, and uſed as a bath for cutaneous diſorders.
Cobham,	Surry in England.	Iron, and ſome purging ſalt.	Purgative, diuretic, and corroborant.
Codſalwood,	Staffordſhire in England.	Sulphur, fixed air, and aerated earth.	Reſembles the Aſkeron water.
Colcheſter,	Eſſex in England.	Epſom ſalt, and aerated calcareous earth.	Strongly purgative.
Colurian,	Cornwall in England.	Iron, fixed air, and aerated earth.	Corroborative and diuretic.
Comner, or Cumner,	Berkſhire in England.	Some purging ſalt, and probably aerated earth; the water is of a whitiſh colour.	Purgative, in the quantity of one, two, or three quarts.
Coolauran,	Fermanagh in Ireland.	Iron, fixed air, and aerated earth.	Diuretic.
Corſtorphine,	Mid Lothian in Scotland.	Sulphur, ſea ſalt, clay, and Epſom ſalt. Cold.	Diuretic and laxative.
Coventry,	Warwickſhire in England.	Iron, fixed air, and ſome purging ſalt.	Purgative, diuretic, and corroborant.
Crickle Spaw,	Lancaſhire in England.	Sulphur, ſea ſalt, and aerated earth.	Purgative, and reſembling Harrowgate water.
Croft,	Yorkſhire in England.	Aerated earth, vitriolated magneſia, and ſea ſalt.	Purgative, and reſembling Aſkeron water.
Croſstown,	Waterford in Ireland.	Martial vitriol.	Diuretic, purgative, and ſometimes emetic.
Cunley-houſe,	Lancaſhire in England.	Sulphur, aerated earth, and fixed air.	Purgative, and reſembling the Aſkeron water.
Das Wild Bad,	Nuremberg in Germany.	Iron, fixed air, and ſome ſaline matter.	Corroborant. Uſeful in obſtructions of the viſcera, and female complaints.
D' ax en Foix,	15 leagues from Thoulouſe in France.	Similar to Aix-la Chapelle. Hot.	Uſed as a bath, and alſo drank, like the Aix-la-Chapelle waters.
Deddington,	Oxford in England.	Iron, ſulphur, aerated earth, ſea ſalt, or foſſil alkali.	Alterative, purgative in large quantity, and uſeful in ſcorbutic and cutaneous diſorders.
Derby,	Near the capital of Derbyſhire in England.	Iron diſſolved by fixed air.	Corroborant.
Derryinch,	Fermanagh in Ireland.	Sulphur and foſſil alkali.	Diuretic and diaphoretic.
Derrindaff,	Cavan in Ireland.	Sulphur and purging ſalt.	Similar to the *Aſkeron* water.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Derrylester,	Cavan in Ireland.	Similar to *Swadlingbar* water.	
Dog and Duck,	St George's Fields, London.	Aerated magnesia, Epsom salt, and sea salt.	Cooling and purgative, but apt to bring on or increase the fluor albus in women.
Dortshill,	Staffordshire in England.	Iron dissolved in fixed air.	Corroborant.
Drigwell,	Cumberland in England.	Similar to Deddington.	
Dropping-well,	Yorkshire in England.	Aerated earth.	Astringent and corroborant.
Drumas-nave,	Leitrim in Ireland.	Sulphur, fossil alkali, with some purging salt.	Powerfully diuretic and anthelmintic, and of use in cutaneous and scrofulous disorders.
Drumgoon,	Fermanagh in Ireland.	Similar to the former.	
Dublin salt springs,	Ireland.	Sea salt and Epsom salt.	Purgative.
Dulwich,	Kent in England.	Sea salt and Epsom salt.	Purgative and diuretic. Useful in nervous cases and diseases proceeding from debility.
Dunnard,	18 miles from Dublin.	Iron dissolved in fixed air.	Diuretic and corroborant.
Dunse,	Scotland.	Iron dissolved in fixed air, with a little sea salt and bittern.	Similar to the former.
Durham,	England.	Sulphur, sea-salt, and a little aerated earth. In the middle of the river is a salt spring.	Similar to the Harrowgate water.—That of the salt spring used as a purgative.
Egra,	Bohemia.	Similar to Cheltenham water.	
Epsom,	Surry in England.	Vitriolated and muriated magnesia, with a small quantity of aerated calcareous earth.	Purgative, and of use in washing old sores.
Fairburn,	Ross-shire in Scotland.	Sulphur, aerated earth, and Glauber's salts.	Alterative, and useful in cutaneous diseases.
Felstead,	Essex in England.	Similar to Islington.	
Filah,	Yorkshire in England.	Sea salt and aerated earth.	Powerfully diuretic and purgative.
Frankfort,	Germany.	Sulphur and sea salt.	Similar to Harrowgate.
Gainsborough,	Lincolnshire in England.	Sulphur, iron, aerated earth, and Epsom salt.	Diuretic and laxative.
Galway,	Ireland.	Similar to Tunbridge water.	
Glanmile,	Ireland.	Similar to Peterhead water.	
Glastonbury,	Somersetshire in England.	Similar to Clifton water.	
Glendy,	Merns county in Scotland.	Similar to Peterhead water.	
Granshaw,	Down in Ireland.	Iron; similar to the German Spaw.	
Haigh,	Lancashire in England.	Green vitriol, iron dissolved by fixed air, with some aerated earth.	Emetic and cathartic.
Hampstead,	England.	Green vitriol, iron dissolved by fixed air, and a small quantity of aerated earth.	Alterative and corroborant. The water is taken from half a pint to several pints; is better in the morning than in the middle of the day, and in cold than hot weather.
Hanbridge,	Lancashire in England.	Similar to Scarborough water.	Less purgative than the Scarborough water.

Names of Springs.	*Countries in which they are found.*	*Contents and Qualities of the Water.*	*Medicinal Virtues.*
Hanlys,	Shropſhire in England.	Epſom, or other purging ſalt.	Purgative.
Harrowgate,	Yorkſhire in England.	Sulphur, ſea ſalt, and ſome purging ſalt. Some chalybeate ſprings here alſo.	Alterative, purgative, and anthelmintic; uſeful in ſcurvy, ſcrophula, and cutaneous diſeaſes. Uſed externally for ſtrains and paralytic weakneſſes.
Hartfell,	Annandale in Scotland.	Green vitriol, alum, and azotic gas.	Aſtringent and corroborant. Uſeful in all kinds of inward diſcharges of blood.
Hartlepool,	Durham in England.	Sulphur, iron diſſolved by fixed air, with ſome purging ſalt.	Diuretic and laxative.
Holt,	Wiltſhire in England.	Purging ſalt, with a large quantity of aerated earth.	Mildly purgative. Uſeful in old ulcers and cutaneous diſorders.
Joſeph's well,	Stock Common near Cobham in Surry.	A very large proportion of Epſom ſalt, and poſſibly a little ſea ſalt.	Alterative, purgative, and diuretic. Drank to about a quart, it paſſes briſkly without griping: taken in leſs doſes as an alterative, it is a good antiſcorbutic.
Ilmington,	Warkwickſhire in England.	Aerated foſſil alkali, with ſome iron diſſolved by fixed air	Diuretic and laxative.
Inglewhite,	Lancaſhire in England.	Sulphur, and iron diſſolved by fixed air.	Alterative. Uſeful in ſcorbutic and cutaneous diſeaſes.
Iſlington,	Near London.	Iron diſſolved by fixed air.	Corroborant. Uſeful in lowneſs of ſpirits and nervous diſeaſes. Operates by urine, and may be drank in large quantity.
Kanturk,	Cork in Ireland.	Similar to the water at Peterhead.	
Kedleſtone,	Derbyſhire in England.	Sulphur, ſea ſalt, and aerated earth.	Similar to Harrowgate; but intolerably fetid.
Kenſington,	Near London.	Similar to Acton water.	
Kilbrew,	Meath in Ireland.	A large quantity of green vitriol.	Emetic and cathartic, in the doſe of half a pint.
Kilburn,	Near London.	Fixed air, hepatic air, Epſom ſalt, Glauber's ſalt; muriated magneſia, ſea ſalt, aerated earth, and iron.	
Killaſher,	Fermanagh in Ireland.	Sulphur and foſſil alkali.	Similar to Swadlingbar water.
Killingſhanvally,	Fermanagh, Ireland.	Similar to Hanlys chalybeate water.	
Kilroot,	Antrim in Ireland.	Nature of Barrowdale water, but weaker.	
Kinalton,	Nottinghamſhire in England.	A purging ſalt.	Purgative.
Kincardine,	Merns in Scotland.	Similar to the water of Peterhead.	
Kingſcliff,	Northamptonſhire in England.	Similar to Cheltenham waters.	
Kirby,	Weſtmorland in England.	Iron, fixed air, and probably ſome foſſil alkali.	Laxative, and uſeful in correcting acidities.
Knareſborough,	See *Dropping-well.*		
Knowſley,	Lancaſhire in England.	Similar to Scarborough water.	
Kuka,	Bohemia.	Aerated fixed alkali.	Operates by inſenſible perſpiration, ſometimes by ſpitting, ſweat or urine.
Lancaſter,	England.	Similar to Tunbridge water.	
Latham,	Lancaſhire in England.	Similar to the former.	

Llandrindod,

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Llandrindod,	Radnor in South Wales.	Three ſprings; a purgative, a ſulphureous, and chalybeate.	Uſeful in the ſcurvy, leproſy, cutaneous diſorders, &c.
Llangybi,	Caernarvonſhire in North Wales.		Uſeful in diſorders of the eyes, ſcrofula, &c.
Leamington,	Warkwickſhire in England.	Sea-ſalt and aerated calcareous earth.	Emetic and cathartic. Uſeful in old ſores, and cures mangy dogs.
Leez,	Eſſex in England.	Similar to Iſlington water.	
Lincom b	Somerſetſhire in England.	Aerated iron, foſſil alkali, and a little Epſom ſalt.	
Liſbeak,	Fermanagh in Ireland	Sulphur, &c.	Similar to Swadlingbar water.
Lis-done-Vurna,	Clare in Ireland.	Foſſil alkali, with much iron.	Emetic, cathartic, and diuretic.
Loanſbury,	Yorkſhire in England.	Sulphur, and ſome purging ſalt.	Uſed only for waſhing mangy dogs and ſcabby horſes.
Maccroomp,	Cork in Ireland.	Similar to Ilmington water.	
Mahereberge,	Kerry in Ireland.	Similar to Borrowdale water.	
Mallow,	Cork in Ireland.	A hot water, ſimilar to that of Briſtol.	
Malton,	Yorkſhire in England.	Iron and fixed air in conſiderable quantity.	Similar to Scarborough water, but is ſometimes apt to vomit.
Malvern,	Glouceſterſhire in England.	Iron. Two ſprings.	Diuretic and cathartic; uſed alſo externally. Recommended as excellent in diſeaſes of the ſkin; in leproſies, ſcorbutic complaints, ſcrofula, old ſores, &c. Alſo ſerviceable in inflammations and other diſeaſes of the eyes; in the gout and ſtone, in bilious and paralytic caſes, and in female obſtructions. The external uſe is by waſhing the part at the ſpout ſeveral times a-day, and afterwards covering it with cloths dipt in the water and kept conſtantly moiſt; alſo by general bathing.
Markſhall,	Eſſex in England.	Similar to Iſlington.	
Matlock,	Derbyſhire in England.	Warm ſprings, of the nature of the Briſtol water, except that they are very ſlightly impregnated with iron, but contain a great quantity of aerated earth. They are colder than the Buxton; but their virtues ſimilar to thoſe of the two places mentioned.	
Maudſley,	Lancaſhire in England.	Sulphur and ſea ſalt.	Similar to Harrowgate.
Mechan,	Fermanagh in Ireland.	Sulphur and foſſil alkali.	Similar to the waters of Drumgoon.
Miller's Spaw,	Lancaſhire in England.	Similar to Tunbridge.	
Moffat,	Annandale in Scotland.	Sulphurated hydrogen, carbonic acid and azotic gaſes, with common ſalt.	Alterant, diuretic, and ſometimes purgative. Is uſed as a bath, and the ſteam of the hot water has been found ſerviceable in relaxing hard tumors and ſtiff joints.
Moſs-houſe,	Lancaſhire in England.	Similar to Iſlington water.	Purges ſtrongly.
Moreton,	Shropſhire in England.	Similar to Holt water.	

Mount

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Mount d'Or,	France.	Warm, and ſimilar to the waters of Aix-la-Chapelle.	Diuretic, purgative, and diaphoretic.
Nevil Holt,	Leiceſterſhire in England.	Selenite or aerated earth, and Epſom ſalt.	Purgative, diuretic, and diaphoretic.—Powerfully antiſeptic in putrid diſeaſes, and excellent in diarrhœa, dyſenteries, &c.
New Cartmall	Lancaſhire in England.	Sea ſalt and aerated earth.	Purgative.
Newnham Regis,	Warwickſhire in England.	Similar to Scarborough water.	
Newtondale,	Yorkſhire in England.	Aerated calcareous earth or magneſia.	Aſtringent or tonic.
Newton-Stewart,	Tyrone in Ireland.	Similar to Tunbridge.	
Nezdenice,	Germany.	Fixed air, foſſil alkali, iron, and earth.	Diuretic, diaphoretic, and tonic.
Nobber,	Meath in Ireland.	Martial vitriol.	Similar to Hartfell.
Normanby,	Yorkſhire in England.	Sulphur, much fixed air, ſome ſea ſalt, and Epſom ſalt.	Similar to Aſkeron water.
Nottington,	Dorſetſhire, England.	Sulphur, foſſil alkali, and earth.	Uſeful in cutaneous diſeaſes.
Orſton,	Nottingham, England.	Much fixed air, Epſom ſalt, and a little ſea ſalt, with ſome iron.	Purgative.—It intoxicates by reaſon of the great quantity of air contained in it.
Oulton,	Norfolk, England.	Similar to Iſlington.	
Owen Breun,	Cavan, Ireland.	Sulphur, Epſom ſalt, and foſſil alkali.	Similar to Aſkeron water.
Pancras,	Near London.	Epſom ſalt, and aerated earth.	Diuretic and purgative.
Paſſy,	Near Paris.	Similar to Pyrmont water.	
Peterhead,	Aberdeen county, Scotland.	A ſtrong chalybeate, but of which no analyſis has been publiſhed.	Similar to Iſlington, but more powerful.
Pettigoe,	Donnegal, Ireland.	Sulphur and purging ſalt.	Similar to Aſkeron water.
Pitkeathly,	Perthſhire, Scotland.	Sea ſalt, a ſmall quantity of muriated and likewiſe of aerated earth.	Gently purgative. Very uſeful in ſcrofulous and ſcorbutic habits.
Plombiers,	Lorraine, France.	Saline matter, probably foſſil alkali, with a ſmall portion of oil.—Warm.	Uſed as a bath, and for waſhing ulcers. Inwardly taken it cures complaints from acidity, hemorrhagies, &c.
Pontgibault,	Auvergne, France.	Foſſil alkali and calcareous earth.	Diuretic and laxative.
Pougues,	Nivernois, France.	Calcareous earth, magneſia, foſſil alkali, ſea ſalt, earth of alum, and ſiliceous earth.	Diuretic and laxative.
Pyrmont,	Weſtphalia, Germany.	Aerated iron, calcareous earth, magneſia, Epſom ſalt, and common ſalt.	Diuretic, diaphoretic, and laxative. Recommended in caſes where the conſtitution is relaxed; in female complaints, in cutaneous diſeaſes, in nervous diſorders, in the gravel and urinary obſtructions; and conſidered as among the beſt reſtoratives in decayed and broken conſtitutions.
Queen Camel,	Somerſetſhire, England.	Sulphur, ſea ſalt, foſſil alkali, calcareous earth, and bituminous oil.	Uſed in ſcrofulous and cutaneous diſorders.
Richmond,	Surry in England.	Similar to Acton water.	
Rippon,	Yorkſhire, England.	Sulphur, ſea ſalt, and aerated earth.	Diaphoretic and alterant.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Road,	Wiltſhire, England.	Sulphur, iron, foſſil alkali, and fixed air.	Uſeful in ſcrofula, ſcurvy, and cutaneous diſorders.—Acts as a laxative.
St Bartholomew's well,	Cork in Ireland.	Foſſil alkali, iron, and fixed air.	Similar to Tilbury water.
St Bernard's well,	Near Edinburgh.	Similar to the waters of Moffat.	Somewhat congenial with Moffat and Harrowgate. In nervous and ſtomachic caſes, analeptic and reſtorative; in ſcorbutic, ſcrofulous, and moſt dropſical caſes, reckoned a ſpecific.
St Eraſmus's well,	Staffordſhire, England.		Similar to Borrowdale water.
Scarborough,	Yorkſhire, England.	Aerated calcareous earth, Epſom ſalt, ſea ſalt, and iron.	Diuretic and purgative.
Scollienſis,	Switzerland.	Iron, foſſil alkali, and a great quantity of fixed air.	Excellent in colic pains, both as a cure and preventive.
Seidlitz,	Bohemia.	Epſom ſalt.	Strongly purgative.
Seltzer,	Germany.	Calcareous earth, magneſia, foſſil alkali, and fixed air.	Diuretic. Uſeful in the gravel, rheumatiſm, ſcurvy, ſcrofula, &c.
Sene, or Send,	Wiltſhire, England.	Similar to Iſlington.	
Seydſchutz,	Germany.	Similar to Seidlitz.	
Shadwell,	Near London.	Green vitriol.	Emetic and cathartic.
Shapmoor,	Weſtmorland, England.	Sulphur and purging ſalt.	Similar to Aſkeron water.
Shettlewood,	Derbyſhire, England.		Similar to Harrowgate water.
Shipton,	Yorkſhire, England.	Sulphur, ſea ſalt, and purging ſalt.	Similar to Harrowgate.
Somerſham,	Huntingdonſhire, England.	Green vitriol, alum, and fixed air.	Corroborant and alterative. Uſeful for waſhing foul ulcers and cancers.
Spaw,	Liege in Germany.	Foſſil alkali, iron, aerated earth, Epſom ſalt, and ſea ſalt.	Diuretic and purgative. Serviceable in many diſorders. See the article Spaw.
Stanger,	Cumberland, England.	Green vitriol.	Emetic and cathartic.
Stenfield,	Lincolnſhire, England.	Similar to Orſton.	
S reatham,	Surry, England.	Aerated earth, Epſom ſalt, ſea ſalt, and muriated magneſia.	Purgative.
Suchaloza,	Hungary.		Similar to Nezdenice.
Sutton bog,	Oxfordſhire, England.	Sulphur, foſſil alkali, and ſea ſalt.	Alterative and laxative.
Swadlingbar,	Cavan in Ireland.	Sulphur, earth, ſea ſalt, and foſſil alkali.	Alterative and diaphoretic.
Swanſey,	Glamorganſhire in North Wales.	Green vitriol.	Similar to Shadwell.
Sydenham,	Kent in England.	Similar to Epſom, but weaker.	
Tarleton,	Lancaſhire in England.	Similar to Scarborough water.	
Tewkſbury,	Glouceſterſhire in England.	Similar to Acton.	
Thetford,	Norfolk in England.	Foſſil alkali, fixed air, and iron.	Purgative and diuretic.
Thoroton,	Nottinghamſhire in England.	Similar to Orſton.	
Thurſk,	Yorkſhire in England.	Similar to Scarborough.	
Tibſhelf,	Derbyſhire in England.	Iron diſſolved in fixed air.	Similar to Spaw water.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Tilbury,	Eſſex in England.	Foſſil alkali.	Diuretic and diaphoretic.
Tober Bony,	Near Dublin in Ireland.	Foſſil alkali, earth, and bituminous oil.	Similar to Tilbury.
Tonſtein,	Cologne in Germany.	Foſſil alkali.	Similar to Seltzer, but more purgative.
Tralee,	Kerry in Ireland.	Similar to Caſtle Connel.	
Tunbridge,	Kent in England.	Iron, ſome ſea ſalt, with a little ſelenites and calcareous earth.	An excellent chalybeate, uſeful in all diſeaſes for which the Spaw is recommended.
Upminſter,	Eſſex in England.	Sulphur, foſſil alkali, and purging ſalt.	Purgative and diuretic.
Vahls,	Dauphiny in France.	Foſſil alkali.	Diuretic and laxative.
Wardrew,	Northumberland.	Sulphur, earth, and ſea ſalt.	Similar to Harrowgate water.
Weatherſtack,	Weſtmorland in England.	Iron, ſea ſalt, and a ſmall quantity of hepatic gas.	Purgative.
Wallenfrow,	Northamptonſhire in England.	Similar to Iſlington water.	
Weſt Aſhton,	Wiltſhire in England.	Similar to Iſlington.	
Weſtwood,	Derbyſhire in England.	Green vitriol.	Similar to Shadwell. Uſed for waſhing ulcers of the legs.
Wexford,	Ireland.	Similar to Iſlington.	
Whiteacre,	Lancaſhire in England.	Aerated iron, and probably calcareous earth.	Somewhat aſtringent.
Wiggleſworth,	Yorkſhire in England.	Sulphur, earth, and common ſalt.	Emetic in the quantity of two quarts, and ſaid to be cathartic in the quantity of three; a ſingular circumſtance if true.
Wildungan,	Waldech in Germany.	Similar to the waters of Bath.	Uſeful in ſcorbutic and gouty diſeaſes.
Windgate Spaw,	Northumberland,	Carbonate of iron, green vitriol, alum, common ſalt, calcareous earth.	Corroborant and diuretic; and uſeful in ſtomach complaints and ſcrofula.
Witham,	Eſſex in England.	Aerated iron, and common ſalt.	Diuretic, alterative, and corroborant.
Wirkſworth,	Derbyſhire in England.	Sulphur, purging ſalt, and aerated iron.	Uſeful in ſcrofulous and cutaneous diſeaſes.
Zahorovice,	Germany.	Similar to Nezdenice water.	Much eſteemed in ſcrofulous caſes.

MINERALOGY.

1 Definition. MINERALOGY is that branch of natural hiſtory which has for its object the deſcription and diſcrimination of inorganized or mineral ſubſtances, as they are found in the earth or on its ſurface.

2 Hiſtory. The knowledge of ſome mineral bodies may be conſidered as coeval with the earlieſt ages of the world. The rudeſt and moſt barbarous nations could not be ignorant of ſome of the properties of the ſubſtances which were moſt familiar to their obſervation; and mankind have made little progreſs in civilization, when they are entirely unacquainted with the nature of thoſe matters from which ſome of the metals are extracted.

Precious ſtones, it ſeems not at all improbable, firſt attracted the notice of mankind. The richneſs of colour, brilliancy, luſtre, and durability of theſe bodies, could not fail to excite admiration, and make them be ſought after as ornaments, even by the leaſt civilized people, and in countries where they are moſt abundant. They were well known, it would appear from the ſacred writings, among the Jews and Egyptians in the time of Moſes. At this period, however, both the Jews and Egyptians had advanced far in refinement.

But this knowledge was too limited to be dignified with the name of *Mineralogy*. It wanted that comprehenſive, connected, and ſcientific view which could entitle it to that denomination. And indeed it may be ſaid to be only of modern date that the knowledge of minerals roſe to the rank of ſcience, and aſſumed any thing like a regular and connected form.

Dioſcorides and Theophraſtus among the Greeks, and Pliny among the Romans, have, it is true, deſcribed a few mineral bodies; and Avicenna, an Arabian philoſopher and phyſician, who flouriſhed in the end of the 10th and beginning of the 11th century, arranged thoſe objects into four great claſſes, viz. 1. Stony bodies. 2. Saline bodies. 3. Inflammable bodies; and 4. Metals —an arrangement, which, it is curious to remark, muſt be well-founded; for it has been adopted, ſometimes indeed with ſlight deviations, by almoſt all mineralogical writers 3 Writers on minerals.

writers ſince that period. But ſtill the knowledge of minerals was bounded by very narrow limits.

The variety and value of mineral productions in Germany have excited more attention to theſe ſtudies, and have thus rendered this knowledge of more intereſt and importance than in any other country. To Germany indeed it muſt be acknowledged that mineralogy is indebted in a great meaſure for its origin, and for a very ample ſhare of its progreſſive improvement. George

4 Agricola.

Agricola, a native of Miſnia, in which country he ſettled as a phyſician, lived during the firſt half of the 16th century. Being ſtrongly attached by inclination to the ſtudy of minerals, he removed to Chemnitz in Hungary, where he might have an opportunity of proſecuting his favourite ſtudies; and there, by the moſt unwearied application to mineralogy, and particularly to the various operations on the metals, he became the moſt celebrated metallurgiſt of his time. He is ſuppoſed to be the firſt German author who profeſſedly wrote on mineral ſubſtances. The following titles chiefly comprehend the various heads into which his works on metallurgy and mineralogy are divided, *De Ortu et Cauſis Subterraneorum; De Natura eorum quæ affluunt ex Terra; De Natura Foſſilium; de Medicatis Fontibus: De Subterraneis Animantibus; De Veteribus et Novis Metallis;* and *De Re Metallica.* His arrangement of minerals is into two great diviſions. 1. Simple or Homogeneous Minerals; and 2. Heterogeneous Minerals. The firſt, or ſimple minerals, includes four ſubdiviſions, viz. 1. Terra; 2. Succus Concretus; 3. Lapis; 4. Metallum. The ſecond great diviſion, the heterogeneous minerals, comprehends two ſubdiviſions, viz. 1. Compound minerals; 2. Mixed minerals.

5 Beccher.

Several writers on mineralogy appeared in the courſe of the 17th century; and about the beginning of the 18th Beccher propoſed an arrangement of bodies on chemical principles, or according to their conſtituent

6 Linnæus.

parts. In the year 1736, Linnæus publiſhed a ſyſtem of mineralogy, in which mineral bodies are divided into three claſſes, viz. 1. *Petræ;* 2. *Mineræ;* 3. *Foſſilia.* Theſe are ſubdivided into orders: the firſt containing three, *Vitreſcentes, Calcareæ, Apyræ;* the ſecond containing three, *Salia, Sulphurea, Mercurialia;* and the third alſo containing three, *Concreta, Petrifacta, Terræ.* Three years afterwards the ſyſtem of Cramer appeared, according to which all mineral ſubſtances are arranged into ſeven claſſes, of which the following are the titles. 1. Metals; 2. Semimetals; 3. Salts; 4. Inflammable ſubſtances; 5. Stones; 6. Earths; and 7. Waters. About 10 years after the firſt publication of the mineral

7 Wallerius.

ſyſtem of Linnæus, Wallerius profeſſor of mineralogy at Upſal, and his cotemporary, communicated to the world a more enlarged and improved arrangement of mineral bodies than any which had hitherto appeared. According to the ſyſtem of Wallerius, all minerals are diſtributed into four claſſes, each of which is ſubdivided into four orders. The firſt claſs, *Terræ*, includes the orders *Macræ, Pingues, Minerales*, and *Arenaceæ;* to the ſecond claſs, *Lapides*, belong the orders *Calcarei, Vitreſcentes, Apyri, Saxa;* the third claſs, *Mineræ*, comprehends the orders *Salia, Sulphurea, Semimetalla* and *Metalla;* and the fourth, *Concreta*, is compoſed of the orders *Pori, Petrifacta, Figurata*, and *Calculi.*

Of the ſyſtematic writers on mineralogy from the time of Linnæus, which have now been mentioned, and of others which the limits of this hiſtorical ſketch do not permit us to notice, it is to be obſerved, that by all of them, although the general arrangement of Avicenna was not followed, yet in the ſubordinate diviſions his claſſes were adopted, and conſtituted ſome of their orders. The claſſes of Avicenna were not reſtored till

8 Cronſtedt.

the time of Cronſtedt, a Swediſh mineralogiſt, in whoſe ſyſtem, which was publiſhed in the year 1758, they reſumed the place which they formerly held. The ſyſtem of Cronſtedt is divided into four claſſes, *Terræ, Salia, Phlogiſtica*, and *Metalla.* The firſt claſs, *Terræ*, includes 9 orders, *Calcareæ, Siliceæ, Granatinæ, Argillaceæ, Micaceæ, Fluores, Aſbeſtinæ, Zeoliticæ*, and *Magneſiæ.* To the ſecond claſs, *Salia*, belong two orders, *Acida* and *Alkalina.* The third claſs, *Phlogiſtica*, conſiſts only of one order; and the fourth claſs, *Metalla*, is compoſed of two orders, *Metalla perfecta* and *Semimetalla.* The ſyſtem of Cronſtedt, the moſt complete which had yet been offered to the world, and which, by comparing it with the ſyſtems accounted by ſome the moſt perfect of the preſent day, will be found not much different in its arrangement, continued to be read and ſtudied for more than twenty years, and was tranſlated into different languages. This arrangement is founded on chemical principles. The firſt claſs, for inſtance, is divided into nine orders already enumerated, and correſponding, as he ſuppoſed, to nine earths, of one of which the ſtones included in each order are chiefly compoſed. But as the improvements in chemical analyſis led to greater accuracy of inveſtigation, the earths which Cronſtedt ſuppoſed to be ſimple were found to be compound. The number of ſimple or primitive earths

9 Bergman.

was then diminiſhed to five; and thus the number of genera, as they appeared in the *Sciagraphia Regni Mineralis* of Bergman, publiſhed in 1782, was alſo five. At that period five earths only were known. The ſame method of conſtructing the genera is ſtill followed, ſo that the number of genera has increaſed in proportion to the number of earths which have been ſince diſcovered.

10 Werner.

In the year 1780, a tranſlation of Cronſtedt's mineral ſyſtem appeared in Germany, accompanied with notes by Werner, the celebrated profeſſor of mineralogy at Freyberg in Saxony. Six years before this time Werner had publiſhed a ſeparate treatiſe on the claſſification of minerals, in which he exhibited his method of deſcribing them by means of external characters. The notes on Cronſtedt's ſyſtem are to be conſidered as a farther illuſtration of this method, as well as a catalogue of minerals belonging to Pabſt Von Ohain, which was drawn up by the ſame naturaliſt and publiſhed in 1791. In Germany the method of Werner, we believe, is almoſt excluſively adopted; and it is chiefly followed in moſt other countries, France excepted, where mineralogical knowledge is alſo greatly cultivated.

11 Kirwan.

Mr Kirwan firſt introduced the knowledge of this ſyſtem into Britain, in his treatiſe on mineralogy publiſhed in 1784; and about ten years afterwards it was ſtill farther elucidated by the ſame author in an improved and enlarged edition of that work. In preparing the latter edition, Mr Kirwan enjoyed the peculiar advantage of conſulting one of the completeſt and beſt arranged collections of minerals which had yet been made in any country. This is the Leſkean collection

12 Leſkean collection of minerals.

of foſſils, which Mr Kirwan pronounces to be the moſt perfect monument of mineralogical ability now extant.

"That

History.

"That the possession of this cabinet, Mr Kirwan proceeds to state, should escape the vigilance of the most learned nations, and fall to the lot of Ireland, hitherto so inattentive to matters of this nature, was little to be expected. Through the active zeal however of two of its most enlightened patriots (A), and the influence secured to them by former services of the most essential nature, the sums requisite for its purchase, and for building a repository to receive it, were obtained *." This splendid and extensive collection, we are farther informed, was made by Leske whose name it now bears, and who was one of the earliest and most eminent of the disciples of Werner. It was arranged between the years 1782 and 1787, according to the principles of Werner, and with his assistance. After the death of Mr Leske, a catalogue was drawn up by Karsten another of Werner's disciples. This catalogue in its arrangement corresponds to the arrangement of the cabinet, which is divided into five parts.

* *Preface to Mineralogy*, p. ix.

The first part, which is denominated the *characteristic* part, consists of 580 specimens. These are intended for the illustration of the external characters or the principles of the classification.

The second, which is the *systematic* or oryctognostic part, comprehends all simple minerals distributed according to their genera and species agreeable to the method then followed by Werner. This part contains 3268 specimens.

The third part, which is called the *geognostic* or *geological*, includes the substances found in the different kinds of rocks, as they are divided into *primitive*, *transition*, *stratiform*, *alluvial*, and *volcanic* mountains. This part of the collection is peculiarly rich in petrifactions; and the whole number of specimens which it contains extends to 1100.

The fourth part is intended to illustrate the mineralogy of every country on the globe, by exhibiting its mineral productions. The order of arrangement of this part is from America to Asia, Europe, and Africa. As there are many countries yet unexplored, it is the most imperfect division of the whole collection; and indeed, as Mr Kirwan observes, it can only be completed by national opulence.

The fifth part is called the *economical* collection. It is formed of 474 specimens of minerals which are employed in arts and manufactures, as in architecture, sculpture, agriculture, jewellery, colouring, dyeing, cloathing, pottery, glazing, enamelling, polishing of metals, furnace building, medicine, metallurgy, &c. The whole cabinet consists of 7331 specimens.

Such is the valuable source from which Mr Kirwan derived the information detailed in his system of mineralogy. And here we are led to throw out a hint that the friends of this science could not more effectually promote its knowledge, and encourage its progress, than by establishing similar collections wherever it is taught and studied. But patriotism and power are unfortunately oftener directed to deeds of splendour and magnificence, than they are occupied in forming and accomplishing the humbler and more permanent plans of national utility.

But to resume our narrative of the history of mineralogy, we cannot help expressing our regret that Mr Kirwan has never found it convenient to revise and improve his system as he might have done, aided by the immense stock of mineralogical knowledge which has been accumulated since its first publication. This is the more to be regretted, because, notwithstanding the rapid progress of the science, and the great improvements which the system of Werner has received, no good or even tolerable account of it has yet appeared in the English language.

France, where many branches of natural history have long flourished, has contributed largely to the science of mineralogy. Even the period of war, which at first sight would appear to be extremely adverse to the tranquil pursuits of knowledge, has in this case proved peculiarly favourable to the study of mineralogy in that kingdom. The knowledge of minerals has not only been encouraged and promoted in France, by being forced to direct her attention to her own resources, while her intercourse with other countries from which she derived various commodities indispensibly necessary for economical purposes was interrupted; but also by the subjugation to her overgrown power, of those parts of Europe where mineralogy has been most cultivated and improved, thus affording every facility of correspondence, and rendering accessible those mineral treasures which exhibit the best and fullest illustration of the science. The French government, indeed, whatever form it may have assumed, has invariably been impressed with the importance of mineralogy; and even during the horrors of revolution, has never failed to promote its progress, by forming and supporting extensive collections, and establishing able and enlightened teachers at the expence of the nation.

Of the works on mineralogy which have appeared in France, we shall only mention the treatises of Brochant, Hauy, and Brongniart. They are the sources from which the information in the following treatise is chiefly derived, and they may be recommended as the best guides to the study of this department of natural history.

13 Brochant.

The system of Brochant is formed entirely on the principles of Werner's classification, and is undoubtedly the most perspicuous account of the system of the German mineralogist which has yet been published. The principles on which the elaborate and ingenious method of arrangement proposed by the celebrated Hauy have been already detailed. (See CRYSTALLIZATION.) Here we shall only remark that the study of the regular forms of minerals with a view to methodical arrangement was successfully prosecuted by Bergman and Romé de Lisle; but has been extended and carried to the highest degree of perfection by the sagacity, profound physical knowledge, and mathematical address of the Abbé Hauy. But although the mineral system of this distinguished philosopher be founded on characters the most certain and the most uniformly permanent, yet it

14 Hauy.

(A) The Right Honourable John Forster late Speaker of the Irish House of Commons, and the Right Honourable W. B. Cunningham.

History.

it may be doubted whether the previous knowledge necessary to understand it, and in some cases the difficulty of applying its principles in ascertaining some of the most essential characters, may not preclude this work from being so generally and practically useful as other systems. The scientific mineralogist however will always regard it as a monument of indefatigable industry and patient research which has rarely been equalled, and will derive from it the most material aid in his studies.

The system of Hauy consists of four classes. I. The first class consists of substances which are composed of an acid united to an earth or an alkali, and sometimes to both; and it contains three orders; 1. Earths combined with an acid; 2. Alkalies combined with an acid; and, 3. Earths and alkalies combined with an acid. II. This class includes only earthy substances, but sometimes combined with an alkali. It constitutes the siliceous genus of other systems. III. The third class comprehends combustible substances which are not metals. It is divided into two orders; the first containing simple, and the second compound combustibles. IV. The metals form the fourth class. It is divided into three orders, which are characterized by different degrees of oxidation. Besides these classes there are three appendices. The first contains those substances whose nature is not sufficiently known to have their places accurately assigned in the system. The second appendix includes aggregates of different mineral substances. It is divided into three orders. The first treats of primitive rocks; the second of secondary and tertiary rocks; and the third of breccias. The third appendix is devoted to the consideration of volcanic products. This is divided into six classes; but it is to be observed, that the volcanic products of this mineralogist comprehend, not only such substances as are universally allowed to have a volcanic origin, but also basalts, traps, and other minerals, the origin of which is still questioned.

15 Brongniart.

The system of Brongniart takes a wider range than other systems, including substances which are not treated of by writers on mineralogy. It is divided into five classes. The first contains those substances, excluding the metals, which are combined with oxygen. It contains two orders; the first including air and water, and the second the acids. The second class, which treats of saline bodies, is divided into two orders: the first comprehends the alkaline salts, and the second the earthy salts. The third class, containing the stones, is divided into three orders: the first, hard stones; the second magnesian; and the third argillaceous. The fourth class contains the combustible substances, which are divided into two orders; first compound, and second, simple combustibles. The fifth class includes the metals, which are divided into two orders; first, the brittle, and second the ductile metals. The treatise of Brongniart, notwithstanding some peculiarities in the classification which are not quite familiar to us, will be found one of the most useful that has hitherto appeared, not only on account of the accuracy of the descriptions, which are divested of every kind of redundancy, but also on account of the interesting geological discussions which are introduced, as well as numerous and important practical details in metallurgy and other useful arts.

The following treatise will be divided into two parts. The first part will contain the classification and description of minerals; and the second part will be destined to the analysis of minerals and to metallurgy, or the method of extracting metals from their ores.

PART I. OF THE CLASSIFICATION OF MINERALS.

THE method to be followed in this treatise is nearly that of Werner, all the material parts of which we shall freely borrow from the work of Brochant already noticed, as the best on the subject which we have had an opportunity of consulting. We shall however occasionally avail ourselves of any useful information which may be derived from the mineralogy of Kirwan, Brongniart, and Hauy; and in particular we shall insert the essential characters of the species given by the latter.

The universal characters employed by Werner in the description of minerals are seven in number: 1. Colour; 2. Cohesion; 3. Unctuosity; 4. Coldness; 5. Weight; 6. Smell; 7. Taste. The table and the illustrations which follow are chiefly taken from Weaver's translation of Werner's treatise on that subject.

In the following table is exhibited the arrangement of the generic external characters of fossils.

Common

Common Generic External Characters.

I. The Colour.
II. The Cohesion of the particles, in relation to which Fossils are distinguished into

Solid and Fluid.

Solid and Friable.

Characters	Appearance	Particular generic characters of solid Fossils.	Particular generic characters of friable Fossils.	Particular generic characters of fluid fossils.
Characters for the Sight.	External Appearance.	The external Form. The external Surface. The external Lustre.	The external Form.	The external Form.
	Appearance of the Fracture.	The internal Lustre. The Fracture. The form of the Fragments.	The Lustre. The appearance of the particles.	The Lustre.
	Appearance of the distinct Concretions.	The Form of the distinct Concretions. The Surface of Separation. The Lustre of Separation.		
	General appearance.	The Transparency. The Streak. The Stain.	The Stain.	The Transparency.
Characters for the Touch.		The Hardness. The Solidity. The Frangibility. The Flexibility. The Adhesion to the Tongue.	The Friability.	The Fluidity. Wetting of the fingers.
Characters for the Hearing.	The Sound.	The Ringing. The Creaking. The Rustling.		

Remaining Common Generic External Characters.

Characters for the	Touch.	III. The Unctuosity. IV. The Coldness. V. The Weight.
	Smell.	VI. The Smell.
	Taste.	VII. The Taste.

External Characters of Minerals arranged according to their respective generic characters, and illustrated by appropriate examples.

Common Generic External Characters.

I. THE COLOUR.

The most obvious of the external characters of minerals, is colour; it is also one of the most certain characters, and often serves as the principal distinguishing mark of many mineral substances. In deriving the characters of minerals from colour, three things are considered: 1. The several principal colours, with their varieties. 2. The shade of colour. 3. The tarnished colours.

I. *Principal Colours.*

The several principal colours are not derived from the division of the solar ray by means of the prism, but are such as are considered simple in common life. The principal colours are the eight following; viz. white, gray, black, blue, green, yellow, red, and brown.

A. White is the first principal colour, and it includes the following eight varieties.

1. *Snow white*, as snow white quartz, white lead ore, Carrara marble.

2. *Reddish*

Classification.

2. *Reddiſh white*, as porcelain earth, reddiſh white quartz.

3. *Yellowiſh white*, as white amber, zeolite, chalk.

4. *Silver white*, as native ſilver, native biſmuth, and arſenical pyrites.

5. *Grayiſh white*, as ſeveral kinds of gypſum, quartz, and foliated granular limeſtone.

6. *Greeniſh white*, as white amianthus, talc, and calcareous ſpar.

7. *Milk white*, as calcedony, opal, and milk white quartz.

8. *Tin white*, as native quickſilver, native antimony, and white cobalt ore.

B. Gray is the ſecond principal colour, and its varieties are the following.

1. *Lead gray*, as in common galena, compact galena, gray antimonial ore, and vitreous copper ore.

2. *Bluiſh gray*, as in bluiſh gray clay, bluiſh gray marble, and bluiſh gray limeſtone.

3. *Pearl gray*, as in quartz, calcedony, and porcelain jaſper.

4. *Reddiſh gray*, as in granular limeſtone and feldſpar.

5. *Smoke gray*, as in gray hornſtone, and in dark gray flint.

6. *Greeniſh gray*, as in cats eye, prehnite, and ſome varieties of argillaceous ſchiſtus.

7. *Yellowiſh gray*, as in yellowiſh gray calcedony, yellowiſh gray tripoli.

8. *Steel gray*, as in ſpecular iron ore, gray copper ore, ſtriated gray ore of manganeſe.

9. *Aſh gray*, as in quartz, wacken, and ſome varieties of argillaceous ſchiſtus.

C. Black, which is the third principal colour, is divided into the ſix following varieties.

1. *Grayiſh black*, as in baſalt, black limeſtone, and black flint.

2. *Browniſh black*, as in black blende, tin-ſtone cryſtals, black cobalt ore, and bituminous ſhale.

3. *Dark black*, or *velvet black*, as in Iceland agate or obſidian, ſchorl, and jet.

4. *Iron black*, as in micaceous iron ore, magnetic iron ſtone, and ſometimes in antimoniated ſilver ore.

5. *Greeniſh black*, as in pitchſtone, hornblende, and ſerpentine.

6. *Bluiſh black*, as in aluminous ſhale, black cobalt ore, dull black lead ore.

D. Blue is the fourth principal colour, including ſeven varieties.

1. *Indigo blue*, as in blue martial earth.

2. *Pruſſian blue*, as in the ſapphire and blue rock ſalt.

3. *Azure blue*, as in lapis lazuli, and azure copper ore.

4. *Violet blue*, as in fluor ſpar, amethyſt, and in rock ſalt.

5. *Lavender blue*, as in a variety of porcelain, jaſper, and lithomarga.

6. *Smalt blue*, as in light azure copper ore, and blue martial earth.

7. *Sky blue*, as in light azure copper ore, blue native vitriol, and ſky blue fluor ſpar.

E. Green is the fifth principal colour, of which there are the following varieties.

1. *Verdigreaſe green*, as in green copper ore, green fluor ſpar.

2. *Celadon green*, as in the Braſilian beryl, and in pure green earth.

3. *Mountain green*, as in actynolite, hornſtone, and in moſt beryls.

4. *Emerald green*, as in fibrous malachite and fluor ſpar.

5. *Leek green*, as in actynolite, jade, and praſium.

6. *Apple green*, as in chryſolite, prehnite, and nickel ore.

7. *Graſs green*, as in ſome varieties of chryſopraſe and ſome green lead ores.

8. *Piſtachio green*, as in chryſolite, iron ſhot green copper ore.

9. *Aſparagus green*, as in chryſo beryl, and ſome varieties of green lead ore.

10. *Olive green*, as in green lead ore, ſerpentine, pitchſtone and garnet.

11. *Blackiſh green*, as in dark green ſerpentine.

12. *Canary green*, as in green lead ore, micaceous uranitic ore, and green ſteatites.

F. Yellow is the ſixth of the principal colours. It includes 12 varieties, which are the following.

1. *Sulphur yellow*, as in native ſulphur and ſome varieties of ſerpentine.

2. *Lemon yellow*, as in yellow orpiment, and ſome yellow lead ores.

3. *Gold yellow*, as in native gold.

4. *Bell metal yellow*, as in iron pyrites.

5. *Straw yellow*, as in calamine and biſmuth ochre.

6. *Wine yellow*, as in Saxon topaz and yellow calcareous ſpar.

7. *Iſabella yellow*, as in calamine and ſparry iron ore.

8. *Ochre yellow*, as in iron ochre, yellow jaſper, and calamine.

9. *Orange yellow*, as in red orpiment and red lead ore.

10. *Honey yellow*, as in amber fluor ſpar and calcedony.

11. *Wax yellow*, as in yellow lead ore, common opal, and calcedony.

12. *Braſs yellow*, as in copper pyrites, and native gold.

G. Red is the ſeventh principal colour, and it includes the following 15 varieties.

1. *Morning* or *aurora red*, as in red lead ore, red orpiment.

2. *Hyacinth red*, as in the hyacinth, and a variety of brown blende.

3. *Brick red*, as in porcelain jaſper.

4. *Scarlet red*, as in light red cinnabar.

5. *Copper red*, as in native copper.

6. *Blood red*, as in Bohemian garnet, and red carnelian.

7. *Carmine red*, as in red copper ore, and clear red cinnabar.

8. *Cochineal red*, as in cinnabar, ſometimes jaſper, and red quartz.

9. *Crimſon red*, as in ruby, oriental garnet, and red cobalt ore.

10. *Columbine red*, as in precious garnet, and red cobalt ore.

11. *Fleſh red*, as in feldſpar, red gypſum, red quartz, and fleſh red barytes.

12. *Roſe*

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12. *Roſe red*, as in red zeolite, roſe red quartz, and ruby.

13. *Peach bloſſom red*, as in ſtriated and earthy red cobalt ores.

14. *Cherry red*, as in red antimony ore and ruby.

15. *Browniſh red*, as in red argillaceous iron ſtone, and red earthy iron ſtone.

H. Brown is the eighth and laſt of the principal colours. It is divided into the eight following varieties.

1. *Reddiſh brown*, as in brown tin ſtone, and brown blende.

2. *Clove brown*, as in rock cryſtal, brown iron ore, and thumerſtone.

3. *Hair brown*, as in wood tin ore from Cornwall.

4. *Yellowiſh brown*, as in brown iron ochre and jaſper.

5. *Tombac brown*, or pinchbeck brown, as in brown mica.

6. *Wood brown*, as in bituminous wood, a variety of aſbeſtus.

7. *Liver brown*, as in brown cobalt ore, and brown jaſper.

8. *Blackiſh brown*, as in lowland argillaceous iron ore, mineral pitch, and bituminous wood.

II. *Shade or Intenſity of Colour.*

Colours may be determined by the relation in which they ſtand to each other with regard to intenſity or ſhade. Thus among the principal colours, there are ſome which are light, as white and yellow; and ſome which are dark, as blue and black; and beſides, the varieties of the principal colours differ from each other in reſpect to ſhade. Thus among the blue colours, indigo blue is dark, azure blue clear, and ſky blue light; and even the varieties may afford a diverſity of ſhade, as, for inſtance, clear canary green, light canary green.

Here it ought to be remarked, that the peculiar ſhade of colour in a mineral is frequently owing to its greater or leſs tranſparency, the paleneſs being in proportion to the degree of tranſparency, and the darkneſs to the degree of opacity. The degree of luſtre alſo in minerals produces great variety in the ſhade of colour.

In diſcriminating the ſhade or intenſity of colour, four degrees have only in general been adopted. Theſe are the following. 1. *Dark.* 2. *Clear.* 3. *Light.* 4. *Pale.*

1. *Dark*, as in Bohemian garnet, which is dark blood red.

2. *Clear*, as in green hornſtone, which is clear mountain green.

3. *Light*, as in red carnelian, which is light blood red.

4. *Pale*, as in aquamarine, which is pale mountain green.

III. *Tarniſhed Colours.*

Tarniſhed colours afford peculiar characteriſtic marks of many minerals. By tarniſhing, is meant a difference in the colour of the ſurface after expoſure to the air from what the freſh fracture of the mineral exhibits.

Some minerals are always found tarniſhed in their natural poſition in the earth, as in common galena, gray ore of antimony and blende: ſome tarniſh on every freſh fracture being made, as in native arſenic and copper pyrites; while others are tarniſhed in both caſes, as in native arſenic, and purple copper ore.

The colours of tarniſhed minerals are divided into, 1. *Simple*, and 2. *Variegated.*

1. Simple Tarnished colours afford five varieties.

a. Gray is the tarniſhed colour of white cobalt ore, and ſteel gray of brown hematites.

b. Black is the tarniſhed colour of native arſenic, brown hematites, and gray cobalt ore.

c. Brown is the tarniſhed colour of native ſilver, which is white.

d. Reddiſh, of native biſmuth, the freſh fracture of which is ſilver white.

e. Yellowiſh, of white cobalt ore, and argentiferous arſenical pyrites.

2. Variegated tarnished colours include four varieties.

a. Pavonine tarniſhed, as in copper pyrites, purple copper ore and common pyrites.

b. Irideſcent tarniſhed, as in gray antimonial ore, galena, ſpecular iron ore.

c. Columbine tarniſhed, as in copper pyrites.

d. Steel coloured tarniſhed, as in gray cobalt ore.

IV. *The Play of Colour.*

The play of colour in a mineral can only be obſerved in ſunſhine or in a ſtrong light. By this is underſtood that property which ſome minerals poſſeſs of refracting from particular ſpots the different rays of light. This effect is produced by the peculiar aſſociation of the molecules of the mineral, and the various degrees of its tranſparency. Accidental cauſes, however, produce a ſimilar effect, ſuch as ſlight rifts, cracks, &c.

The play of colour is remarkable in the diamond and in the opal, and ſometimes in rock cryſtal.

V. *The Mutable Reflection of Colour.*

This is diſtinguiſhed from the play of colour by the mineral exhibiting in the ſame ſpot a change of colour according to the poſition of its ſurface being varied, producing a different angle with the incident rays of light. This change takes place, 1. *On the ſurface*; 2. *Internally.*

1. The *ſuperficial* mutable reflection is finely exemplified in Labrador ſtone, and in a variety of marble which contains petrified ſhells.

2. The *internal* mutable reflection of colour appears in cat's eye, precious opal, and moonſtone.

VI. *The Mutation of Colour.*

This is diſtinguiſhed from the tarniſh; in which latter the ſurface only undergoes a change of colour, but in the mutation of colour, the effect penetrates the mineral, and ſometimes pervades the whole. This affords two varieties.

1. *The fading of colour.*—By this is meant that the colour of a mineral becomes paler when it is expoſed to the light, heat, or is undergoing decompoſition. Examples of theſe changes may be obſerved in ſtriated red cobalt ore, which expoſed to the air becomes pale browniſh; blue fluor ſpar becomes green; chryſopraſe becomes light green; pearl gray ſilver ore becomes clear brown.

2. *The perfect change of colour* is often the conſequence of fading, when one colour is loſt, and a new one

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one appears, as in light coloured ſparry iron ore; earthy gray ore of manganeſe, and argillaceous iron ſtone.

VII. *Delineations of Colours.*

The delineations of colours are obſerved on ſimple minerals, the ſame ſpecimen containing ſeveral colours, which paſs through its interior, according to certain delineations. Of theſe delineations the following nine varieties are deſcribed.

1. *Dotted*, when fine points of another colour are diſperſed over the ſurface, as in ſerpentine, and ſome varieties of jaſper.

2. *Spotted*, when the points or ſpots are of the ſize of a lentil to that of a ſixpence, or from one-fourth to one inch in diameter. The ſpots are round and regular, or irregular.

a. Regular, as in ſome varieties of ſerpentine, and in argillaceous ſchiſtus.

b. Irregular, as in a variety of marble from Bayreuth.

3. *Nebulous or cloudy*, when the ſpots are large and irregular, forming with the ground colour the appearance of clouds, as in calcedony and jaſper.

4. *Flamy*, when the ſpots are large, and drawn in one direction to a ſharp point, as in ſtriped jaſper and ſome marbles.

5. *Striped*, when large ſpots are drawn in the ſame direction, and run parallel through the whole ſpecimen. There are two varieties.

a. Straight or curved ſtirped, as in ſtraight ſtriped jaſper.

b. Broad or linear, as in linear ſtriped agate, calcedony, &c.

6. *Annular*, when the ſtripes form concentric circles, as in jaſper, carnelian, and flints.

7. *Dendritic*, when the delineation reſembles the trunk of a tree ſeparating into ramifications, as in ſteatites, ſome limeſtones, Egyptian marble, and calcedony.

8. *Ruinous*, when the delineation preſents the appearance of ruins, as in Florentine or landſcape marble.

9. *Veined*, when the delineation conſiſts of variouſly coloured narrow ſtripes, croſſing each other in different directions, forming ſometimes the appearance of a net, as in marble, ſerpentine, and jaſper.

II. THE COHESION OF THE PARTICLES.

The coheſion of the particles in minerals is the ſecond common generic character, which is obſerved by the ſight, and alſo by the touch. According to this property, minerals are divided into ſolid, friable, and fluid; but theſe properties alſo belong to the particular generic characters of minerals, to be afterwards deſcribed.

Particular Generic External Characters of Solid Minerals.

I. The External Appearance.

In the external appearance of a mineral, three things are to be obſerved, the external form, the external ſurface, and the external luſtre.

1. The external form of a mineral is that figure or ſhape of the natural ſurface, which its primitive individuals are found to poſſeſs. The external forms of ſolid minerals are diſtinguiſhed into common, particular, regular or cryſtallized, and extraneous.

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1. *Common External Shape.*

When a mineral exhibits no reſemblance to any known ſubſtances in common life, it is ſaid to be of a common form. Of common forms there are ſix kinds.

A. *Maſſive*, when a mineral is of an indeterminate form, or amorphous, and of nearly equal dimenſions, from the ſize of a hazel nut to the greateſt magnitude, and when it is incorporated with another ſolid mineral, it is ſaid to be maſſive. Solid minerals are moſt frequently found of this external form, and ſome are never found otherwiſe, as in ſteatites, common pit-coal, galena, and copper pyrites.

B. *Diſſeminated*, or interſperſed, when a mineral, without any particular form, is in ſmall pieces not exceeding the ſize of a hazel nut, incorporated with another ſolid mineral. This affords three varieties.

a. Coarſely interſperſed, in ſize of a hazel nut to that of a pea, as in copper pyrites.

b. Finely interſperſed, from the ſize of a pea to that of a grain of millet, as in tinſtone, in granular quartz.

c. Minutely interſperſed, from the ſize of a grain of millet till it is ſcarcely perceptible to the eye, as in interperſed native gold.

C. In angular pieces, of which there are two varieties.

a. Sharp-cornered, as in calcedony and in quartz.

b. Blunt-cornered, as in common opal.

D. In grains. Detached minerals, from the ſize of a hazel nut to that which may be diſtinguiſhed by the eye, are ſaid to be in grains. Theſe are diſtinguiſhed,

a. According to ſize, into

α. In groſs grains from the ſize of a hazel nut to that of a pea, as in lowland argillaceous iron ore.

β. Large grains, from the ſize of a pea to that of a hemp ſeed, as in precious garnet, magnetic iron ſand.

γ. Small grains, from the ſize of hemp ſeed to that of millet, as in the above minerals.

δ. In minute or fine grains, ſuch as are ſmaller than millet ſeeds, as platina, native gold, tinſtone.

b. According to the form, which is in

α. Angular grains, as in magnetic iron ſand.

β. Rounded grains, as in platina and native gold.

c. According as they inhere in other minerals. In this reſpect they are, *α*. Looſe, *β*. Partially, or *γ*. Wholly.

E. In plates, diſtinguiſhed into

a. Thick plates, as in red ſilver ore.

b. Thin plates, as in vitreous ſilver ore.

F. In membranes or flakes, when the thickneſs does not much exceed that of paper, divided into,

a. Thick, as in native ſilver.

b. Thin, as in iron pyrites.

c. Very thin, as in vitreous ſilver ore.

2. *Particular External Forms.*

The forms which come under this denomination exhibit a greater or leſs reſemblance, both to natural and artificial objects. They are called particular, becauſe, like the former, they are not uſual or common.

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There are five kinds of particular external forms, viz. elongated, rounded, flattened, impressed, and confused.

A. Elongated. Of this there are 11 varieties.

a. Dentiform, as in native silver, and dentiform vitreous silver ore.

b. Filiform, as in native silver, and vitreous silver ore.

c. Capillary, resembling hairs, as in native gold and native silver.

d. Reticulated, as in native silver, native copper, and a variety of galena.

e. Dendritic, which is either regular or irregular, as in native silver and native copper.

f. Coralliform, as in calcareous stalactites, commonly known by the name of *flos ferri*, and brown hæmatites.

g. Stalactitiform, as in calcareous sinter, brown iron stone, and calcedony.

h. Tubuliform, as in compact brown iron stone, and galena.

i. Fistuliform, as in martial pyrites.

k. Frutescent, or *arbustiform*, as in black iron stone, and compact gray ore of manganese.

l. Matrasiform, having the figure of a chemical matrass, as in black hæmatites, and gray ore of manganese.

B. Rounded, of which there are five varieties.

a. Botryform, resembling a bunch of grapes, as in black cobalt ore, malachite, and copper pyrites.

b. Globular, of which there are five varieties.

α. Perfectly globular, as in pisolite, and white cobalt ore.

β. Elliptical, as in quartz and flint.

γ. Amygdaloid, as in zeolite and green earth.

δ. Spheroidal, as in Egyptian jasper and calcedony.

ε. Imperfectly globular, as in carnelian and calcedony.

c. Kidneyform, as in red hæmatites, native arsenic, and malachite.

d. Bulbous or *nodular*, as in nodular flint and martial pyrites.

e. Liquiform, as in a singular variety of galena, from Freyberg.

C. Flattened. Of the particular forms of this denomination there are three kinds.

a. Specular, as in compact galena, and compact red ironstone.

b. In *laminæ* or *leaves*, which form is peculiar to metals, as in native gold and silver.

c. Pectinated, as in quartz from Schemnitz.

D. Impressed. Particular forms of these afford six varieties.

a. Cellular, of which there are several kinds, as,

α. Straight cellular, which presents two varieties. 1. Hexahedral, as in quartz; 2. Polyhedral, as in cellular quartz and calcareous spar.

β. Round cellular, as, 1. Parallel round, as in quartz; 2. Spongiform, as also in quartz; 3. Indeterminate, as in brown iron stone; 4. Double, as in quartz and hepatic pyrites; 5. Veiny, as in white cobalt ore.

b With impressions, which are,

α Cubical, as in quartz and fluor spar.

β. Pyramidal, as in quartz, fluor spar, and vitreous silver ore.

γ. Conical, as in native arsenic and quartz.

δ. Tabular or *prismatic*, as in quartz.

ε. Globular, as in vitreous silver ore.

c. Perforated, as in lowland argillaceous iron ore.

d. Corroded, as in quartz, galena, and vitreous silver ore.

e. Heteromorphous, as in native iron, swampy iron ore, and native arsenic.

f. Vesicular, as in lavas, pumice stones, basalt and wacken.

E. Confused, of which there is only one variety.

a. Ramose, as in native iron, sometimes native copper, and vitreous silver ore.

3. *Regular External Forms* or *Crystallizations*.

In describing crystallizations or regular forms of minerals, four things are to be considered; the essential quality of the crystals; the form, aggregation, and magnitude.

A. The essential quality of crystals, which is either genuine or spurious.

a. Genuine or *true crystals*, which are the most common, as in calcareous and fluor spars.

b. Spurious or *after crystals*, which are distinguished from true crystals by being hollow, having a rough or drusy surface, and the solid angles or edges never sharp or well defined. Examples are found in quartz of the spurious crystals of the cube, and of the octahedron of fluor spar.

B. Form of crystals. This is the most conspicuous property of crystals, and commonly serves as a distinctive character of those minerals which have regular forms. The form of crystals is composed of planes; of edges formed by the junction of two planes; of determinate angles, and of solid angles formed by the union of three or more planes in one point.

α. In the form of crystals, the primary or fundamental forms are first to be considered, and then the variations or modifications of these forms.

I. The parts of the primary form are,

1. Planes, which are either

a. Lateral planes, forming the confines of the body towards its smallest extent; or, *b.* Extreme or terminal planes, which form the confines of the body towards its greatest extent.

2. Edges, which are,

a. Lateral edges, or, *b.* Extreme edges.

3. Solid angles, which have been defined above.

II. Kinds of primary forms, which are the seven following.

1. *The Icosahedron*, which is composed of 20 equilateral triangular planes, united under equal angles, as in iron pyrites.

2. *The Dodecahedron*, which is composed of twelve regular, pentangular planes, united under equal obtuse angles, as in iron pyrites, and white cobalt ore.

3. *The Hexahedron*, including the cube and the rhomb, is composed of six quadrilateral planes, as in calcareous spar, fluor spar, iron pyrites, galena, &c.

4. *The Prism*, which is one of the most common crystallizations among minerals, is composed of an indeterminate number of quadrangular lateral planes, having the same direction, and all terminating in two extreme planes, each of which has as many sides as the crystallization possesses lateral planes; as in various lead ores, rock crystal, topaz, and shorl.

5. *The Pyramid* is composed of an indeterminate number of triangular, lateral planes, converging to a point,

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point, and of a base having as many sides as the crystallization has lateral planes; as in quartz, calcareous spar, and amethyst.

6. *The Table*, which is composed of two parallel lateral planes, much larger in comparison than the other planes; the extreme planes being indeterminate in number, small, and narrow; as in tabular crystallized specular iron ore, calcareous spar, and heavy spar.

7. *The Lens*, consists of two lateral planes only, differing according as the lateral planes are differently curved. Of this there are two kinds: 1. The common lens, composed of two convex lateral planes; and 2. The selliform, consisting of one convex and one lateral plane, somewhat resembling a saddle. Crystals of both kinds are observed in sparry iron ore and calcareous spar.

III. Differences in each kind of primary forms.

These primary forms differ from each other according to simplicity, position, number of planes, size of the planes, angles under which they meet, direction of the planes, and fulness of the crystal.

1. *Simplicity*. This distinction is confined to the pyramid, which is either,

A. *Simple*, as in light red silver ore, gray copper ore, quartz, amethyst; and

B. *Double*, in which those of the one pyramid are either.

a. Set on the lateral planes of the other, and this *α*. directly, or *β* obliquely; or *b*. on the lateral edges of the other. Examples of this are observed in double pyramidal vitreous silver ore, galena, rock crystal, ruby, and diamond.

2. *Position*, which is either

A. *Erect*, which is very common; or B. *Inverted*, which has only been observed in simple hexahedral pyramidal crystals of calcareous spar.

3. *Number of planes*, in the primary form, is in some determinate, and in the others variable. Here are to be considered,

A. The kind of planes, as

a. In the prism and pyramid, in which the lateral planes vary; and, *b*. In the table, in which the extreme planes vary.

B. The number of planes, which in the prism and pyramid are found,

a. *Trihedral*, having three planes, as in the trihedral prism of shorl, and the trihedral pyramid of gray copper ore.

b. *Tetrahedral*, having four planes, as in the tetrahedral prism of arsenical pyrites, and in the double tetrahedral pyramid of ruby and galena.

c. *Hexahedral*, as in the hexahedral prism and pyramid of calcareous spar.

d. *Octahedral*, as in the octahedral prism of topaz; and in the double octahedral pyramid of garnet and zeolite.

The table occurs,

a. *Quadragonal*, having four extreme planes, as in heavy spar, yellow lead ore, and calamine.

b. *Hexagonal*, having six extreme planes, as in mica and heavy spar.

c. *Octagonal*, or with eight extreme planes, as in yellow lead ore and heavy spar.

4. *The size of the planes* in relation to each other, which are said to be

A. Equal, or

B. Unequal; and this latter is either indeterminate, or determinate.

a. *Indeterminate*, which is observed in the lateral planes of the hexahedral prism of rock crystal.

b. *Determinately unequal*, as in prismatic white lead ore, and hexahedral prismatic calcareous spar. In this latter the following varieties are observed.

α. Alternately broad and narrow. *β*. The two opposite broader; and, *γ*. The two opposite narrower.

5. *Angles under which the planes are associated.* These are angles of the lateral edges, of the extreme edges, and of the summit.

A. *Angles of the lateral edges*. These are,

a. *Equiangular*, as in the icosahedral crystals of iron pyrites.

b. *Rectangular*, as in cubical fluor spar.

c. *Oblique angular*, as in rhomboidal calcareous spar.

d. *Unequiangular*, as in the hexahedral prism of rock crystal, and in the octahedral prism of topaz.

B. Angles of the extreme edges are,

a. *Equiangular*, as in the hexagonal table of mica.

b. *Rectangular*, as in the quadragonal table of heavy spar.

c. *Oblique angular*, which is either, *α*. Parallel, as in the tetrahedral prism of feldspar; or, *β*. Alternate oblique angular, as in copper pyrites.

d. *Unequiangular*, as in the hexagonal table of prehnite.

C. Angles of the summit, which are confined to the pyramid, and present the following varieties.

a. *Very obtuse*, when the angle is from 150° to 130°, as in tourmalin.

b. *Obtuse*, when the angle is from 130° to 110°, as in calcareous spar.

c. *Rather obtuse*, from 110° to 90°, as in honey stone.

d. *Rectangular*, as in zircon

e. *Rather acute*, from 90° to 70°, as in quartz.

f. *Acute*, from 70° to 50°, as in calcareous spar.

g. *Very acute*, from 50° to 30°, as in sapphire.

6. *The direction of the lateral planes*. These are either straight or curvated.

A. *Straight planes* are even surfaces, and are the most common.

B. *Curvated planes* are distinguished according to position and form.

a. *Position*, which is, *α*. Inwardly curvated or concave; or, *β*. Outwardly curvated or convex; and, *γ*. Inwardly and outwardly curvated, or concave and convex. The first is observed in fluor spar, the second in diamond, and the third in sparry iron stone.

b. *The form* is either, *α*. Spherical, as in brown spar; *β*. Cylindrical, in which the curvature runs, 1. Parallel to the sides, as in iron pyrites, or, 2. Parallel to the diagonal, as in fluor spar; and, *γ*. Conical, as in gypsum.

7. *The fulness of the crystal*. Crystals are either full and perfect, or hollowed at the extremity, or throughout.

A. Full or perfect crystals, which is most commonly the case.

B. Hollowed

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B. Hollowed at the extremity, as in calcareous ſpar, green lead ore, &c.

C. Hollow through the whole cryſtal, as in priſmatic beryl.

β. Modifications of the primary form.

The changes or alterations which take place on the principal or fundamental form, are three; truncation, bevelling, and acumination.

I. Truncation. In the truncation are to be conſidered the parts and the determination.

1. The parts of the truncation are the planes, the edges, and the angles.

2. The determination of the truncation relates to,

a. The ſituation as it occurs at the angles or edges of the primary form.

b. Its magnitude, which, in relation to the planes of the primary form, is ſmall or large: in the one caſe the angles or edges are ſaid to be ſlightly, in the other deeply truncated.

c. The application of the truncation, which is either direct or oblique. The edges of cubical iron pyrites afford an example of oblique truncation.

d. The direction of the truncation, which preſents either an even or a curvated ſurface.

Cubical galena, with truncated angles; tetrahedral priſmatic tin ſtone cryſtals, with truncated edges; double tetrahedral pyramidal tin ſtone cryſtals, with truncated edges, are inſtances of truncation.

II. Bevelling, in which the parts and determination are alſo to be conſidered.

1. The parts of the bevelling are, the planes, the edges, and the angles. The bevelling edges are diſtinguiſhed into the proper bevelling edge, which is formed by the conjunction of the bevelling planes, and the bevelling edges formed by the junction of the bevelling planes with the lateral planes of the primary form.

2. The determination of the bevelling, in which is to be obſerved.

A. Its ſituation as it takes place, *a*. At the extreme planes, which is confined to the priſm and table; *b*. At the edges, which is met with in the hexahedron, priſm, pyramid, and table; and, *c*. At the angles, which is a very rare occurrence.

B. Its magnitude, which is ſaid to be ſlight or deep.

C. The angle under which the bevelling planes conjoin, which is ſaid to be, *a*. Acutely, *b*. Rectangularly, or, *c*. Obtuſely bevelled.

D. The continuation of the bevelling, which is either uninterrupted, or interrupted. Of the latter caſe there are two varieties, when it is once or twice interrupted. The lateral edges of double trihedral pyramidal calcareous ſpar are once interruptedly bevelled; and the obtuſe extreme edges of quadrangular tabular heavy ſpar, are twice interruptedly bevelled.

E. The application, *a*. Of the bevelling itſelf, which is either direct or oblique (the former is the moſt common, and the latter occurs in priſmatic baſaltic hornblende); and, *b*. Of the bevelling planes, which are ſet, either on the lateral planes, or on the lateral edges.

III. The acumination, in which are alſo to be conſidered the parts of the acumination and the determination.

1. The parts of the acumination conſiſt of,

A. The acuminating planes. B. The acuminating edges: which are diſtinguiſhed into, *a*. Proper edges of acumination, formed by the junction of the acuminating planes; *b*. The extreme edges of acumination; *c*. The edges between the acuminating and lateral planes. C. The angles of acumination.

2. The determination of the acumination relating to,

A. Its ſituation, as it occurs at, *a*. The ſolid angles; or, *b*. At the extreme planes of the primary form. The acumination of the priſm is always at the extreme planes; of the cube uſually at the angles, and of the pyramid generally at the ſummit.

B. The planes themſelves, in which are to be obſerved.

a. Their number, which is either equal to, or fewer than thoſe of the primary form. In the hexahedral priſm of calcareous ſpar and garnet, and in the trihedral priſm of tourmaline, the acumination is by three planes; in the tetrahedral priſm of jargon and hyacinth, by four planes; in the hexahedral priſm of calcareous ſpar and rock cryſtal, by ſix planes; and in tetrahedral priſmatic topaz, by eight planes.

b. Their relative ſize, which is either equal or unequal. In quartz and rock cryſtal, the planes of acumination are generally indeterminately unequal; and in heavy ſpar they are determinately equal.

c. Their form, which is determinate, as in hyacinth and calcareous ſpar; or indeterminate, as in jargon and wolfram.

d. Their application, which is either on the lateral planes of the primary form, as in jargon and hyacinth, or on the lateral edges, as in calcareous ſpar and garnet.

C. The ſummit of the acumination, which is, *a*. Obtuſe, as in hexahedral priſmatic garnet; *b*. Rectangular, as in tetrahedral priſmatic jargon; or, *c*. Acute, as in hexahedral priſmatic calcareous ſpar.

D. The magnitude of the acumination, which is ſaid to be, *a*. Slightly acuminated, as in gray copper ore and copper pyrites; or, *b*. Deeply, as in fluor ſpar, with the angles acuminated by 6 planes.

E. Determination of the acumination; which is either a point or a line. The firſt is the moſt common; and the laſt is met with in priſmatic white lead ore and heavy ſpar.

γ. Manifold modifications of the primary form.

In theſe modifications cryſtals are either, 1. Situated beſide each other; or, 2. Placed the one above the other.

But in deſcribing a cryſtallization, the number of its planes in general, and of each kind in particular, and their figure, if determinate, may be noticed, to render the deſcription more accurate. As, for inſtance, cubical galena, with truncated angles, conſiſts of 6 octangular and 4 triangular planes.

And ſtill further, in explaining the form of cryſtallizations, by way of addition may be mentioned,

1. The different modes of determination of which they are capable. Two different modes may in ſome caſes be adopted.

a. The repreſentative, by which is underſtood the deſcription of a cryſtallization according to its apparent form; or,

b. The derivative, which is founded on the conſideration of its derivation, and its relation to the other cryſtals of the ſame mineral. The priſmatic cryſtallization of the tourmaline is repreſentatively an enneahedral

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dral prism, and derivative[*] a trihedral prism, with the three lateral sides bevelled.

But, in general, the chief or essential form of a crystallization is determined by, *a*. The largest planes; *b*. The greatest regularity; *c*. The most frequent occurrence of the crystallizations; *d*. The affinity to the other primary forms; *e*. The suitableness and peculiarity of its modifications; and, *f*. The greatest simplicity in the mode of determination.

2. The transitions from one primary form into another. These arise,

a. From the gradually increased extent of the modifying planes, and the decreased extent of the primary planes; or,

b. From a change in the relative size of the planes; or,

c. From a change in the angles under which the planes are associated; or,

d. From the convexity of the planes; or,

e. From the aggregation of crystals.

3. The difficulties which are opposed to the exact determination of crystals. These proceed, *a*. From their compression, some planes being uncommonly large or small; or, *b*. From their penetrating each other, as in tin-stone crystals; or, *c*. From their partial concealment, as in feldspar, hornblende, and garnet; or, *d*. From their being broken, as often happens in the crystallization of precious stones; or, *e*. From their extreme minuteness.

C. The aggregation of crystals. According to this, crystals are either,

a. *Single*, in which case they are, *α*. Loose or detached, as in precious stones, cubical iron pyrites, &c.; *β*. Inhering or inlaying in another mineral, as feldspar in porphyry; or, *γ*. Adhering, as in quartz crystals; or,

b. *Aggregated*, which are either regular or irregular.

α. Regular or determinate; such are, 1. Twin crystals, as in staurolite or cross stone; and, 2. Triple crystals, as in calcareous spar and ruby: but this is very rare.

β. Many singly aggregated crystals, are such crystals as are, 1. Heaped upon one another, as in calcareous and fluor spars; 2. Adhering laterally, as in amethyst crystals; and, 3. Implicated one in the other, as in gray antimonial ore, and in the hexahedral prisms of calcareous spar.

γ. Many doubly aggregated crystals are distributed according to the form they assume; such as the following, are enumerated.

1. *Scopiform*, when aggregated, needle-like, and capilliform crystals diverge from a common centre, as in zeolite, striated red cobalt ore, and capilliform pyrites.

2. *Fasciform*, which is composed of double scopiform, with a common centre, as in calcareous spar, zeolite, and prehnite.

3. *Acicular* or *columnar*. Elongated, equally thick prisms adhering laterally together, are of this description, as in acicular heavy spar, and a variety of white lead ore.

4. *In a row*, like a string of pearls, as in pyramidal crystals of quartz.

5. *Bud-like*, in simple pyramids whose bases are connected, and whose joints are directed towards each other, as in bud-like drusen of quartz.

6. *Globular*, a casual aggregation, consisting mostly of tables or cubes, arranged in a globular form, as in octahedral iron pyrites.

7. *Amygdaloid*, when the tables are externally accumulated, smaller upon smaller, as in heavy spar.

8. *Pyramidal*, which takes place chiefly in prisms nearly parallel, the summits inclining to each other; the central prism being the highest, as in calcareous spar.

9. *Rose-like*, composed of thin tables, on whose lateral planes others are assembled, and arranged in a rose-like appearance.

D. The magnitude of crystals, which is determined,

a. According to the greatest dimension, as *α*. Of an uncommon size, in crystals which exceed two feet, as in quartz and rock crystal; *β*. Very large, from two feet to six inches, as in rock crystal and calcareous spar; *γ*. Large, from six to two inches, as in iron pyrites, fluor spar, and garnet; *δ*. Of a middling size, from two inches to half an inch, which are very common; *ε*. Small, from half an inch to one-eighth of an inch, also very common; *ζ*. Very small, from one-eighth of an inch to such as may be distinguished by the naked eye, as in corneous silver ore, and very small tin stone crystals; *η*. Minute, whose form cannot be distinguished by the naked eye, as in native gold and green lead ore.

b. According to relative dimensions, when compared with others; and this is distinguished into *α*. Short or low, and long or high; *β*. Broad and narrow, or longated; *γ*. Thick and thin, or slender; *δ*. Needle-like and capilliform; *ε*. Spicular, and *ζ*. Globular or tessular.

4. Extraneous external forms, or petrifactions, which are divided into petrifactions of animals, and petrifactions of vegetables.

A. Petrifactions of animals, or zoolites, as

a. Of the class mammalia, the parts of which commonly found are the bones, the teeth, horns, and skeletons. Such are the bones of the elephant and the rhinoceros, which are found in Siberia, and the bones of the mammoth from North America.

b. Of birds, petrifactions of which are very rare. Some skeletons of aquatic birds have been met with in limestone near Oening.

c. Of amphibious animals, such as those of the tortoise, found in the same vicinity as the bones of the elephant; of frogs and toads, in the swine stone of Oening; and of an animal resembling a crocodile in aluminous shale near Whitby in Yorkshire.

d. Of fishes, of which whole fishes, skeletons, and impressions, have been found in different places.

e. Of insects, petrifactions of which are not very common, excepting insects, such as crabs, which have been frequently observed.

f. Of vermes, of which numerous petrifactions are found belonging to the orders *testacea*, *crustacea*, and *corallina* or corals.

B. Petrifactions of vegetables, which are less numerous in the mineral kingdom than those of animals. These are distinguished into

a. *Petrified wood*, the most usual of which are petrifactions of the trunk, branches, or roots of trees, and commonly

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commonly conſiſting of ſiliceous ſubſtances, as wood-ſtone, jaſper, horn ſtone.

b. Impreſſions of leaves and plants, which are not uncommon in the ſtrata of coal countries, particularly in the ſhale, ſand ſtone, the argillaceous iron ſtone, and the coal itſelf.

II. THE EXTERNAL SURFACE, which is the ſecond particular generic character of ſolid minerals; and this is,

1. *Uneven*, having irregular elevations and depreſſions, as in calcedony.

2. *Granular*, when the elevations are ſmall, round, and nearly equal, as in ſtalactitical brown hæmatites.

3. *Druſy*, having minute, prominent, equal cryſtals on the ſurface, as in iron pyrites and quartz cryſtals.

4. *Rough*, when the elevations are minute and almoſt imperceptible, as in cellular quartz.

5. *Scaly*, when the ſurface is compoſed of ſlender ſplinters like ſcales, as in chryſolite.

6. *Smooth*, as in hæmatites and fluor ſpar.

7. *Streaked*, which is either ſingly or doubly ſtreaked.

A. Singly ſtreaked ſurfaces are,

a. Tranſverſely, as in rock cryſtals; *b.* Longitudinally, as in topaz and priſmatic ſhorl; *c.* Diagonally, as in ſpecular iron ore; and *d.* Alternately, as in ron pyrites.

B. Doubly ſtreaked, which is,

a. Plumiformly, or like a feather, as in native ſilver and native biſmuth; and

b. Retiformly, as in gray cobalt ore.

8. *Rugoſe*. Of ſlight linear elevations, as in calcedony.

III. THE EXTERNAL LUSTRE, in which are to be determined,

1. The intenſity of the luſtre, which is diſtinguiſhed into different degrees, as

A. *Reſplendent*, which is the ſtrongeſt kind of luſtre, as in native quickſilver, galena, and rock cryſtal.

B. *Shining*, as in gray copper ore, heavy ſpar, and pitch-ſtone.

C. *Weakly ſhining*, as in iron pyrites, fibrous gypſum, and garnet.

D. *Glimmering*, as in earthy talc, in the fracture of flint, and of ſteatites.

E. *Dull*, as in moſt friable minerals, as in earthy lead ore, mountain-cork, chalk, &c.

2. The kind of luſtre, which is either common or metallic.

A. The common luſtre belongs chiefly to earthy ſtones and ſalts. It is diſtinguiſhed into

a. Glaſſy, as in quartz and rock cryſtal.

b. Waxy or *greaſy*, as in opal, and in yellow and green lead ores.

c. Pearly, as in zeolite.

d. Diamond, as in white lead ore and diamond.

e. Semimetallic, as in mica and hæmatites.

B. Metallic luſtre, which is peculiar to metals and moſt of their ores, as native gold and native ſilver, copper pyrites, and galena.

Appearance of the fracture.

Here, as in the external appearance, three kinds of characters preſent themſelves; I. The internal luſtre; II. The fracture; III. The form of the fragment.

I. *The internal luſtre*, the characters of which are to be determined in the ſame manner as the external luſtre.

II. The *Fracture*, which is either compact or jointed.

1. The compact fracture, which is diſtinguiſhed into ſplintery, conchoidal, uneven, earthy, and hackly.

A. *Splintery*, which is either

a. Coarſe ſplintery, as in quartz, praſe, and jade; or

b. Fine ſplintery, as in hornſtone and fine ſplintery limeſtone.

B. *Even*, which happens in minerals that are uſually opake, and have only a glimmering luſtre, as in compact galena, calcedony, and yellow carnelian.

C. *Conchoidal*, which is diſtinguiſhed,

a. According to the ſize, into large and ſmall.

b. According to the appearance, into perfect and imperfect; and

c. According to the depth, into deep and flat.

Flint, opal, jaſper, and obſidian, afford examples of the conchoidal fracture.

D. *Uneven*, which is either,

a. Of a coarſe grain, as in copper pyrites.

b. Of a ſmall grain, as in gray copper ore, and

c. Of a fine grain, as in arſenical pyrites.

E. *Earthy*, which is the common fracture in earths and ſtones, as in marl, chalk, limeſtone.

F. *Hackly*, in which the fracture exhibits ſharp points, which is peculiar to the metals, as in native gold and native copper.

2. The jointed fracture. This is divided into the fibrous, ſtriated, foliated, and ſlaty.

A. The fibrous fracture, in which are to be obſerved,

a. The thickneſs of the fibres, as they are coarſe, fine, or delicate, as gypſum, fine fibrous malachite, and in wood-tin-ore.

b. The direction of the fibres, which are ſtraight, as in red hæmatites, and gray antimonial ore; or curved, as in black hæmatites, and fibrous rock ſalt.

c. The poſition of the fibres, which is *α.* Parallel, as in rock ſalt and amianthus: *β.* Diverging, which is, 1. Stelliform, as in black hæmatites, and fibrous zeolite; or 2. Scopiform, as in fibrous malachite: or *γ.* Promiſcuous, as in gray antimonial ore.

d. The length of the fibres, which is *α.* Long, as in gypſum and amianthus; or *β.* Short, as in red hæmatites.

B. Striated, in which are to be conſidered,

a. The breadth of the ſtriæ, which are, *α.* Narrow, as in azure copper ore; *β.* Broad, as in actynolite and hornblende; or *γ.* Very broad, as in ſapphire and zeolite.

b. The direction of the ſtriæ, which is either, *α.* Straight, as in gray ore of manganeſe; or *β.* Curved, as in zeolite and actynolite.

c. The poſition of the ſtriæ, which is *α.* Parallel, as in aſbeſtus and hornblende; *β.* Diverging, which is diſtinguiſhed into ſtelliform, as in iron pyrites and zeolite, or ſcopiform, as in actynolite and limeſtone; or *γ.* Promiſcuous, as in gray antimonial ore and actynolite.

d. Length of the ſtriæ, as being *α.* Long ſtriated, as in aſbeſtus and gray antimonial ore; or *β.* Short ſtriated, as in actynolite.

C. *The*

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C. *The foliated fracture*, in which are to be determined,

a. The magnitude of the folia, as being *α.* Large foliated, as in mica and specular gypsum. *β.* Scaly foliated, which is distinguished into 1. Coarse, 2. Small, and 3. Fine scaly foliated, as in micaceous iron ore and gypsum. *γ.* Granularly foliated, which is distinguished into 1. Gross, 2. Coarse, 3. Small, and 4. Fine granularly foliated, as in sparry iron ore, blende, and calcareous spar.

b. The perfectness of the folia, as being *α.* Perfectly foliated, as in feldspar; *β.* Imperfectly foliated, as in topaz; or *γ.* Concealed foliated, as in emerald.

c. The direction of the folia, which is *α.* Straight, as in large foliated blende; or *β.* Curved foliated. The latter is distinguished into 1. Spherically curved, as in heavy spar; 2. Undularly curved, as in talc; 3. Petaloidally curved, as in galena; or, 4. Indeterminately curved, as in mica and specular gypsum.

d. The passage or cleavage of the folia, which is,

α. According to the angle which one passage forms with another; and this is either, 1. Rectangular, or 2. oblique angular; or,

β. According to the number of the cleavages, and is either,

1. A single cleavage, as in mica and talc; 2. A double cleavage, as in feldspar and hornblende; 3. A triple cleavage, as in calcareous spar and sparry iron ore; 4. A quadruple cleavage, as in fluor spar; 5. A sextuple cleavage, as in yellow, brown, and black blende.

D. The slaty fracture, in which are to be determined the thickness and direction of the lamellæ.

a. The thickness of the lamellæ, which is either, *α.* Thick, or *β.* Thin slaty.

b. The direction of the lamellæ, as being either, *α.* Straight, or *β.* Curved slaty; the latter being distinguished into, 1. Undularly, or 2. Indeterminately curved.

In some minerals which possess distinct parts, two kinds of fracture may be observed. Thus, in fibrous gypsum, and in red and brown hæmatites, both the fibrous and foliated fracture appear; the fibres are then intersected by the folia under a certain angle. In topaz, the transverse fracture is foliated, and the longitudinal fracture is conchoidal.

III. The form of the fragments, which is either regular or irregular.

1. Regular fragments, as when they are,

A. Cubical, as in galena and rock salt.

B. Rhomboidal, in which case the fragments are

a. Specular on all the planes, as in heavy spar;

b. On four planes, as in feldspar and hornblende; and,

c. On two planes, as in specular gypsum.

C. Trapezoidal fragments, &c.

D. Trihedral pyramidal fragments are rarely to be seen distinctly, excepting in fluor spar.

D. Dodecahedral fragments, as in blende.

2. Irregular fragments, as when they are,

a. Cuneiform, as in wood-tin-ore, and malachite.

B. Specular, as in amianthus.

C. Tabular, as in mica and talc.

D. Indeterminate, which are the most common among solid minerals, and are distinguished into

a. Very sharp edged, as in obsidian, common opal, and rock crystal.

b. Sharp edged, as in hornstone and quartz.

c. Moderately sharp edged, as in limestone.

d. Rather blunt edged, as in steatites; and

e. Blunt edged, as in chalk and fuller's earth.

3. The appearance of the distinct concretions.

In determining this character, the form of the distinct concretions, the surface of separation, and the lustre of separation, are to be considered.

I. The form of the distinct concretions, which is either granular, lamellar, columnar, or pyramidal.

1. Granular, distinct concretions are distinguished,

A. With respect to the form, into

a. Round granular, which is either *α.* Spherically round, as in roe stone and pisolite; or *β.* Lenticularly granular, as in argillaceous iron stone; or *γ.* Elongated round granular, as in quartz: and,

b. Angularly granular, which is either *α.* Common, as in galena and calcareous spar; or *β.* Elongated annularly granular, as in hornblende and granular limestone.

B. With regard to the size of the concretions. These are,

a. Gross granular, as in zeolite and blende.

b. Coarse granular, as in mica, galena, and pisolite.

c. Small granular, as in roe stone and garnet; and

d. Fine granular distinct concretions, as in granular limestone and galena.

2. Lamellar distinct concretions. The differences to be observed here are, with respect to the direction or form, and the thickness.

A. With respect to the direction or form, they are either,

a. Straight lamellar: and again either quite straight, as in some galena and heavy spar; or fortification-like, as in some amethyst and calcedony.

b. Curved lamellar, which is either indeterminate, as in galena and specular iron ore; reniform, as in fibrous malachite and native arsenic; or concentric, which is either spherical concentric, as in calcedony and pisolite, or conically concentric, as in some stalactites and hæmatites.

B. With regard to the thickness, as being

a. Very thick, the concretions exceeding one-half inch, as in amethyst and heavy spar.

b. Thick, the concretions being between one-half and one-fourth inch, as in heavy spar and native arsenic.

c. Thin, between one-fourth and one-half inch, as in calcedony.

d. Very thin, from a line to a thickness just perceptible to the naked eye, as in specular iron.

3. Columnar distinct concretions, which are distinguished with regard to the direction, thickness, form, and position.

A. The direction, which is either,

a. Straight columnar, as in schorl and calcareous spar, and,

b. Curved columnar, as in argillaceous iron stone, and specular iron ore.

B. The thickness is distinguished into,

a. Very thick, when the diameter exceeds two inches, as in basalt and quartz.

b. Thick

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b. Thick columnar, from two inches to one-fourth inch, as in amethyst and calcareous spar.

c. Thin, from one-fourth to one-half inch, as in calcareous spar and argillaceous iron stone.

d. Very thin, the thickness being less than a line, as in schorl and columnar argillaceous iron stone.

C. The form of the concretions being either

a. Perfectly columnar, as in argillaceous iron stone.

b. Imperfectly, as in amethyst.

c. Cuneiform columnar, as in calcareous spar and arsenical pyrites.

D. The position of the concretions, which is either

a. Parallel columnar, as in schorlite, or

b. Diverging or promiscuous columnar, as in schorl and arsenical pyrites.

4. Pyramidal distinct concretions. This form of concretion is very rare, and has been observed only in the basalt of Iceland, Faro, and Bohemia.

II. The surface of separation, which is distinguished into

1. Smooth, as in wood tin ore.

2. Rough, as in native arsenic.

3. Uneven, as in galena and blende; and

4. Streaked, which is either,

A. Longitudinally streaked, as in schorl and schorlite.

B. Transversely and fortification-like, as in amethyst and specular iron ore.

III. The lustre of separation. This character is to be determined in the same manner as the external lustre.

4. *The General Appearance.*

This comprehends three particular generic characters, the transparency, the streak, and the stain.

I. The transparency, which is distinguished into the following five degrees.

1. Transparent, which is either,

A. Common, as when objects appear single through a transparent mineral; or,

B. Doubling, when objects appear double, as in calcareous spar, or double refracting spar, jargon, and chrysolite.

2. Semitransparent, as in opal and calcedony.

3. Translucent, as in flint, cats eye, and fluor spar.

4. Translucent at the edges, as in hornstone and foliated gypsum.

5. Opake, which is peculiar to minerals of a metallic lustre, as in malachite and jasper.

II. The streak, which is either,

1. Of the same colour, or,

2. Different from that of the mineral, and whose lustre is the same; or,

B. more or less different.

In red silver ore the streak is a dark crimson red; in cinnabar, scarlet red; in green lead ore, greenish-white; in red lead ore, clear lemon yellow.

III. The stain. With respect to this character, minerals are distinguished into such as,

1. Simply stain, and this either strongly or weakly, as gray ore of manganese, and red scaly iron ore; and into such as

2. Both stain and mark, as chalk and plumbago; and,

3. Such as do not stain.

Characters for the Touch.

Characters of this description are, hardness, solidity, frangibility, flexibility, and adhesion to the tongue.

I. The *hardness*, which is determined by the following degrees.

1. Hard, as when a mineral gives fire with steel, but cannot be scraped with the knife. This character is distinguished into,

A. Hard, when the file makes a considerable impression, as in feldspar and schorl.

B. Very hard, on which it makes a weak impression, as in rock crystal and topaz.

C. Extremely hard, on which the file makes no impression, as diamond and emery.

2. Semihard may be slightly scraped with a knife, but gives no fire with steel, as red copper ore, blende, limestone.

3. Soft, easily scraped with the knife, as in galena, mica, asbestus.

4. Very soft, which receives an impression from the nail, as in gypsum, chalk, talc.

II. The *solidity*, according to which solid minerals are distinguished into,

1. Brittle, when the particles are in the highest degree coherent and immoveable, as in quartz, gray copper ore, and copper pyrites.

2. Sectile, when the particles are coherent but not perfectly immoveable among one another, as in plumbago and galena.

3. Malleable, when the integrant particles are coherent and also more or less moveable among one another, as in most of the native metals.

III. The *frangibility*, with regard to which solid minerals are either,

1. Very difficultly frangible, as native metals, and massive common hornblende.

2. Difficultly frangible, as in prase, massive quartz, and asbestus.

3. Rather easily frangible, as iron pyrites, vitreous copper ore.

4. Easily frangible, as in galena, opal, and heavy spar.

5. Very easily frangible, as in amber and pitcoal.

IV. The *flexibility*, according to which solid minerals are,

1. Flexible, which is distinguished into,

A. Common, as in malleable minerals, amianthus, gold ore.

B. Elastic, as in mica, elastic mineral pitch from Derbyshire.

2. Inflexible, such minerals as break when the direction of the fibres is changed.

V. The *adhesion to the tongue*, according to which some minerals possess this property

1. Strongly, as in hydrophane.

2. Rather strongly, as in bole and lithomarga.

3. Weakly, as talc.

4. Very weakly, as in clay.

5. No adhesion at all, as is the case with most minerals.

Characters for the Hearing.

I. The sound, which is distinguished into

1. Ringing or sounding, as in native arsenic and common slate.

2. Creaking, as in native amalgam when pressed with the finger.

3. Rustling,

3. Ruſtling, as in paſſing the finger over mountain cork and farinaceous zeolite.

2. Particular generic characters of friable minerals. The characters included under this title are the external form, the luſtre, the appearance of the particles, the ſtain and the friability.

I. The external form, which is either *maſſive*, as in porcelain earth; *interſperſed*, as in black ſilver ore; as a *thick or thin cruſt*, as in black copper ore; *ſpumiform*, as in red and brown ſcaly iron ores; *dendritic*, as gray ore of manganeſe; or *reniform*, as pure clay and earthy talc.

II. The luſtre, which is determined as in ſolid minerals; but here it is diſtinguiſhed,

1. With regard to intenſity, as

A. Glimmering, as in earthy talc and ſcaly iron ore; and,

B. Dull, as in earthy lead ore and lithomarga.

2. With regard to the kind, as it is *common* or *metallic*.

III. The appearance of the particles, which is either,

1. Duſty, as in black copper ore, iron ochres.

2. Scaly, as in earthy talc.

IV. The ſtain is diſtinguiſhed in friable minerals as being either

1. Strong, as in ſcaly iron ore.

2. Weak, as in earthy lead ores.

V. The friability, with regard to which friable minerals are either

1. Pulverulent, as earthy lead ores, and blue martial earth.

2. Looſely coherent, as ſcaly iron ore and clays.

3. Particular generic characters of fluid minerals. Theſe characters relate to the external form, the luſtre, the tranſparency, the fluidity, and the wetting of the fingers.

I. The external form, which is either,

1. In globules; and, 2. Liquiform; both which characters belong to native mercury.

II. The luſtre, which is determined as formerly explained, and is either 1. Common; or 2. Metallic, as in native mercury.

III. The tranſparency, of which three degrees are diſtinguiſhed in fluid minerals: 1. Tranſparent, as in naphtha; 2. Turbid, as in petroleum; 3. Opake, as in native mercury.

IV. The fluidity, which is characteriſed by being, 1. Perfectly fluid, as mercury, and, 2. Coheſive, as in mineral tar.

V. The wetting of the fingers. 1. Some fluid minerals wet the fingers, as mineral tar; and, 2. Some do not, as native mercury.

Remaining Common Generic External Characters.

The remaining common generic characters are the unctuoſity; the coldneſs; the weight; the ſmell; and the taſte.

III. The unctuoſity, of which there are four degrees.

1. Meagre, as is the caſe with moſt minerals.

2. Rather greaſy, as pipe clay.

3. Greaſy, as fullers earth and ſteatites.

4. Very greaſy, as talc and plumbago.

IV. The coldneſs, which includes three degrees.

1. Cold, having the coldneſs of quartz, as hornſtone, jaſper, marble.

2. Rather cold, as ſerpentine, gypſum.

3. Slightly cold, as amber, pitcoal, and chalk.

By this character cut and poliſhed ſtones may be diſtinguiſhed, where ſome of the other characters are loſt; and by it alſo natural gems may be diſtinguiſhed from thoſe which are artificial.

V. The weight.—This character is moſt accurately diſcovered by taking the ſpecific gravity of a mineral by means of a hydroſtatic balance. See HYDRODYNAMICS. But when this cannot be had recourſe to, a mineral is examined by lifting it in the hand and comparing its weight, thus eſtimated by the feeling, with its volume, by which means an approximation may be made to its ſpecific gravity. Five degrees of this mode of eſtimating the weight of minerals have been aſſumed.

1. Supernatant, ſuch minerals as ſwim in water, as naphtha, mountain cork.

2. Light, ſuch minerals as have a ſpecific gravity between 1.000 and 2.000, (taking water at 1.000) as amber, mineral pitch, and pitcoal.

3. Rather heavy, are ſuch minerals as have a ſpecific gravity between 2.000 and 4.000, which is the caſe with moſt kinds of ſtones, as amianthus, rock cryſtal, mica, fluor ſpar, diamond.

4. Heavy, when the ſpecific gravity is from 4.000 to 6.000, as in moſt metallic ores, ſuch as gray copper ore, red hæmatites, white lead ore, and in ſome others as heavy ſpar.

5. Extremely heavy, when the ſpecific gravity exceeds 6.000, which includes the native metals, as native gold, native copper, and native ſilver, and ſome others, as galena, tinſtone cryſtals, ſulphurated biſmuth, and vitreous ſilver ore.

VI. The ſmell is characteriſtic of only a ſmall number of minerals. It is obſerved either,

1. Of itſelf without addition, and is,

A. Bituminous, as mineral pitch and naphtha.

B. Slightly ſulphureous, as in native ſulphur and gray antimonial ore.

C. Bitteriſh, as in ochre kept cloſe ſhut up for ſome time.

D. Clayey, as in yellow chalk.

2. After breathing on a mineral, which ſhould be cold and breathed upon ſtrongly and quickly, when the ſmell perceived is,

A. Clayey bitter, as in hornblende and ſome ſienites.

3. After rubbing or ſtriking, when the ſmell emitted is,

A. Urinous, as in ſwineſtone after rubbing.

B. Sulphureous, as in pyrites.

C. Garlic, as in arſenical pyrites and white cobalt ore.

D. Empyreumatic, as in quartz and pitcoal.

VII. The taſte, which is characteriſtic of one claſs of minerals, only, viz. the ſalts; and it is either,

1. Sweetiſh ſaline, as rock ſalt.

2. Sweetiſh aſtringent, as native alum.

3. Souriſh aſtringent, as native vitriol.

4. Bitter ſaline, as native epſom ſalt.

5. Cooling ſaline, as native nitre.

6. Lixivious, as native alkali.

7. Urinous, as native ſal ammoniac.

Beſide the characters which we have now illuſtrated, ſome others are occaſionally and ſucceſsfully employed in the deſcription of minerals. Theſe have been brought under

Claſſification.

under the denomination of phyſical, chemical, and empirical characters.

1. *Phyſical.* The moſt common of the phyſical characters is the property which ſome minerals poſſeſs of exhibiting ſigns of electricity and magnetiſm. Some minerals become electric by being heated, and others by friction; and the electricity thus excited is in ſome vitreous or poſitive, and in others reſinous or negative. Some minerals, too, and particularly ſome varieties of iron ore, are diſtinguiſhed by being attracted by the magnet. Such are magnetic pyrites, and magnetic iron ſand. By filing a mineral ſo fine that the particles ſhall ſwim on water, and then applying a magnet, the ſlighteſt degree of magnetic effect may be obſerved. Among the phyſical properties of minerals alſo, may be reckoned the phoſphoreſcence, which is produced by friction, as in ſome varieties of blende; or by expoſure to heat, as fluor ſpar, and ſome calcareous ſpars. To theſe characters alſo belongs the peculiar property of Lemnian earth and ſome other boles, which being thrown into water ſplit into pieces with a crackling noiſe; and the property of ſome opals and other ſtones, of acquiring a higher degree of tranſparency when they are immerſed in water, hence called hydrophanes.

2. *Chemical characters.*—By ſome ſimple experiments, the nature of many mineral ſubſtances may be eaſily and quickly aſcertained, and particularly by means of acids. Thus, the nitrous acid is employed to diſcover whether a mineral effervesces, from which character the nature of the mineral can be more certainly known than by any other. Ammonia, or the volatile alkali, diſſolves copper, and aſſumes a blue colour. Acetic acid is ſucceſsfully employed as a teſt of lead, which communicates to the acid a ſweetiſh taſte. By means of heat, and particularly by the uſe of the blowpipe, much knowledge may be obtained of the nature of minerals. Some are volatilized; in others the colour is changed; and while ſome are nearly fuſed at different temperatures, others burn with a flame of peculiar colours.

3. *Empirical characters.*—Among theſe characters, the moſt common is the peculiar efflореſcence which takes place in ſome ores. In copper ores the effloreſcence is green or blue; in iron ores, brown, yellow, or red; in cobalt, peach bloſſom red; and in arſenic, white.

Characters for the diſtinction of minerals may be obtained from the circumſtance of certain minerals being found generally accompanying others; as native arſenic with orpiment; gray copper ore with copper pyrites, and gray ſilver ore; red copper ore with native copper: white cobalt ore is rarely found without nickel; and by attending to this circumſtance, it will not be miſtaken for arſenical pyrites.

For the ſake of brevity, Mr Kirwan, and others after him, have adopted a method of expreſſing ſome of the characters by means of numbers. The following table exhibits ſome of theſe characters and correſponding numbers.

Reſplendent, denoted by the number	4.
Shining	3.
Weakly ſhining	2.
Glimmering	1.
Dull	0.
Fragments, when the form is indeterminate.	
Very ſharp-edged	4.
Sharp-edged	3.
Rather ſharp-edged	2.
Rather blunt	1.
Perfectly blunt	0.
Tranſparency.	
Tranſparent	4.
Semitranſparent	3.
Tranſlucent	2.
Tranſlucent at the edges	1.
Opake	0.
Hardneſs.	
Of chalk, denoted by	3.
Yielding to the nail	4.
May be ſcraped with a knife	5.
Yields more difficultly to the knife	6.
Scarcely yields to the knife	7.
Does not give fire with ſteel	8.
Gives feeble ſparks with ſteel	9.
Gives lively ſparks	10.

But it is obvious that this abridged mode of expreſſing theſe characters, by means of numbers, can only be advantageouſly employed by thoſe who have made themſelves quite familiar with the different numbers correſponding to the different ſhades of character, and who can thus recollect them with facility and preciſion. To others this method of deſcription, by requiring conſtant reference to the explanation, may prove rather embarraſſing, ſo that what is gained in brevity may be loſt in perſpicuity. We propoſe therefore, ſtill to retain the verbal mode of expreſſion in preference to the numerical.

TABLE OF MINERALS arranged in the order of their Genera and Species, each Genus being divided into Families or Groupes, the characters of which latter are derived from their external properties according to the method of Werner.

FIRST CLASS.

EARTHS & STONES.

I. DIAMOND Genus.

Diamond.

II. ZIRCON Genus.

Zircon.
Hyacinth.

III. SILICEOUS Genus.

Chryſolite Family.

Chryſoberyl.
Chryſolite.
Olivine.
Coccolite.
Augite.
Veſuvian.

Garnet Family.

Leucite.
Melanite.
Garnet.
a. Precious.
b. Common.
c. Bohemian or Pyrope.
Grenatite or Staurolite.

Ruby Family.

Ceylanite.
Spinelle.
Sapphire.
Corundum.
Adamantine ſpar.
Emery.

Classification.

Schorl Family.
Topaz.
Pyrophysalite.
Euclase.
Emerald.
Beryl.
Schorlite.
Schorl.
a. Common.
b. Electric or Tourmaline.
Pistazite.
Zoisite.
Axinite or Thumerstone.
Quartz Family.
Quartz.
a. Amethyst.
Common.
Fibrous.
b. Rock crystal.
c. Rose-coloured or milk quartz.
d. Common quartz.
e. Prase.
f. Ferruginous quartz, or iron flint.
Hornstone.
a. Splintery.
b. Conchoidal.
c. Ligniform.
Flinty slate.
a. Common.
b. Lydian stone.
Flint.
Calcedony.
a. Common.
b. Carnelian.
Opal.
a. Precious.
b. Common.
d. Ligniform.
Menilite.
Jasper.
a. Egyptian.
b. Ribband.
c. Porcelain.
d. Common.
e. Agate.
f. Opal.
Heliotrope or Bloodstone.
Chrysoprase.
Plasma.
Cats eye.
Pitchstone Family.
Obsidian.
Pitchstone.
Pearlstone.
Pumice.
Zeolite Family.
Prehnite.
a. Fibrous.
b. Foliated.
Zeolite.
a. Mealy } Mesotype.
b. Fibrous }
c. Radiated } Stilbite.
d. Foliated }
Cubizite, Chabasie or Analcime.
Cross-stone, Staurolite.
Laumonite.
Dipyre.
Natrolite.
Azurite.
Lazulite.
Hydrargillite.
Feldspar Family.
Andalusite.
Feldspar.
a. Adularia.
b. Labradore stone.
c. Common feldspar.
d. Compact.
e. Hollow spar, chiastolite.
Scapolite.
Arctizite or Wernerite.
Diaspore.
Spodumene.
Meionite.
Sommite.
Ichthyophthalmite.
IV. ARGILLACEOUS Genus.
Clay Family.
Native alumina.
Porcelain earth.
Common clay.
a. Loam.
b. Pipe clay.
c. Potters clay.
d. Variegated clay.
e. Slaty clay.
Claystone.
Adhesive slate.
Polishing slate.
Tripoli.
Floatstone.
Alum stone.
Clay Slate Family.
Aluminous schistus.
a. Common.
b. Shining.
Bituminous schistus.
Drawing slate.
Whet slate.
Clay slate.
Mica Family.
Lepidolite.
Mica.
Pinite.
Potstone.
Chlorite.
a. Earthy.
b. Common.
c. Foliated.
d. Schistose.
Trap Family.
Hornblende.
a. Common.
b. Basaltic.
c. Labradore.
d. Schistose.
Basalt.
Wacken.
Phonolite or Clinkstone.
Lava.
Lithomarga Family.
Green earth.
Lithomarga.
a. Friable.
b. Indurated.
Rock soap.
Umber.
Yellow earth.
V. MAGNESIAN Genus.
Soap Stone Family.
Native magnesia.
Bole.
Sea froth.
Fullers earth.
Steatites.
Figure stone.
Talc Family.
Nephrite.
a. Common.
b. Axe-stone.
Serpentine.
a. Common.
b. Precious.
Schillerstone.
Talc.
a. Earthy.
b. Common.
c. Indurated.
Asbestus.
a. Mountain cork.
b. Amianthus.
c. Common asbestus.
d. Ligniform asbestus.
Actynolite Family.
Cyanite.
Actynolite.
a. Asbestous.
b. Common.
c. Glassy.
Tremolite.
a. Asbestous.
b. Common.
c. Glassy.
Smaragdite.
Sahlite.
Schalstone.

VI. CALCAREOUS Genus.

Family of *Carbonates*.
Agaric mineral.
Chalk.
Limestone.
a. Compact.
a'. Common.
b'. Oolite or roe-stone.
b. Foliated.
a'. Granular.
b'. Calcareous spar.
c. Fibrous.
a'. Common.
b'. Calcareous sinter.
d. Pisolite or pea-stone.
Calcareous tufa.
Foam earth.
Slaty spar.
Arragonite.
Brown spar.
Dolomite.
Rhomb or bitter spar.
Swinestone.
Marl.
a. Earthy.
b. Indurated.
Bituminous marl slate.
Family of *Phosphates*.
Apatite.
Asparagus stone.
Phosphorite.
Family of *Fluates*.
Fluor.
a. Earthy.
b. Compact.
c. Fluor spar.
Family of *Sulphates*.
Gypsum.
a. Earthy.
b. Compact.
c. Foliated.
d. Fibrous.
Selenite.
Anhydrite.
Cube spar.

VII. BARYTIC Genus.

Family of *Carbonates*.
Witherite.
Family of *Sulphates*.
Heavy spar.
a. Earthy.
b. Compact.
c. Granular.
d. Foliated.
e. Common.
f. Columnar.
g. Fibrous.
h. Bolognian.
VIII. STRONTIAN Genus.
Family of *Carbonates*.
Strontites.
Family of *Sulphates*.
Celestine.
a. Fibrous.
b. Foliated.

SECOND CLASS.

SALTS.

I. Genus SULPHATES.
Native vitriol.
Native alum.
Mountain butter.
Capillary salt.
Native Epsom salt.
Native Glauber salt.

II.

Classification.

II. Genus NITRATES.
Native nitre.
III. Genus MURIATES.
Rock salt.
a. Foliated.
b. Fibrous.
Sea salt.
Native sal ammoniac.
IV. Genus CARBONATES.
Native soda.
Native magnesia.
V. Genus BORATES.
Boracite.
VI. Genus FLUATES.
Cryolite.

THIRD CLASS.

COMBUSTIBLES.

I. Genus SULPHUR.
Native sulphur.
a. Common.
b. Volcanic.
II. BITUMINOUS Genus.
Petroleum, or mineral oil.
Mineral pitch.
a. Elastic.
b. Earthy.
c. Slaggy.
Amber.
a. White.
b. Yellow.
Brown coal.
a. Common.
b. Bituminous wood.
c. Earth coal.
d. Alum earth.
e. Moor coal.
Black coal.
a. Pitch coal.
b. Columnar coal.
c. Slaty coal.
d. Cannel coal.
e. Foliated coal.
f. Coarse coal.
Coal blende.
a. Conchoidal.
b. Slaty.
III. GRAPHITE Genus.
Graphite.
a. Scaly.
b. Compact.
Mineral charcoal.

FOURTH CLASS.

METALLIC ORES.

I. PLATINA Genus.
Native platina.
II. GOLD Genus.
Native gold.
a. Golden yellow.
b. Brass yellow.
c. Grayish yellow.
III. MERCURY Genus.
Native mercury.
Native amalgam.
Corneous ore of mercury.
Liver ore of mercury.
a. Compact.
b. Slaty.
Cinnabar.
a. Common.
b. Fibrous.
IV. SILVER Genus.
Native silver.
a. Common.
b. Auriferous.
Antimonial silver ore.
Arsenical silver ore.
Corneous silver ore.
Sooty silver ore.
Vitreous silver ore.
Brittle vitreous silver ore.
Red silver ore.
a. Dark red.
b. Bright red.
White silver ore.
Black silver ore.
V. COPPER Genus.
Native copper.
Vitreous copper ore.
a. Compact.
b. Foliated.
Variegated copper ore.
Copper pyrites.
White copper ore.
Gray copper ore.
Black copper ore.
Red copper ore.
a. Compact.
b. Foliated.
c. Capillary.
Brick-red copper ore.
a. Earthy.
b. Indurated.
Emerald copper ore.
Azure copper ore.
a. Earthy.
b. Indurated.
Malachite.
a. Fibrous.
b. Compact.
Green copper ore.
Ferruginous green copper ore.
a. Earthy.
b. Slaggy.
Micaceous copper ore.
a. Foliated.
b. Lenticular.
Muriate of copper.
VI. IRON Genus.
Native iron.
Iron pyrites.
a. Common.
b. Radiated.
c. Capillary.
d. Hepatic.
Magnetic pyrites.
Magnetic iron ore.
a. Common.
b. Arenaceous.
Specular iron ore.
a. Common.
a'. Compact.
b'. Foliated.
b. Micaceous iron ore.
Red iron ore.
a. Red iron froth.
b. Compact.
c. Red hæmatites.
d. Red ochre.
Brown iron ore.
a. Brown iron froth.
b. Compact.
c. Brown hæmatites.
d. Brown ochre.
Sparry iron ore.
Black iron ore.
a. Compact.
b. Black hæmatites.
Argillaceous iron stone.
a. Red chalk.
b. Columnar argillaceous iron stone.
c. Granular.
d. Common.
e. Reniform.
f. Pisiform.
Bog iron stone.
a. Morassy.
b. Swampy.
c. Meadow.
Blue earthy iron stone.
Green earthy iron stone.
VII. LEAD Genus.
Galena.
a. Common.
b. Compact.
Blue lead ore.
Brown lead ore.
Black lead ore.
White lead ore.
Green lead ore.
Red lead ore.
Yellow lead ore.
Native sulphate of lead.
Earthy lead ore.
a. Friable.
b. Indurated.
VIII. TIN Genus.
Tin pyrites.
Common tinstone.
Grained tin ore.
IX. BISMUTH Genus.
Native bismuth.
Vitreous bismuth.
Ochre of bismuth.
X. ZINC Genus.
Blende.
a. Yellow.
b. Brown.
c. Black.
Calamine.
a. Compact.
b. Foliated.
XI. ANTIMONY.
Native antimony.
Gray ore of antimony.
a. Compact.
b. Foliated.
c. Radiated.
d. Plumose.
Red ore of antimony.
White ore of antimony.
Ochre of antimony.
XII. COBALT Genus.
White cobalt ore.
Gray cobalt ore.
Shining cobalt ore.
Black cobalt ochre.
a. Friable.
b. Indurated.
Brown cobalt ochre.
Yellow cobalt ochre.
Red cobalt ochre.
a. Earthy.
b. Radiated.
XIII. NICKEL Genus.
Copper-coloured nickel.
Nickel ochre.
XIV. MANGANESE Genus.
Gray ore of manganese.
a. Radiated.
b. Foliated.
c. Compact.
d. Earthy.
Black ore of manganese.
Red ore of manganese.
XV. MOLYBDENA Genus.
Sulphuret of molybdena.
XVI. ARSENIC Genus.
Native arsenic.
Arsenical pyrites.
a. Common.
b. Argentiferous.
Orpiment.
a. Yellow.
b. Red.
Native oxide of arsenic.
XVII. TUNGSTEN Genus.
Wolfram.
Tungstate of lime.
XVIII. TITANIUM Genus.
Menachanite.
Octahedrite.
Titanite.
Nigrine.
Brown ore.
Iserine.
XIX. URANIUM Genus.
Pitchy ore.
Micaceous uranite.
Uranite ochre.
XX. TELLURIUM Genus.
Native tellurium.
Graphic ore.
Yellow ore.
Black or foliated ore.
XXI. CHROMIUM Genus.
Needle ore.
Ochre of chromium.
XXII. COLUMBIUM Genus.
XXIII. TANTALIUM Gen.
XXIV. CERIUM Genus.

Diamond genus.

Classification.

I. Genus. DIAMOND.

One Species. Diamond.

Id. Kirwan, I. 393. *Le Diamant*, Brochant, II. 153. Haüy, III. 287.

Essential character.—Scratches all other minerals.

External characters.—Its most common colours are grayish white and yellowish white; smoke gray and yellowish gray; clove brown; sometimes asparagus green, passing to pistachio green and apple green; sometimes a wine yellow and citron yellow, and also blue and rose red.

When the diamond is cut, it presents a splendid and varied play of colours, which is one of its most striking characters.

It is found sometimes in rounded grains, which are supposed to have been crystals with the edges worn; but it is most frequently met with crystallized.

The primitive form is a regular octahedron, the integrant molecule a regular tetrahedron; but the form which it commonly assumes is the spheroidal, with 48 curvilineal faces, six of which correspond to the same face of the primitive octahedron. Besides this form there are various others, as the double three-sided pyramid, the dodecahedron, &c. All the modifications of the crystals of the diamond, Haüy observes, seem to be the effects of its tendency to crystallize in a regular figure of 48 plane faces, which, if it ever has existed, has not yet been discovered; and it is easy to conceive that this form would be produced by intermediate decrements on all the angles of the nucleus; but the deviations from this form seem to have been occasioned by its precipitate formation.

The external lustre is from four to one; internal four. The fracture is straight foliated, with a fourfold cleavage, parallel to the faces of the octahedron; transparency four to three; hardness ten; brittle; specific gravity 3.518 to 3.600. Becomes positively electric by friction, even before it is polished.

Chemical character.—When exposed to a sufficient temperature, it is entirely consumed. This has been fully ascertained by the experiments of modern chemists, from which it is concluded, that the diamond is entirely composed of pure carbone. See Chemistry.

Mr Boyle was the first, according to Henckel, who subjected the diamond to the action of heat, and in his experiments he found that it exhaled very copious and acrid vapours. This was about the year 1673; but in the year 1694 the experiment was repeated by the order of Cosmo III. grand duke of Tuscany. Diamonds were exposed to the heat of the powerful burning glass of Tschirnhausen, the action of which was even aided by means of another burning glass; and about the end of 30 seconds a diamond of 20 grains lost its transparency, separated into small pieces, and was at last entirely dissipated. The same experiment was repeated on other diamonds, always with the same result, and without exhibiting the least sign of fusion. Newton, in his treatise on Optics, has placed the diamond among combustibles, supposing that it is a coagulated unctuous substance. He had been led to this by observing its extraordinary refractive power, which in combustible bodies he found to be in a ratio considerably higher than their density. According to this general law he concluded, that the diamond as well as water contained an inflammable principle, both of which have since been verified. Newton's treatise was not published till 1704; but it appears that part of it was composed and read to the Royal Society in the year 1675, nearly 20 years before the Florentine experiments were made.

But nearly 70 years before this latter period, Boetius de Boodt, in his History of Stones, appears to have been perfectly satisfied, from an experiment which he describes, that the diamond was of an inflammable nature. This document, which we presume will gratify the curiosity of many of our readers, is too singular to be omitted. "Mastix deinde calefieri parum, quemadmodum et adamas debet, idque, ut impositus ac supra positus mastici statim illi unione vera uniatur, ac vivos undique radios a se jaceat. Hanc unionem respuunt aliæ omnes gemmæ diaphanæ—cur vero legitimus adamas solus tincturam illam recipiat, aliæ gemmæ non, difficile est scire. Existimo mutuum illum et amicum amplexum *propter similitudinem aliquam quam habent in materia et qualitatibus;* hoc est, tota utriusque natura fieri, quod itaque mastix *quæ igneæ naturæ est* adamanti facile jungi possit, signum est; id propter materiæ similitudinem fieri, *ac adamantis materiam igneam, et sulphuream esse*, atque ipsius humidum intrinsicum et primogenium cujus beneficio coagulatus est; *plane fuisse oleosum et igneum*, aliarum vero gemmarum aqueum.—Non mirum itaque si pinguis, oleosa, et ignea masticis substantia illi absque visus termino adpingi et applicari, aliis vero gemmis non possit." *Boetius de Boodt, Gem. et Lapid. Hist.* Hanoviæ, 1609. 4to, lib. ii. cap. 1.

For the sake of the English reader we shall translate this curious document. "If mastich and the diamond be exposed to heat, and brought into contact, they enter into perfect union, and emit a very lively flame, which does not take place in any other gem. But what is the reason that the diamond alone possesses this property? I am of opinion that this mutual combination arises from a certain resemblance which each of the substances possesses in its nature and properties: on this account, therefore, the mastich, which is of a combustible nature, may be united to the diamond from a similarity in their nature, which shows that the diamond is composed of *combustible* and sulphureous matter; and that the humid and original particles of its composition, by means of which it was coagulated, or assumed a solid form, have been decidedly of an oily and *inflammable* nature, while those of other gems have been of an aqueous nature. It is not, therefore, surprising that the fat, oily, and combustible substance of mastich may enter into intimate union with the diamond, but cannot be combined with other gems."

Localities, &c.—The diamond is found in various places of the East Indies, as in the provinces of Golconda and Visapour, in the peninsula of Hither India; and in the kingdoms of Pegu and Siam, in the peninsula of Farther India, and nearly, it is observed, in the same degree of latitude. In 1728 the diamond was discovered in Brasil, in the district of Serro-do-Frio, which is situated in the same southern latitude as the countries which produce the diamond on the north side of the equator. The native repository of the diamond, so far as is known, is a ferruginous soil, but whether it

be

Classification. be produced on the ſpot where it is diſcovered, or have been tranſported from the place of its origin, has not been aſcertained. It is found alſo in veins filled with ſoil of a ſimilar nature. We ſhall here add a ſhort hiſtory of the diamond mines.

15 Diamond mines

The diamond mines are found only in the kingdoms of Golconda, Viſapour, Bengal, the iſland of Borneo, and Braſil. There are four or five mines, or rather three mines and two rivers, whence diamonds are obtained. The mines are, 1. That of Raolconda, in the province of Carnatica, five days journey from Golconda, and eight from Viſapour. It has been diſcovered about 200 years. 2. That of Gani, or Coulour, ſeven days journey from Golconda eaſtward. It was diſcovered 150 years ago by a peaſant, who digging in the ground found a natural fragment of 25 carats. 3. That of Soumelpour, a large town in the kingdom of Bengal, near the Diamond-mine. This is the moſt ancient of all: it ſhould rather be called that of *Goual*, which is the name of the river, in the ſand whereof theſe ſtones are found. 4. The fourth mine, or rather the ſecond river, is that of Succudan, in the iſland of Borneo; and 5. That of Serro-do-Frio in Braſil.

Diamond-mine of Raolconda.—In the neighbourhood of this mine the earth is ſandy, and full of rocks and copſe-wood. In theſe rocks are found ſeveral little veins of half and ſometimes a whole inch broad, out of which the miners, with a kind of hooked irons, draw the ſand or earth wherein the diamonds are; breaking the rocks when the vein terminates, that the track may be found again, and continued. When a ſufficient quantity of earth or ſand is drawn forth, they waſh it two or three times, to ſeparate the ſtones. The miners work quite naked, except a thin linen cloth before them; and beſides this precaution, have likewiſe inſpectors, to prevent their concealing diamonds, which, however, they frequently find means to do, by watching opportunities when they are not obſerved, and ſwallowing them.

Diamond-mine of Gani or Coulour.—In this mine are found a great number of diamonds from 10 to 40 carats, and even more. It was here that the famous diamond of the Great Mogul, which before it was cut weighed 793 carats, was found. The diamonds of this mine are not very clear: their water is uſually tinged with the quality of the ſoil; being black where that is marſhy, red where it partakes of red, ſometimes green and yellow, if the ground happen to be of thoſe colours. Another defect of ſome conſequence is a kind of greaſineſs appearing on the diamond, when cut, which takes off part of its luſtre.—There are uſually no leſs than 60,000 perſons employed in this mine.

When the miners have found a place where they intend to dig, they level another ſomewhat bigger in the neighbourhood thereof, and incloſe it with walls about two feet high, only leaving apertures from ſpace to ſpace, to give paſſage to the water. After a few ſuperſtitious ceremonies, and a kind of feaſt which the maſter of the mine makes for the workmen, to encourage them, every one goes to his buſineſs, the men digging the earth in the place firſt diſcovered, and the women and children carrying it off into the other walled round. They dig a few feet deep, and till ſuch time as they find water. Then they ceaſe digging; and the water thus found ſerves to waſh the earth two or three times, after which it is let out at an aperture reſerved for that end. This earth being well waſhed, and well dried, they ſift it in a kind of open ſieve, and laſtly, ſearch it well with the hands to find the diamonds. This mine is in a plain of about one league and a half in extent, bounded on one ſide by a river, and on the other by a range of lofty mountains, which form a ſemicircle. It is ſaid that the nearer the digging is carried to the mountains, the diamonds are the larger. Diamond genus.

Diamond-mine of Soumelpour, or river Goual.—Soumelpour is a conſiderable town near the river Goual, which runs into the Ganges. It is from this river that all our fine diamond points, or ſparks, called *natural ſparks*, are brought. They never begin to ſeek for diamonds in this river till after the great rains are over, that is, after the month of December; and they uſually even wait till the water is grown clear, which is not before January. The ſeaſon at hand, eight or ten thouſand perſons, of all ages and ſexes, come out of Soumelpour and the neighbouring villages. The moſt experienced among them ſearch and examine the ſand of the river, and particularly where it is mixed with pyrites, going from Soumelpour to the very mountain whence it ſprings. When all the ſand of the river, which at that time is very low, has been well examined, they proceed to take up that wherein they judge diamonds likely to be found; which is done after the following manner: They dam the place round with ſtones, earth, and faſcines, and throwing out the water, dig about two feet deep: the ſand thus got is carried into a place walled round on the bank of the river. The reſt is performed after the ſame manner as at other mines.

Diamond mine in the iſland of Borneo, or river of Succudan.—We are but little acquainted with this mine; ſtrangers being prohibited from having acceſs to it: though very fine diamonds have been brought to Batavia by ſtealth. They were formerly imagined to be ſofter than thoſe of the other mines; but experience ſhows they are in no reſpect inferior.

Diamond mine of Serro-do-Frio.—A deſcription of this mine was given by D'Andrada in 1792, to the Natural Hiſtory Society of Paris. The mine is ſituated to the north of Villa Rica, in the 18th degree of ſouth latitude. The whole country in which the diamonds are found abounds with ores of iron; and the ſtratum of ſoil, immediately under the vegetable ſoil, contains diamonds diſſeminated in it, and attached to a gaugue or matrix which is more or leſs ferruginous; but they are never found in veins.

When this mine was firſt diſcovered, the ſearching for diamonds was ſo ſucceſsful, that the Portugueſe fleet which arrived from Rio de Janeiro in 1730 brought no leſs than 1146 ounces of diamonds. This unuſual quantity introduced into the market immediately reduced the price; and to prevent this circumſtance recurring, the Portugueſe government determined to limit the number of men employed in the mines.

16 Method of cutting and poliſhing diamonds.

As the diamond is the hardeſt of all ſubſtances, it can only be cut and poliſhed by itſelf. To bring it to that perfection which augments its price ſo conſiderably, the lapidaries begin by rubbing ſeveral againſt each other, while rough; after having firſt glued them to the ends of two wooden blocks, thick enough to be

held

Diamond genus.

held in the hand. It is this powder thus rubbed off the ſtones, and received in a little box for the purpoſe, that ſerves to grind and poliſh them.

Diamonds are cut and poliſhed by means of a mill, which turns a wheel of ſoft iron ſprinkled over with diamond-duſt mixed with oil of olives. The ſame duſt, well ground, and diluted with water and vinegar, is uſed in the ſawing of diamonds; which is performed with an iron or braſs wire, as fine as a hair. Sometimes, in lieu of ſawing the diamonds, they cleave them, eſpecially if there be any large ſhivers in them.

The method of cutting and poliſhing the diamond was not diſcovered till the 15th century. The diamonds which were employed as ornaments before that period, were in their rough and natural ſtate. The invention is aſcribed to Louis Berguen, a native of Bruges, who in the year 1476, cut the fine diamond of Charles the Bald, duke of Burgundy, which he loſt the ſame year at the battle of Morat. This diamond was then ſold for a crown, but afterwards came into the poſſeſſion of the duke of Florence.

The *firſt water* in diamonds means the greateſt purity and perfection of their complexion, which ought to be that of the pureſt water. When diamonds fall ſhort of this perfection, they are ſaid to be of the *ſecond* or *third* water, &c. till the ſtone may be properly called a *coloured one*.

17 Of eſtimating.

The value of diamonds is eſtimated by Mr Jefferies by the following rule. He firſt ſuppoſes the value of a rough diamond to be ſettled at 2l. per carat, at a a medium; then to find the value of diamonds of greater weights, multiply the ſquare of their weight by 2, and the product is the value required. *E. g.* to find the value of a rough diamond of two carats: $2\times2=4$, the ſquare of the weight; which, multiplied by two, gives 8l. the true value of a rough diamond of two carats. For finding the value of manufactured diamonds, he ſuppoſes half their weight to be loſt in manufacturing them; and therefore, to find their value, we muſt multiply the ſquare of double their weight by 2, which will give their true value in pounds. Thus, to find the value of a wrought diamond weighing two carats; we firſt find the ſquare of double the weight, viz. $4\times4=16$; then $16\times2=32$. So that the true value of a wrought diamond of two carats is 32l. On theſe principles Mr Jefferies has conſtructed tables of the price of diamonds from 1 to 100 carats.

18 Celebrated diamonds.

The greateſt diamond ever known in the world is one belonging to the king of Portugal, which was found in Braſil. It is ſtill uncut: and Mr Magellan informs us, that it was of a larger ſize; but a piece was cleaved or broken off by the ignorant countryman, who chanced to find this great gem, and tried its hardneſs by the ſtroke of a large hammer upon the anvil.

This prodigious diamond weighs 1680 carats: and although it is uncut, Mr Romé de l'Iſle ſays, that it is valued at 224 millions ſterling; which gives the eſtimation of 79,36 or about 80 pounds ſterling for each carat: viz. for the multiplicand of the ſquare of its whole weight. But even in caſe of any error of the preſs in this valuation, if we employ the general rule above mentioned, this great gem muſt be worth at leaſt 5,644,800 pounds ſterling, which are the product of 1680 by two pounds, viz. much above five millions and a half ſterling. But this gem is ſuppoſed by ſome to be a white topaz.

Claſſification.

The famous diamond which adorns the ſceptre of the empreſs of Ruſſia under the eagle at the top of it weighs 779 carats, and is worth at leaſt 4,854,728 pounds ſterling, although it hardly coſt 135,417 guineas. This diamond was one of the eyes of a Malabarian idol, named *Scharingham*. A French grenadier, who had deſerted from the Indian ſervice, contrived ſo well as to become one of the prieſts of that idol, from which he had the opportunity to ſteal its eye: he run away to the Engliſh at Trichinopoly, and thence to Madras. A ſhip-captain bought it for twenty thouſand rupees: afterwards a Jew gave ſeventeen or eighteen thouſand pounds ſterling for it: at laſt a Greek merchant named *Gregory Suffras*, offered it to ſale at Amſterdam in the year 1766: and Prince Orloff made this acquiſition for his ſovereign the empreſs of Ruſſia. This diamond is of a flattened oval form and of the ſize of a pigeon's egg.

The diamond of the great Mogul is cut in roſe; weighs $279\frac{9}{10}$ carats, and it is worth 380,000 guineas. This diamond has a ſmall flaw underneath near the bottom: and Tavernier, page 389, who examined it, valued the carat at 150 French livres. Before this diamond was cut, it weighed $793\frac{5}{8}$ carats, according to Romé de l'Iſle: but Tavernier, page 339, of his ſecond volume, ſays, that it weighed 900 carats before it was cut. If this be the very ſame diamond, its loſs by being cut was very extraordinary.

Another diamond of the king of Portugal, which weighs 215 carats, is extremely fine, and is worth at leaſt 369,800 guineas.

The diamond of the grand duke of Tuſcany, now of the emperor of Germany, weighs $139\frac{1}{2}$ carats; and is worth at leaſt 109,520 guineas. Tavernier ſays, that this diamond has a little hue of a citron colour; and he valued it at 135 *livres tournoiſes* the carat. Robert de Berquen ſays, that this diamond was cut into two: that the grand Turk had another of the ſame ſize: and that there were at Biſnagar two large diamonds, one of 250 and another of 140 carats.

The diamond of the late king of France, called the *Pitt* or *Regent*, weighs $136\frac{3}{4}$ carats: this gem is worth at leaſt 208,333 guineas, although it did not coſt above the half of this ſum. Patrin ſays, that it is believed to be at Berlin, (I. 226.) and we may add, that it has probably been carried back to France among other ſpoils.

The other diamond of the ſame monarch, called the *Sancy*, weighs 55 carats; it coſt 25,000 guineas: and Mr Dutens ſays, that it is worth much above that price.

Brilliant DIAMOND, is that cut in faces both at top and bottom; and whoſe table, or principal face at top, is flat. To make a complete ſquare brilliant, if the rough diamond be not found of a ſquare figure, it muſt be made ſo; and if the work is perfectly executed, the length of the axis will be equal to the ſide of the ſquare baſe of the pyramid.—Jewellers then form the table and collet by dividing the block, or length of the axis, into 18 parts. They take $\frac{5}{18}$ from the upper part, and $\frac{1}{18}$ from the lower. This gives a plane at $\frac{4}{18}$ diſtance from the girdle for the table; and a ſmaller plane at $\frac{5}{18}$ diſtance for the collet; the breadth of which will be

Classification.

be $\frac{1}{5}$ of the breadth of the table. In this ſtate the ſtone is ſaid to be a *complete ſquare table* diamond.—The brilliant is an improvement on the table-diamond, and was introduced within the 17th century, according to Mr Jefferies.

II. Genus. ZIRCON.

1. Species. Zircon.

Jargon, Kirw. I. 257. *Zircon*, Haüy, II. 465. *Id.* Brochant, I. 159.

Eſſen. Char.—Its ſpecific gravity about 4.4; the joints natural, ſome of which are parallel, and others are oblique to the axis of the cryſtals.

Exter. Char.—Colours reddiſh and yellowiſh, greeniſh, greeniſh yellow, and whitiſh. The colour in general varies from green to gray, and is moſt commonly pale; and the poliſhed ſtone exhibits in ſome degree the play of colours of the diamond.

It is found in rounded, angular, or flattened grains, or in ſmall angular fragments with notched edges, and alſo cryſtallized. The primitive form is an octahedron with iſoſceles triangles, and the integrant molecule is an irregular tetrahedron. The following are the moſt common forms of its cryſtals.

1. A priſm with four rectangular faces, each baſe of which has a pyramid with four faces placed on the four lateral faces, which terminates ſometimes in a line, but moſt frequently in a point.
2. The preceding cryſtal, in which the oppoſite lateral edges of the priſm are truncated.
3. The cryſtal (1) in which the edges of the faces of the pyramid are bevelled.
4. The cryſtal (1.) having the lateral edges of the priſm, and the ſummit of the pyramid truncated.
5. The cryſtal (1.) in which the angles between the priſm and the pyramid are bevelled.
6. A priſm with four faces, having the two oppoſite narrow, and the two others broad.
7. A double pyramid with four faces, with the edges of the common baſe truncated.
8. The perfect octahedron with obtuſe angles.

The cryſtals are commonly ſmall; the ſurface ſmooth, but that of the angular fragments is rough. Luſtre, 3 and 4; internal luſtre, 4 and 3; ſomewhat vitreous, or approaching to that of the diamond. Fracture imperfect or flat conchoidal; fragments, 3. Tranſparency, 4, 3. Cauſes double refraction. Hardneſs, 9; brittle. Spec. grav. 4.416 to 4.4700.

Chem. Char.—Infuſible by the blow-pipe without addition, but with borax it forms a tranſparent colourleſs glaſs. The following are its conſtituent parts.

Zirconia	70
Silica	26
Iron	1
Loſs	3
	100

Localities.—The zircon was firſt found in Ceylon, accompanied with cryſtals of ſpinelle and tourmaline, in a river near the middle of the iſland; and more lately it has been found in Norway, in a rock compoſed of feldſpar and hornblende.

Zircon genus.

Uſes.—The zircon is employed as a precious ſtone, and particularly as an ornament in mourning.

2. Species. Hyacinth.

Id. Kirw. I. 257. *Zircon*, Haüy, II. 465. *L'Hyacinthe*, Brochant, I. 163.

Eſſen. Char.—The ſame as the firſt ſpecies.

Exter. Char.—The moſt common colour is what is called hyacinth red, blood red, and yellowiſh brown.

It is found in rounded grains, and frequently in cryſtals, the primitive form of which is the ſame as the firſt ſpecies. The cryſtals are,

1. A priſm with four faces.
2. The ſame ſlightly truncated on its edges.
3. The double pyramid with four faces, or a very obtuſe octahedron, which is a rare variety.
4. A priſm with ſix faces, each baſe of which is terminated by an acumination with three faces, placed alternately on the three lateral edges, forming the rhomboidal dodecahedron.

The cryſtals are commonly ſmall, the ſurface ſmooth; external luſtre, 3, 4; internal, 4; greaſy: fracture ſtraight foliated; cleavage double, rectangular; fragments, 3; tranſparency, 4, 2; cauſes double refraction; hard and brittle; unctuous to the touch when cut; ſpec. grav. 4.385 to 4.620.

Chem. Char.—By the action of the blow-pipe the hyacinth loſes its colour, but retains its tranſparency. It is infuſible without borax, which converts it into a tranſparent colourleſs glaſs.

Conſtituent Parts.

	From Ceylon.	From Expailly.	
Zirconia	70	64.5	66
Silica	25	32	31
Oxide of iron	0.5	2	2
Loſs	4.5	1.5	1
	100. Klap.	100.0 Vauq.	100 Vauq.

Localities.—It is found in Ceylon in ſimilar ſituations with the former; in Brazil, Bohemia, and in the rivulet Expailly, in Velay in France; and alſo in the neighbourhood of Piſa in Italy.

Uſes.—As it is ſuſceptible of a fine poliſh, the hyacinth has been ranked among precious ſtones.

Remarks.—The analogy between the cryſtalline forms of the zircon and hyacinth; their double refraction; the ſimilarity of their other characters, and particularly the reſults of chemical analyſis, have led Haüy to form them into one ſpecies.

A variety, under the name of *cinnamon ſtone*, has been conſidered as a diſtinct ſpecies; but the differences are ſo very ſlight, that it may be included in the deſcription of the preceding.

III. Genus. SILICEOUS.

1. Species. Chrysoberyl.

Id. Emm. Wid. Lenz. Kirw. *Chryſopale*, Lam. *Cymophane*, Haüy.

Exter. Char.—The colour is an aſparagus green; paſſing

paſſing ſometimes to a greeniſh white, and ſometimes to an olive green; ſometimes bright brown and yellowiſh brown, paſſing to yellowiſh gray; affords a feeble change of colour from bluiſh to milky white.

It is found in angular or rounded grains, which appear to have been water worn; and in cryſtals, exhibiting, 1. A table with ſix faces, elongated, of various thickneſs, truncated on the terminal edges. 2. A priſm with four rectangular faces. 3. A priſm with ſix faces, of which four are broader and two are narrower oppoſite to each other.

The grains are ſlightly rough, and have a conſiderable external luſtre. The cryſtals are ſtriated lengthwiſe on their lateral faces; the other faces are ſmooth; luſtre external very ſhining—internal the ſame, intermediate between that of the diamond and the vitreous luſtre.

The fracture is in all directions perfectly conchoidal; the fragments are indeterminate with ſharp edges. It has little tranſparency, but a conſiderable degree of hardneſs. Spec. grav. 3.698 to 3.719 Wern. 3.710 Klap. 3.796 Haüy.

Chem. Char.—It is infuſible without addition by the action of the blow-pipe. By Klaproth's analyſis, the following are its conſtituent parts.

Alumina	71.5
Silica	18
Lime	6
Oxide of iron	1.5
Loſs	3
	100

Localities.—Brazil, Ceylon, Siberia.

Uſes.—The hardneſs of the chryſoberyl, and change of colour which it exhibits, have procured it a place among precious ſtones of inferior value. It is known in commerce under the name of *changeable opal* or oriental chryſolite.

2. Species. Chrysolite.

Id. Emm. Wid. Lenz. Muſ. Leſk. Kirw. *Peridot*, Daub. Haüy.

Exter. Char.—The moſt common colour is a bright piſtachio green, paſſing to an olive green; ſometimes of a bright aſparagus or clear meadow green; rarely the green approaches to brown and almoſt to a cherry red.

It is found in angular fragments with the edges a little notched, or in rounded grains, or in cryſtals having the angles and edges a little notched. The forms of its cryſtals are, 1. A large rectangular priſm having its lateral edges truncated and ſometimes bevelled, and terminated by a ſix-ſided priſm, of which two oppoſite ſides are placed on the ſmall lateral faces of the priſm. The four others on the lateral truncated faces, the latter forming a more acute angle than the two former.

2. The next form varies from the preceding, in having two additional terminating faces, placed on the broad faces of the priſm, each of which is conſequently ſituated between two of the planes correſponding to the truncated planes.

3. In another variety the ſummit of the pyramid is truncated by a convex cylindrical plane, the convexity of which paſſes from one of the ſmall oppoſite lateral planes towards the other.

4. In ſome inſtances the cryſtals are ſo ſmall, that the ſmall lateral faces almoſt entirely diſappear, while the two larger aſſume a curved form, giving ſuch cryſtals a tabular appearance.

The external ſurface of the angular fragments and of the rounded cryſtals is ſcaly, which affords an eſſential character to this mineral. The ſmall lateral planes are ſmooth, the broad ones are diſtinctly ſtriated lengthwiſe, Externally the ſurface is ſhining; internally ſhining and vitreous.

The fracture in all directions is perfectly conchoidal; the form of the fragments is indeterminate, with very ſharp edges. It is almoſt always tranſparent, and refracts double; it is not ſo hard as quartz. Brittle. Spec. grav. 3.340 to 3.420 Wern. 3.428 Haüy.

Chem. Char.—By the action of the blow-pipe it is fuſed with borax without effervеſcence, and affords a greeniſh, tranſparent glaſs.

Conſtituent parts.

	Cryſtalliſed.	Cut.	Cryſtalliſed.
Silica	38	39	38
Magneſia	39.5	43.5	50.5
Oxide of iron	19.	19	9.5
Loſs	3.5		2.
	100 Klap.	100.5 Vauq.	100 Vauq.

Localities, &c.—This mineral is brought from the Levant, but it is not known whether it is found in Aſia or Africa. It has been diſcovered in Bohemia; and cryſtallized ſpecimens included in a kind of lava, have been brought from the iſle of Bourbon. As it is uſually found in rounded fragments, in the midſt of earthy ſubſtances, its relative ſituation is ſcarcely known.

Uſes.—The chryſolite has been often employed for various purpoſes as a precious ſtone, but as it poſſeſſes no great degree of hardneſs, it is not much eſteemed.

Subſtances of a very different nature have been, at different times, deſcribed under the name of *Chryſolite*. It appears that the yellow chryſolite of the ancients is the ſame with our topaz, and that their green topaz is our chryſolite. Plin. lib. xxxvii. cap. 8.

3. Species. Olivine.

Id. Emm. Wid. Lenz. Kirw. Lameth. *Chryſolite en grains irreguliers*, De Born. *Peridot Granuliforme*, Haüy. *Chryſolith des Volcans*, of many mineralogiſts.

Exter. Char.—The moſt common colour is a bright olive green, ſometimes of an apple green, piſtachio, or mountain green; a wine, honey, or orange yellow, and ſometimes alſo a reddiſh brown, and browniſh black; but theſe latter varieties are rare. It is found in rounded pieces, from the ſize of the head to that of a grain of millet, moſt commonly included, and diſſeminated in baſalt. It has been found cryſtallized.

Internally,

Classification.

Internally, this mineral varies in its lustre between shining and weakly shining; in the yellow varieties the lustre is between vitreous and resinous.

The fracture is more or less conchoidal; sometimes uneven; the shape of the fragments is indeterminate, with sharp edges. The rounded pieces of a certain size are composed of distinct granular concretions, with small grains.

It is sometimes transparent, and varies to semitransparent and translucent. It is brittle and not so hard as quartz. Spec. grav. 3.225 to 3.265.

Chem. Char.—Olivine is infusible by the action of the blow-pipe; in nitric acid it loses its colour, giving to the liquid a pale yellow colour.

Constituent parts. Klaproth.

Silica	48	to	52.0	52
Magnesia	37		38.5	37.75
Lime	00.25		00.25	0.25
Oxide of iron	12.5		12.	10.75
Loss	2.25			
	100.00	—	102.75	100.75

Localities, &c.—Olivine is found in different countries, as in Bohemia and Saxony, and in Vivarais in France, and most commonly in rounded pieces in the cavities of basalt. Brochant says that it has not been discovered in the basalts of Ireland, England, Sweden, Norway, and Italy. We have, however, collected specimens of olivine among the basaltic rocks of the Giant's Causeway in Ireland.

Olivine and chrysolite are considered by Haüy as one species, and described under the name peridote.

4. Species. COCCOLITE.

Coccolithe, Brochant, ii. 504. Haüy, iv. 355. D'Andrada. Nich. 4to. Jour. v. 495.

Exter. Char.—Colour, meadow green, olive, or blackish green. It is found in masses which are composed of separate pieces, granular, in small grains, which may be easily separated; these grains are angular, and discover some appearance of tendency to crystallization.

Lustre, resplendent, vitreous; fracture foliated; cleavage double, as examined by Haüy, but single according to D'Andrada: it is hard, scratches glass; the grains are often translucent. Spec. grav. 3.316 to 3.373.

Chem. Char.—Coccolite is infusible without addition before the blow-pipe. With borax it melts into a pale yellow transparent glass, and with carbonate of potash into an olive green vesicular glass.

Constituent parts.

Silica	50.0
Lime	24.0
Magnesia	10.0
Oxide of iron	7.0
Oxide of manganese	3.0
Alumina	1.5
Loss	4.5
	100

Localities.—It is found in the iron mines of Hellesta and Assebo in Sudermania, at Nerica in Sweden, and near Arendal in Norway.

Siliceous genus.

5. Species. AUGITE.

Octahedral Basaltine, Kirw. i. 219. *L'Augite*, Brochant, i. 179. *Pyroxene*, Haüy, iii. 80.

Essen. Char.—Divisible, parallel to the sides of an oblique rhomboidal prism, of about 92° and 88°, which is subdivided in the direction of the great diagonals of the bases.

Exter. Char.—Colour, olive green, black, white, and gray. It is found sometimes in rounded pieces, and in grains, but most frequently crystallized. The primitive form is an oblique-angled prism, the bases of which are rhombs; the integrant molecule is an oblique triangular prism. The form of the crystals is generally a six and eight sided prism, which is terminated by a two sided summit. The crystals are commonly small, smooth, and brilliant, sometimes a little shining. Internal lustre shining, and almost resplendent, resinous. Fracture perfectly foliated; cleavage double; translucent at the edges; harder than olivine; gives lively sparks with steel, and scratches glass; rather brittle; spec. grav. 3.226 to 3.777.

Chem. Char.—Fusible before the blow-pipe with difficulty, and only in small fragments, which melt into a black enamel.

Constituent parts.

	From Ætna, Vauquelin.	From Arendal, Roux.
Silica	52	45
Lime	13.20	30.5
Alumina	3.33	3
Magnesia	10	
Oxide of iron	14.66	16
Oxide of manganese	2	5
Loss	4.81	.5
	100.00	100.

Localities, &c.—Augite is found in basalt along with olivine and hornblende, in Bohemia, Hungary, and Transylvania; in the basalt of Arthur's-seat near Edinburgh.

6. Species. VESUVIAN.

La Vesuvienne, Brochant, i. 184. *Idocrase*, Haüy, ii. 574.

Essen. Char.—Divisible, parallel to the faces and diagonals of a rectangular prism, with square bases; melts into a yellow glass.

Exter. Char.—Colour brown, orange, dark green, and yellowish green.

This mineral is found massive, disseminated, or crystallized. Primitive form, a rectangular prism, little different from a cube; integrant molecule a triangular prism. The forms of its crystals are, a rectangular prism, with four sides, truncated on all its edges, or truncated on its lateral edges; or a six-sided prism truncated on all its edges. The crystals are usually small, single sometimes, and sometimes in groups. Lateral planes longitudinally streaked. Some are smooth;

Siliceous genus.

smooth; lustre resplendent, vitreous; internal lustre shining, resinous. Fracture imperfectly conchoidal, sometimes uneven, often also foliated. Fragments indeterminate, with rather sharp edges. Translucent, and almost semitransparent; hard, brittle; specific gravity 3.365 to 3.420.

Chem. Char.—Fusible without addition into a yellow glass.

Constituent Parts. Klaproth.

	From Vesuvius.	From Siberia.
Silica,	35.50	42
Lime,	33.	34
Alumina,	22.25	16.25
Oxide of iron,	7.5	5.50
Oxide of manganese,	.25	an atom.

Localities, &c.—It is found in the neighbourhood of Vesuvius, accompanied by limestone in small grains, feldspar, mica, hornblende, and calcareous spar; and it is supposed to have been thrown out of the volcano unchanged. In Siberia it is found in steatites, sometimes mixed with crystals of magnetic iron.

Uses.—At Naples it is employed as a precious stone.

7. Species. Leucite.

La Leucite, Brochant, i. 188. *Vesuvian*, Kirwan, i. 285. *Amphigene*, Haüy, ii. 559.

Essen. Char.—Divisible, parallel to the faces of a cube, and at the same time to those of a rhomboidal dodecahedron.

Exter. Char.—Colour grayish or yellow white.

It is rarely found massive or in grains, but most frequently crystallized. The primitive from of its crystals is the cube; the integrant molecule an irregular tetrahedron; the most common form of the crystals is a short double pyramid with eight faces opposed base to base, each summit of which is surmounted by an obtuse acumination with four faces, corresponding alternately to the four lateral edges of the pyramid, and thus producing a figure of twenty-four trapezoidal faces; the crystals are commonly small, the surface rough and dull, or at most feebly shining. Internal lustre shining, vitreous. Fracture foliated, sometimes conchoidal. Fragments indeterminate with sharp edges. Semitransparent or translucent. Scarcely scratches glass. Brittle. Spec. grav. 2.455 to 2.490.

Chem. Char.—Infusible before the blow-pipe, but with borax gives a transparent glass.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica,	54	56
Alumina,	24	20
Potash,	21	20
Lime,	—	2
Loss,	1	2
	100	100

Localities, &c.—Leucite is found in the lavas of Vesuvius, and in the basalts of Italy; in basalts and other rocks of Bohemia, and also, it is said, in a granitic rock in the Pyrenees.

Classification.

8. Species. Melanite, or *Black Garnet.*

La Melanite, Brochant, i. 191.

Exter. Char.—Colour velvet black, or brownish or grayish black. It is most commonly found crystallized, in six-sided prisms, terminated at each extremity by an obtuse acumination, with three planes placed alternately on three of the lateral edges; the prisms are sometimes truncated on all the edges, and sometimes only the lateral edges. The surface is smooth and shining. Internal lustre shining. Fracture imperfect, flat, conchoidal. Fragments indeterminate, sharp-edged, opaque, hard, and rather brittle. Spec. grav. 3.691 to 3.800.

Constituent Parts. Vauquelin.

Silica,	35
Alumina,	6
Lime,	32
Oxide of iron and of manganese,	25
Loss,	2
	100

Localities.—It has been found only at Frescati and St Albano near Rome.

9. Species. Garnet.

Le Grenat, Brochant, i. 193. *Garnet*, Kirwan, i. 238. *Grenat*, Haüy, ii. 540.

Essen. Char.—Specific gravity at least 3.5. The forms derived from the rhomboidal dodecahedron.

The primitive form is a rhomboidal dodecahedron. The inclination of each rhomb to the two adjacent is 120°, the plain angles 109° 28′ 16″ and 70° 31′ 44″. The integrant molecule is the tetrahedron, whose faces are isosceles triangles equal and similar.

The garnet is divided into three subspecies, the precious, common, and Bohemian garnet.

Subspecies 1. Precious Garnet.

Exter. Char.—Colour red, of which there are several varieties, as blood red, cherry red, hyacinth red, sometimes brown and even black.

The garnet is rarely found massive or disseminated, but sometimes in rounded grains, and most frequently crystallized, of which the following are the forms.

1. A prism with six sides terminated by a double obtuse summit with three faces, corresponding alternately to the three lateral edges at each end of the prism, and thus forming a rhomboid of twelve faces.

2. The same crystal truncated on all its edges, forming a figure of 36 faces. The faces of the truncations are elongated hexagons.

3. A short double pyramid, with eight faces opposed base to base, the summits of each of which are surmounted by an obtuse acumination, corresponding alternately to the four lateral edges of one of the pyramids,

Classification.

mids, forming a cryſtal of 24 ſides, which are pretty equal trapezoids.

4. The preceding form with twelve truncations; eight on the eight acute alternating angles of the two ſummits, and four on the obtuſe angles of the common baſe of the two pyramids, making in all 36 faces.

The ſurface is a little unequal in the grains, ſmooth in the cryſtals, and almoſt always ſtreaked diagonally. The luſtre varies from ſhining to reſplendent, and is vitreous. Fracture more or leſs perfectly conchoidal, ſometimes uneven or ſplintery, and ſometimes foliated. Fragments indeterminate with ſharp edges. Tranſparent or tranſlucent. Scratches quartz. Refraction ſimple. Brittle. Spec. grav. 4.085 to 4.352.

Chem. Char.—Before the blow-pipe it is fuſible into a dark enamel.

Conſtituent Parts.

	Klaproth.	Vauquelin.
Silica,	35.75	36
Alumina,	27.25	22
Lime,	—	3
Oxide of iron,	36	41
Oxide of mangaueſe,	.25	–
Loſs,	.75	–
	100.00	102

Localities, &c.—The garnet is not uncommon in moſt countries of the world, and it is ſuually found in primitive rocks.

Uſes.—It is employed as a precious ſtone.

The precious garnet is ſuppoſed to be the carbuncle of the ancients.

Subſpecies 2. Common Garnet.

Eſſen. Char.—The ſame as the precious garnet.

Exter. Char.—It is found maſſive and diſſeminated, and alſo ſometimes cryſtallized. The forms of the cryſtals are the ſame as thoſe of precious garnet. The ſurface of the cryſtals is diagonally ſtreaked.

Colour brown, green, greeniſh black, browniſh red, and orange yellow. Luſtre ſhining, reſinous, or vitreous. Fracture uneven, ſometimes ſplintery. Fragments ſharp-edged. Rarely tranſparent, ſometimes tranſlucent, and commonly at the edges; not ſo hard as the precious garnet. Brittle. Spec. grav. from 3.668 to 3.757.

Chem. Char.—Melts before the blow-pipe into a dark enamel, and eaſier than the former.

Conſtituent Parts. Vauquelin.

	Black Garnet.	Yellowiſh Garnet.
Silica,	43	38
Alumina,	16	20
Lime,	20	31
Oxide of iron,	16	10
Water,	4	–
Loſs,	1	1
	100	100

Localities, &c.—The common garnet is found in micaceous ſchiſtus, gneis, ſerpentine, and other primitive rocks, in Saxony, Bohemia, France, Sweden.

Siliceous genus.

Uſes.—It is rarely employed as a precious ſtone, but frequently as a flux for iron ores.

Subſpecies 3. Pyrope, or *Bohemian Garnet.*

Pyrope, Brochant, ii. 498.

Eſſen. Char.—The ſame as the garnet.

Exter. Char.—This mineral is found in ſmall, round angular fragments: it is never cryſtallized.

Colour dark blood red, which, by holding it between the eye and the light, becomes yellow. Luſtre reſplendent, vitreous. Fracture conchoidal. Fragments indeterminate and ſharp-edged. Perfectly tranſparent. Scratches quartz. Spec. grav. 3.718 to 3.941.

Conſtituent Parts. Klaproth.

Silica,	40
Alumina,	28.5
Lime,	3.5
Magneſia,	10
Oxide of iron,	16.5
Oxide of manganeſe,	.25
Loſs,	1.25
	100

Localities, &c.—This mineral is found in ſerpentine in Saxony; the moſt beautiful are from Bohemia, where it is found in alluvial land.

Uſes.—It is employed in jewellery. The ſmall grains are uſed as a ſubſtitute for emery in poliſhing.

This mineral is formed into a ſeparate ſpecies by ſome, and is diſtinguiſhed from the garnet by its colour, want of cryſtallization, and tranſparency; but theſe differences in the external characters Haüy conſiders as inſufficient to conſtitute a different ſpecies of two minerals which agree in a greater number of other characters. Magneſia indeed has been detected in the latter as one of its conſtituents, no trace of which has been yet diſcovered in the former.

10. Species. Grenatite.

Grenatite, Brochant, ii. 496. *Id.* Sauſſure, § 1900. *Staurotide*, Haüy, iii. 93. *Pierre de Croix*, De Liſle, ii. 434.

Eſſen. Char.—Diviſible parallel to the ſides of a rhomboidal priſm, whoſe angles are equal to 129° 30′, and 50° 30′, which may be ſubdivided in the direction of the ſhort diagonals of the baſes.

Exter. Char.—Grenatite is always found cryſtallized. The primitive form is a rectangular priſm with rhomboidal baſes, having the angles inclined, as mentioned in the eſſential character. The integrant molecule is a triangular priſm. It is frequently met with in double cryſtals, croſſing each other in the form of a croſs, from which the name is derived, ſometimes at right angles, and ſometimes obliquely; ſometimes alſo there are oblique triple croſſings. The ſurface is ſmooth and ſhining, or uneven and dull.

The colour is reddiſh or blackiſh brown; internal luſtre ſhining, between vitreous and reſinous. Fracture

Siliceous genus.

imperfectly foliated, in the direction of the axis; in other directions uneven, ſmall grained, or ſometimes a little conchoidal; often opaque, ſometimes tranſlucent. Scratches quartz feebly: ſpecific gravity 3.2861.

Chem. Char.—Before the blow-pipe it becomes brown without fuſion, and is then converted into a fritty ſubſtance.

Conſtituent Parts.

	Vauquelin.
Silica	33.
Alumina	44.
Lime	3.84
Oxide of iron	13.
Oxide of manganeſe	1.
Loſs	5.16
	100.

Localities, &c.—It is found in ſmall cryſtals in micaceous ſchiſtus, at St Gothard in Switzerland, in Brittany in France, and in Spain, in primitive rocks.

11. Species. CEYLANITE.

Pleonaſte, Haüy, iii. 17. *Spinelle Pleonaſte*, Brongniart, i. 438.

Eſſen. Char.—Scratches glaſs ſlightly, and is diviſible into a regular octahedron.

Exter. Char.—This mineral is found in rounded maſſes, and alſo cryſtallized. Primitive form of the cryſtals, a regular octahedron. The integrant molecule a regular tetrahedron. The edges of the octahedron are ſometimes truncated, and form a regular 12 ſided rhomboid. The cryſtals are ſmall; the fracture is conchoidal; the luſtre ſhining and vitreous.

The colour is ſometimes perfectly black, brown, bright blue, purpliſh red, or dark green. It is hard, but not very brittle. Spec. grav. 3.76 to 3.79.

Chem. Char.—Infuſible before the blow-pipe.

Conſtituent Parts.	Deſcotils.
Alumina	68
Magneſia	12
Silica	2
Oxide of iron	16
Loſs	2
	100

Localities, &c.—This mineral is met with in the iſland of Ceylon, along with tourmaline and other cryſtallized ſubſtances, which have been carried from their native repoſitories by means of water. It has been found alſo in diſſeminated cryſtals in the cavities of the lava of Veſuvius; and very ſmall blue cryſtals of ceylanite have been obſerved in the volcanic (baſaltic) rocks at Cloſterlach on the banks of the Rhine.

12. Species. SPINELLE.

Spinel and *Balaſs Ruby*, Kirw. i. 253. *Le Spinel*, Brochant, i. 202. *Spinelle*, Haüy, ii. 496.

Eſſen. Char.—Scratches quartz ſtrongly; the primitive and common form, a regular octahedron.

Claſſification.

Exter. Char.—Spinelle is found in rounded grains, or cryſtallized: the primitive form of the cryſtals is a regular octahedron; the integrant molecule the regular tetrahedron. Its uſual forms are a double pyramid with four faces applied baſe to baſe, conſtituting a perfect octahedron; or it is truncated on all its edges, or only on thoſe of the common baſe of the two pyramids. It is met with alſo in the form of a double cryſtal, compoſed of two octahedrons, which are often flattened.

Colour uſually red, of various ſhades, from carmine red to roſe red; ſometimes reddiſh white, and orange yellow. Faces of the octahedron ſmooth, thoſe of the truncations longitudinally ſtreaked. Luſtre reſplendent, vitreous; fracture conchoidal; the longitudinal fracture is foliated; fragments indeterminate, ſharp-edged; ſemitranſparent, and ſometimes tranſparent. Scratches quartz; is ſcratched by ſapphire. Spec. grav. 3.570 to 3.645.

Chem. Char.—Before the blow-pipe it is infuſible; but with borax it melts, and without frothing up.

Conſtituent Parts.

	Klaproth.	Vauquelin.
Alumina	74.50	82.47
Silica	15.50	—
Magneſia	8.25	8.78
Oxide of iron	1.50	—
Lime	.75	—
Chromic acid	—	6.18
Loſs	—	2.57
	100.5	100

Localities, &c.—Cryſtals of ſpinelle are found in Ceylon, in a river which comes from the high mountains in the middle of that iſland: they are accompanied with zircon, tourmaline, and different other ſtones. It is found alſo in Pegu.

Uſes.—Spinelle is ranked among precious ſtones, and is greatly eſteemed when it is of a certain ſize. It is ſaid that a fine ſpinelle ruby, whoſe weight exceeds four carats, is worth half the price of a diamond of the ſame weight.

13. Species. SAPPHIRE.

Oriental Ruby, *Sapphire*, and *Topaz*, Kirwan, i. 250. *Le Saphir*, Brochant, i. 207. *Teleſie*, Haüy, ii. 480.

Eſſen. Char.—Specific gravity about 4; natural joints very diſtinct, and perpendicular to the axis of the cryſtals.

Exter. Char.—Sapphire is found in fragments, in rounded pieces, and alſo cryſtallized. The primitive form of the cryſtal, according to Haüy, is a regular ſix-ſided priſm, and the integrant molecule is a triangular, equilateral priſm; but, according to Bournon, the primitive form is a rhomboid, whoſe angles are 96° and 84°. The uſual forms of the cryſtals are, 1. A ſmall ſix-ſided priſm. 2. A pyramid with ſix faces, very ſharp, double, the two pyramids applied baſe to baſe. 3. The ſame cryſtal with the ſummit truncated. 4. A pyramid with ſix faces, double; the two pyramids applied baſe to baſe, but leſs ſharp than the ſecond form. The ſurface of the cryſtals is ſmooth, and often ſtreaked tranſverſely.

The

Classification

The principal colour is blue, varying between Prussian and indigo blue; other varieties are of a deep violet blue. Sapphires are also found red, yellowish, and greenish. Two or three colours appear in the same crystal, sometimes in bands and sometimes in concentric circles. Externally, the lustre of the sapphire is shining; internally, resplendent and vitreous. Fracture perfectly conchoidal. Fragments sharp edged; transparent or semitransparent, sometimes only translucent. Scratches all other earthy substances. Brittle. Spec. grav. 3.991 to 4.283.

Chem. Char.—Infusible before the blow-pipe. Melts with borax without intumescence. The blue variety, exposed to a strong heat, loses its colour, Haüy.

Constituent Parts.

	Klaproth.	Bergman.
Alumina	98.5	58.
Silica		35.
Lime	00.5	5.
Oxide of iron,	1.	2.
	100	100

	Sapphire.	Oriental Ruby.
Alumina	92	90
Silica	5.25	7
Oxide of iron	1.	1.2
Loss	1.75	1.8
	100	100

Localities, &c.—The finest sapphires are brought from Pegu and the island of Ceylon. The sapphire is also found in Bohemia, accompanied with zircon, Bohemian garnet, and magnetic iron; and in the river Expailly in France.

Uses.—The sapphire, next to the diamond, is the most highly valued of precious stones.

14. Species. CORUNDUM.

Corindon, Haüy, iii. 1. *Adamantine Spar*, Kirw. i. 335. *Le Spath Adamantin*, Broch. i. 356.

Essen. Char.—Scratches quartz; divisible into a rhomboid somewhat acute.

Exter. Char.—This mineral is found massive, disseminated, and crystallized; 1. In six-sided prisms, having the extremities broken, and the faces sometimes unequal. 2. A six-sided prism, terminated by a six-sided pyramid. 3. A pyramid with six short faces, whose summit is strongly truncated; and, 4. The preceding crystal terminated by a three-sided pyramid. From the investigations of Count de Bournon and Mr Greville, it appears that the crystallization of corundum is similar to that of the sapphire *. Lustre, which is intermediate between resinous and vitreous, shining or weakly shining; cross fracture uneven, or splintery, sometimes foliated; fragments rhomboidal, sometimes sharp-edged.

* Phil. Transf. 1798.

The colour is greenish white, greenish gray, and asparagus green, translucent at the edges; refraction double. Extremely hard. Spec. grav. 3.710 to 3.873.

Chem. Char.— Entirely infusible before the blow-pipe.

Siliceous genus.

Constituent Parts. Klaproth.

	From China.	From Bengal.
Silica	6.5	5.50
Alumina	84.	89.50
Oxide of iron	7.5	1.25
Loss	2.	3.75
	100	100

According to Chenevix.

	From the Carnatic.	From Malabar.
Silica	5	7
Alumina	91	86.5
Oxide of iron	1.5	4
Loss	2.5	2.5
	100	100

Localities.—Corundum is found in a hard rock near the river Cavery, south of Madras; on the Malabar coast; in the island of Ceylon; in the kingdom of Ava; and in China.

15. Species. ADAMANTINE SPAR.

Exter. Char.—This mineral, which ought undoubtedly to be considered as a variety of corundum, is found massive, in rolled pieces, and crystallized in six sided prisms, and six-sided acute pyramids with truncated extremities. Internal lustre splendent; fracture foliated; fragments rhomboidal.

Colour dark hair brown; very hard. Spec. grav. 3.981.

Constituent Parts. Klaproth.

	From China.
Silica,	6.5
Alumina,	84.
Oxide of iron,	7.5
Loss	2
	100

Localities.—This mineral has been only met with in China.

16. Species. EMERY.

Fer Oxydé Quartzifére, Haüy, iv. 112. *Emery*, Kirw. ii. 193. *L'Emeril*, Broch. ii. 292.

Essen. Char.—The powder scratches all bodies except the diamond.

Exter. Char.—This mineral is found massive and disseminated. The lustre is glimmering or weak shining, and adamantine. Fracture fine-grained, uneven; fragments a little blunt edged.

Colour grayish black, bluish, smoke or steel gray; generally opaque, but sometimes translucent at the edges: extremely hard. Spec. gr. about 4.

Chem. Char.—Becomes black under the blow-pipe, but is infusible. Colours borax of a dirty yellow.

Constituent

Siliceous genus.

Classification.

Constituent Parts.

	Tennant.
Alumina,	86
Silica,	3
Oxide of iron,	4
Loss,	7
	100 *

* *Phil. Trans.* 1802. p. 400.

Localities, &c.—This mineral is found in Saxony, disseminated in a bed of indurated steatites, mixed with common talc; also in the island of Naxos in the Archipelago; and in Italy, Spain, and Peru.

Uses.—Emery, as well as the two former species, is employed, when reduced to powder, in cutting and polishing hard stones, glass, and metals.

Not only the external characters, but also the near approach in the proportion of their constituent parts, of the three species last described, would lead to consider them as the same species, or at least as varieties. Emery is by some mineralogists arranged among the ores of iron.

17. Species. Topaz.

Occidental Topaz, Kirw. i. 254. *La Topaze*, Broch. i. 212. *Topaze*, Haüy, ii. 504.

Essen. Char.—Refraction double; joints very distinct; perpendicular only to the axis of the crystals.

Exter. Char.—The topaz is sometimes found massive, sometimes disseminated, and sometimes in rounded fragments; but it is most commonly crystallized. The primitive form of its crystals is a right-angled prism, whose bases are rhombs, and having the large angle 124° 22′; the integrant molecule is the same. The most common forms of the topaz are,

1. A prism with eight sides, terminated at the one end by a four-sided summit, and at the other (which but rarely happens), by one of a different form. In a variety of the Brazilian topaz, the one summit presents six sides, and the other ten; and the electricity exhibited by the latter by means of heat, is negative, while that of the former is positive. This difference in the two opposite summits of a crystal, as has been observed by Haüy, is a peculiarity in all crystals which acquire by means of heat two kinds of electricity.

2. The next common form of the topaz is an eight-sided prism, whose base is horizontal, and bordered with a row of six oblique faces. This variety, which is found in the mines of Saxony, becomes readily electric by friction, but not by heat.

The prevailing colour of the topaz is yellow of various shades. The crystals are of middling size; their lateral faces are sometimes convex and cylindrical; the surface of the same faces is longitudinally striated, while that of the other faces is smooth. Lustre vitreous; cross fracture perfectly foliated; longitudinal fracture conchoidal; fragments indeterminate; transparent; sometimes semitransparent or translucent; refraction double; scratches rock-crystal. Spec. grav. 3.464 to 3.564.

Chem. Char.—Infusible before the blow-pipe, but melts with borax without intumescence. The Brazilian topaz heated in a crucible assumes a rose red colour, when it is called by the jewellers *ruby of Brazil*. The Saxon topaz becomes white when exposed to heat; and thus deprived of colour, is sold for the diamond. According to Vauquelin, all the varieties of topaz reduced to powder, and added to syrup of violets, at the end of two or three hours communicate a green colour.

Constituent parts.

According to Klaproth and Vauquelin.

Alumina	47	to	50
Silica	28	to	30
Fluoric acid	17	to	20
Iron	0	to	4

Localities, &c.—The topaz is found in different parts of Saxony, particularly in the mountain Schneeckenstein, which is denominated *topaz rock*, and is arranged with the primitive mountains. In this rock the topaz is mixed with quartz, schorl, mica, and lithomarga. Near Zinnwald it is found in granite. It is also found mixed with ores of tin. In Siberia the topaz is found in graphic granite, accompanied with beryl, quartz, and garnet. Topaz is also met with in Brazil and Asia Minor.

Uses.—The topaz is employed for the purposes of jewellery as a precious stone, but it is not considered of very great value.

18. Species. Pyrophysalite.

This mineral which was described and analysed by Hisenger and Berzelius, is of a greenish white colour. When thrown on hot coals it becomes phosphorescent, and gives out a greenish flame. When it is strongly heated by the action of the blow-pipe, the surface is covered with small vesicles which explode. These phenomena are ascribed to the fluate of lime which forms one of its constituent parts, and which sometimes appears surrounding it with a crust.

Localities, &c.—Gahn found this stone at Finbo near Fahlun in Sweden, in nodules imbedded in a granite, composed of white quartz, feldspar, and silvery mica. The nodules are separated from the rock by a greenish yellow talc †.

† *Brongniart*, ii. 401.

19. Species. Euclase.

Id. Haüy, ii. 531. *Id.* Brochant, ii. 508.

Essen. Char.—Divisible by two longitudinal lines perpendicular to each other.

Exter. Char.—This mineral has only been found crystallized. The primitive form of the crystals is a rectangular prism with square bases, and that of the integrant molecule is the same. The most common form under which it appears is an oblique four-sided prism with the edges truncated in various ways. The crystals are streaked longitudinally. The lustre is resplendent and vitreous. Longitudinal fracture foliated; cross fracture conchoidal.

Colour, bright sea green. Transparent, and refracts double. Scratches quartz. Very frangible, hence its name signifying easily broken. Spec. grav. 3.062.

Chem. Char.—Loses its transparency before the blow-pipe, and melts into a white enamel.

Constituent

Classification.

Constituent parts. Vauquelin.

Silica	35	to 36
Alumina	18	19
Glucina	14	15
Iron	2	3
Loss	31	27
	100	100

Localities.—This mineral was brought from Peru, and has never been found any where else. It was in single crystals, so that its repository is unknown. It is by some mineralogists arranged among the ores of iron.

20. Species. Emerald.

Id. Kirw. i. 247. *L'Emeraude*, Brochant, i. 217. *Emeraude*, Haüy, ii. 516.

Essen. Char.—Scratches glass easily; divisible, parallel to the faces, and to the bases of a regular hexahedral prism.

Exter. Char.—The emerald is only found crystallized, and the primitive form of its crystals is a regular six-sided prism; the integrant molecule is a triangular prism, the sides square, and the bases equilateral triangles. The usual forms are, 1. A perfect six-sided prism; 2. Truncated on its lateral edges; 3. Truncated on its terminal edges; 4. Truncated on its terminal angles; and, 5. Having the terminal edges bevelled. The crystals are seldom large. Their surface is smooth and shining; internal lustre shining and resplendent; vitreous; fracture conchoidal or unequal, sometimes transversely foliated; fragments indeterminate, sharp edged.

Colour emerald green of all shades; most commonly transparent, sometimes only translucent; refraction double; with difficulty scratches quartz. Spec. grav. 2.600 to 2.775.

Chem. Char.—Fusible before the blow-pipe, but with difficulty; melts readily with borax.

Constituent Parts.

	Vauquelin.	Klaproth.
Silica	64.50	68.50
Alumina	16.	15.75
Glucina	13.	12.50
Oxide of chromium	3.25	.30
Lime	1.60	.25
Oxide of iron		1.
Water	2.	
	100.35	98.3

Localities, &c.—The finest emeralds are brought from Peru, where they are found in veins or cavities of the granite mountains. They are also found in Upper Egypt, Ethiopia, and in the island of Ceylon. The emerald is accompanied by calcareous substances, as carbonate of lime and gypsum.

Uses.—The rich green of the emerald has obtained for it a high rank among precious stones, and it is employed for similar purposes.

Siliceous genus.

21. Species. Beryl.

Aqua Marina et Samaragdus, Beryllus, Wallerius, i. 254. *Aigue Marine de Siberie*, Romé de Lisle, ii. 252. *Id.* De Born, i. 71. *Beryl*, Kirw. i. 248. *Le Beril Noble*, Brochant, i. 220. *Emeraude Limpide, vert-bleuatre, jaune-verdatre*, &c. Haüy, ii. 521.

Essen. Char.—The same as the emerald.

Exter. Char.—The beryl is sometimes found in rounded fragments, but most commonly crystallized, and the forms of its crystals are the same as the emerald. The lateral faces of the crystals are deeply striated.

The colours of the beryl are usually a pale or yellowish green; external lustre shining; internal resplendent, vitreous; longitudinal fracture conchoidal, or foliated. Cleavage fourfold. Fragments indeterminate and sharp-edged; often transparent, sometimes semitransparent, and translucent. The latter variety is distinguished by transverse rents. Refraction in a slight degree double; nearly as hard as topaz; brittle; spec. grav. 2.65 to 2.75. Becomes electric by friction.

Chem. Char.—Before the blow-pipe it is fusible, but with difficulty, and yields a white, scarcely translucent glass.

Constituent parts.

	Vauquelin.	Rose.
Silica	68	69
Alumina	15	14
Glucina	14	14
Lime	2	
Oxide of iron	1	1
	100	98

Localities, &c. The beryl is brought from the East Indies, and from Brazil; but the finest and purest are found in Daouria, on the frontiers of China, in the neighbourhood of Nertschink; and the matrix of these beryls is said to be an indurated clay, resembling jasper. The beryl is also found in Siberia, where it is usually accompanied with quartz, feldspar, garnets, tourmaline, mica, and fluor spar, in the veins of primitive mountains. The beryls from Siberia are almost all found in graphic granite. Beryl is also found in Saxony, and lately in France, in a large vein of quartz traversing graphic granite. Dolomieu found the beryl perfectly transparent and colourless, in the granite of the island of Elba.

Uses.—The beryl is employed as a precious stone, but is not greatly esteemed.

Remarks.—The emerald and the precious beryl approach so nearly to each other, not only in the forms of their crystals, which are almost the same, and in their constituent parts, which afford but slight variations, but also in their other characters, that they ought to be considered, as has been done by Haüy, as varieties of the same species. The only differences which exist between them seem to be accidental. These are chiefly in the colour, and in the crystallization; the former of which is a finer green, and the latter is more perfect in the emerald than in the beryl. The colouring matter of the emerald is oxide of chromium, while that of the beryl

Siliceous genus.

ryl is oxide of iron. In all the other characters they are nearly the same.

22. Species. SCHORLITE, or *Schorlous Beryl.*

Schorlite, Kirw. i. 286. *Le Beril Schorliforme*, Brochant, i. 224. *Leucolite* and *Pycnite*, Haüy, iii. 236.

Essen. Char.—Infusible. Original form of the crystals a regular hexahedral prism.

Exter. Char.—This mineral is usually found crystallized, in longish masses, mixed with other substances, and generally imbedded in granite; the form of the crystals when they are regular, is a six-sided prism, which is sometimes truncated on its terminal edges, and sometimes the form disappears from its being deeply and longitudinally striated. The crystals are generally large.

Colour white, straw yellow, or reddish. Translucent or nearly opaque. External lustre shining, between vitreous and resinous. Cross fracture imperfectly foliated, longitudinal, imperfectly conchoidal. Scratches quartz slightly. Brittle. Spec. grav. 3.514 to 3.530.

Chem. Char.—Infusible with the blow-pipe; with borax yields a transparent glass.

Constituent Parts.

	Klaproth.	Vauquelin.	Vauquelin, another analysis.
Silica,	50	36.8	30
Alumina,	50	52 6	60
Lime,	—	3.3	2
Water,	—	1.5	1
Fluoric acid,	—	—	6
Loss,	—	5.8	1
	100	100	100

Localities, &c.—This mineral is generally found imbedded in granite; sometimes it is met with in gneis, accompanied with lepidolite. It enters into the composition of a rock formed of quartz and gray mica at Altenberg in Saxony. A red variety of this mineral was formerly considered by mineralogists as a crystallized lepidolite. Shorlous beryl has been arranged as a subspecies of beryl; but its specific gravity, different degree of hardness, and especially its composition, are characters sufficiently distinct to constitute a separate species.

23. Species. SCHORL.

This species is divided into two subspecies; 1. Black or common schorl, and 2. Tourmaline.

Subspecies 1. BLACK SCHORL.

Schorl, Kirw. i. 265. *Le Schorl Noir*, Brochant, i. 226. *Tourmaline*, Haüy, iii. 31.

Essen. Char.—Electric by heat in the two opposite extremities; forms of the crystals derived from a rhomboid.

Exter. Char.—This mineral is found in masses, and disseminated, but most frequently crystallized. The primitive form of its crystals is an obtuse rhomboid; the integrant molecule is a tetrahedron. Its usual forms are, 1. A three-sided prism, with the lateral edges either truncated or bevelled; 2. The same prism having a three sided obtuse summit, the sides corresponding to the lateral edges. The truncations, and bevelments of the lateral edges vary in the size of the faces, thus producing prisms of six and nine sides. The lateral faces of the three-sided prism are often convex. The lateral surfaces are longitudinally and deeply striated. The lustre, both external and internal, which is vitreous, varies between shining and weakly shining. The fracture is imperfectly conchoidal or uneven; cross fracture is sometimes convex on the one side and concave on the other. When black schorl is massive, it is found in separate pieces, thin, and apparently fibrous, parallel, or interwoven and divergent. The faces of these separate pieces are striated lengthwise. The fragments are indeterminate.

Classification.

Colour velvet black of various shades. Commonly opaque, rarely translucent, except in small crystals. Streak gray. Inferior to quartz in hardness. Specific gravity 3.092 to 3.212.

Chem. Char.—Under the blow-pipe it froths up, and melts into a grayish white enamel.

Constituent Parts. Wiegleb.

Alumina,	40.83
Silica,	33.33
Iron,	20.41
Manganese,	3.33

Physical Char.—Black schorl becomes electric by heat; and the electricity of one extremity of the crystal is positive, while that of the other is negative; but when it cools, it is said, that the nature of the electricity is reversed; the positive extremity becomes negative, and the negative becomes positive.

Localities, &c.—Black schorl is usually found in granite, gneis, and other primitive rocks; in veins of tin and ores of iron; in the topaz rock of Schneeckenstein in Saxony, of which it constitutes a part. It is also met with in Switzerland, Spain, Hungary, and Britain.

Subspecies 2. TOURMALINE.

Id. Kirw. i. 271. *Le Schorl Electrique*, Brochant, i. 229. *Tourmaline Verte*, Haüy, iii. 41.

Essen. Char.—The same as black schorl.

Exter. Char.—The tourmaline is found sometimes in masses and grains, but most commonly crystallized. The form of its crystals is a regular three-sided prism, with the edges, 1. Either truncated or bevelled. 2. A regular three sided prism with the lateral faces convex, and terminating in an obtuse, three-sided prism, the sides of which correspond to the lateral faces at one extremity, and to the lateral edges at the other. 3. An obtuse, double, three-sided pyramid, the faces of the one corresponding to the edges of the other. 4. A six-sided prism with equal angles. 5. A six-sided prism, the sides meeting two and two alternately under three obtuse angles. 6. A nine sided prism, having three lateral angles acute, and six obtuse alternately. 7. The same crystal having the three acute lateral edges truncated, and thus forming a twelve-sided prism. The surface of the crystals is sometimes smooth, but most

Classification.

most frequently striated longitudinally. Lustre shining and vitreous. Longitudinal fracture conchoidal; cross fracture foliated. The direction of the plates is inclined to the axis of the prism. Fragments indeterminate; the crystals are usually opaque, when seen laterally.

The colour of the tourmaline is greenish, of various shades, yellowish brown, and very rarely indigo blue. The colours are usually very deep, and at first sight appear black. It is usually translucent, and sometimes approaching to transparent, particularly when it is seen in a direction perpendicular to the axis of the prism; but it appears opaque when it is seen in a direction perpendicular to the basis of the prism, even when the height of the prism is less than its thickness. It is harder than quartz. Brittle. Spec. grav. 3.086 to 3.363.

Chem. Char.—With the blow-pipe the tourmaline melts into a grayish white, porous enamel.

Constituent Parts.

	Bergman.	Vauquelin.
Silica	37	40.
Alumina,	39	39.
Lime,	15	3.84
Oxide of iron,	9	12.50
——— manganese,		2.
	100	97.34

Bergman's analysis is of the tourmaline of Ceylon. Vauquelin's is that of the green tourmaline of Brazil.

Physical Char.—The property of the tourmaline, of becoming electric by heat, has been already noticed as one of its distinctive characters. This physical property has occupied the attention of philosophers for a long time. It was observed by Lemery in 1719, and examined by Epinus in 1770. Pliny indeed mentions a reddish or purple coloured stone, which being heated or rubbed, attracts light bodies. This is supposed to have been the tourmaline. This property is susceptible of various modifications. The electricity of the tourmaline may be conveniently exhibited by heating two crystals, suspending the one by a thread, and presenting successively to its extremities the extremities of the other crystal. The extremities which possess the same kind of electricity will be repelled, while those which possess a different kind will be attracted. If a crystal of tourmaline be broken while it is electrified, the fragments immediately present electrical poles, situated in the same direction as those of the entire crystal.

The extremity of the crystals of tourmaline which has the greatest number of faces, exhibits positive electricity, while the extremity having the smaller number of faces exhibits negative electricity. The proper degree of heat for exciting the electricity of tourmaline is from 100° to the boiling point of Fahrenheit. When heated beyond this point, it is deprived of its electricity, and recovers it only in cooling; but if the temperature be increased still more, the crystal becomes again electric, but the poles are reversed. The electric poles may be also reversed, by heating a crystal of tourmaline unequally, by means of a burning glass.

Localities, &c.—The tourmaline is found in almost all primitive mountains; the finest crystals are brought from Ceylon, Madagascar, Saxony, the Tyrol, Spain, and Brazil. The tourmaline of the Tyrol is found in a talcky rock mixed with chlorite, mica, and hornblende. Those of Saxony and Spain are found imbedded in gneis, but those of Brazil and Ceylon are in separate crystals. In Bohemia they are found in mines. The tourmaline is also a native of France, Sweden, Norway, and Britain.

Siliceous genus.

24. Species. Pistazite.

Glassy actynolite, Kirwan i. 168. *Delphinite*, Saussure Voyages, N° 1918. *Acanticone*, *Arendalite* D'Andrada, Nich. Jour. 4to. v. 193. *La Rayonnante Vitreuse*, Brochant, i. 510. *Epidote*, Haüy iii. 102.

Essen. Char.—Divisible parallel to the faces of a rhomboidal prism of $114\frac{1}{2}°$, and $65\frac{1}{2}°$.

Extern. Char.—Pistazite is found massive or crystallized in flattened four sided prisms, terminated by four-sided pyramids, and also sometimes in regular six-sided prisms; the summit of the pyramid almost always truncated, as well as the lateral edges. The crystals are sometimes acicular and streaked longitudinally. Internal lustre shining. Fracture foliated or radiated. Fragments wedge-shaped and splintery.

Colour deep green, olive green, or greenish yellow. Translucent, sometimes transparent. Hard, easily scratches glass, and is brittle. Spec. gr. 3.45. Powder greenish yellow or whitish.

Chem. Char.—Fusible by the blow-pipe, and is converted into a brown slag, which blackens by continuing the heat.

Constituent Parts.

	Vauquelin.	Descotils.
Silica,	37	37
Alumina,	21	27
Lime,	15	14
Oxide of iron,	24	17
——— manganese,	1.5	1.5
Loss,	1.5	3.5
	100.0	100.0

Localities, &c. Pistazite is found in Dauphiny, on the surface and in the fissures of an argillaceous rock, accompanied by quartz, amianthus, and feldspar, and in the Pyrenees in limestone; near Arendal in Norway; and in argillaceous schistus, north end of the island of Arran in Scotland.

25. Species. Zoysite.

This mineral which was discovered by Baron de Zoys, and therefore bears his name, is considered by Hauy as a variety of Epidote.

It appears in prisms which are deeply furrowed or rhomboidal, and very much flattened. They are of a gray colour, or grayish yellow, with a pearly lustre.

Localities. Zoysite is found particularly in Carinthia, and also in the Tyrol and in the Valais *.

* *Brongniart*, ii. 400.

26. Species. Axinite, or Thumerstone.

Id. Kirw. i. 273. *La Pierre de Thum*, Brochant, i. 236. *Axinite*, Hauy, iii. 22.

Essen. Char.—Divisible parallel to the faces of a rhomboidal prism of $101\frac{1}{2}°$, and $78\frac{1}{2}°$.

Exter.

Siliceous genus.

Exter. Char.—Thumerſtone is found in maſſes, diſſeminated and cryſtallized. The primitive form of its cryſtals is a right-angled priſm, whoſe baſes are oblique-angled parallelograms, having their angles of 101° 32′, and 78° 28′. The integrant molecule is an oblique triangular priſm. The moſt common form of its cryſtals is a quadrangular priſm, ſo oblique and flattened, that its angles become as ſharp as the cutting part of a hatchet. The faces of the cryſtals are longitudinally ſtriated, but the truncated faces are ſmooth. External luſtre ſplendent; internal ſhining and vitreous. Fracture vitreous, ſometimes rough and ſplintery. Fragments indeterminate, ſharp edged. Maſſive thumerſtone is compoſed of ſeparate teſtaceous, thin, and ſlightly curved concretions, with a ſmooth ſurface, which is ſomewhat irregularly ſtriated.

The colour is clove brown, varying to violet blue, yellowiſh, and greeniſh gray. Maſſive thumerſtone is only tranſlucent. The cryſtals are ſemitranſparent, and ſometimes tranſparent. It is harder than feldſpar, but leſs ſo than quartz; gives fire with ſteel, and diffuſes an odour ſimilar to what is produced by flint. Brittle. Spec. grav. 3.213 to 3.300.

Chem. Char.—Thumerſtone froths up under the blow-pipe, and is converted into a grayiſh enamel, and with borax into a fine olive green enamel.

Conſtituent Parts.

	Klaproth.	Vauquelin.
Silica,	52.70	44
Alumina,	25.79	18
Lime,	9.39	19
Oxide of iron,	8.63	14
——— manganeſe	1.	4
Loſs	2.49	1
	100.00	100

Localities, &c. Thumerſtone, which is hitherto a rare mineral, has been only found in veins and fiſſures of primitive rocks, and chiefly in rocks with a baſe of ſerpentine. It is uſually accompanied with aſbeſtus, rock cryſtal, and ſometimes calcareous ſpar. It was firſt diſcovered at Thum in Saxony, from which it derives its name; but has been ſince found in the Pyrenees, in France, at Mount Atlas in Africa, and in Norway.

27. Species. Quartz.

Eſſen. Char.—Diviſible into a rhomboid, which is ſlightly obtuſe.

Quartz, which is found, either maſſive, cryſtallized, or in rounded pieces, is one of the moſt abundant mineral ſubſtances. The primitive form of its cryſtals is a ſlightly obtuſe rhomboid, of 94° 4′, and 85° 56′. The integrant molecule is a regular tetrahedron.

On account of the variety of forms and appearances, quartz has been divided into ſubſpecies; into five by Werner; by others only into two, viz. rock-cryſtal and common quartz. We ſhall nearly follow the former ſubdiviſions, which are, amethyſt, rock-cryſtal, milk-quartz, common quartz, and praſe, including alſo ferruginous quartz.

Subſpecies 1. Amethyst.

Id. Kirw. i. 264. *L'Amethyſte*, *Quartz-hyalin Violet*, Hauy, ii. 417.

Claſſification.

Exter. Char.—The amethyſt is found frequently cryſtallized, but it is alſo found maſſive and in rounded pieces. 1. The form of its cryſtals is a regular ſix-ſided priſm, terminated by a ſix-ſided pyramid, the ſides of which correſpond to thoſe of the priſm. 2. A double ſix ſided pyramid. Fracture conchoidal, rarely ſplintery, or fibrous. Fragments indeterminate, ſometimes wedge-ſhaped. Maſſive amethyſt is compoſed of ſeparate pieces, which are ſometimes granulated, ſometimes ſcopiform when the cryſtals are combined together.

The colour is commonly violet blue of various ſhades, blackiſh brown and greeniſh white. External luſtre reſplendent; internal reſplendent and ſhining, vitreous. It varies between tranſparent and tranſlucent. Scratches glaſs. Brittle. Spec. grav. 2.653 to 2.750.

Chem. Char.—Entirely infuſible under the action of the blow-pipe.

Conſtituent Parts. Roſe.

Silica,	97.50
Alumina,	.25
Oxide of iron and manganeſe,	.50
	98.25

Localities, &c.—Amethyſt is found in Bohemia, Saxony, Siberia, very abundant in the Uralian mountains, Hungary, and Auvergne in France. It is uſually met with in the veins of metalliferous mountains, very rarely in granitic mountains. It is frequently met with cryſtallized, lining the cavities of balls of agate; in amygdaloid and porphyry rocks.

Uſes. When the amethyſt is cut and poliſhed, it aſſumes an agreeable colour and luſtre, ſo that it is employed in jewellery.

Werner has divided the amethyſt into two varieties, the common and fibrous; the latter being chiefly characterized by its fibrous fracture and reſinous luſtre. This latter variety too, is only found maſſive.

Subſpecies 2. Rock Crystal.

Mountain Cryſtal, Kirw. i. 241. *Le Criſtal de roche*, Brochant, i. 243. *Quartz-hyalin Limpide*, Hauy, ii. 417.

Exter. Char.—Rock cryſtal is uſually found cryſtallized, ſometimes in rounded pieces, but rarely maſſive. The form of its cryſtals is, 1. A ſix-ſided priſm, having one of its baſes or both ſurmounted by a ſharp pointed pyramid; the ſides of the pyramid and priſm correſponding. This is its moſt uſual form; but it exhibits many apparent varieties, ariſing from modifications in the magnitude of one or ſeveral of the faces at the expence of the others. 2. A double ſix-ſided pyramid, which is ſometimes perfect, and ſometimes truncated on the edges of the common baſe; and ſometimes too, three alternating faces on each pyramid are larger than the others, giving to the cryſtal the appearance of a cube. 3. A ſimple, very acute pyramid with ſix ſides, having its ſummit, and often alſo its baſe, acuminated with ſix faces; but this is rather an irregularity in the cryſtallization than a new form.

The cryſtals of this mineral are ſometimes very large, and they are alſo found very ſmall. In the rounded pieces the external ſurface is rough, but in the perfect cryſtals

Claſſification.

cryſtals the faces of the priſm are ſtriated tranſverſely; but thoſe of the pyramids and acuminations are ſmooth. The luſtre is reſplendent and vitreous; fracture perfectly conchoidal, ſometimes, however, foliated; fragments indeterminate, very ſharp edged.

Colours of rock-cryſtals are grayiſh white, yellowiſh white, pearl gray, yellowiſh and blackiſh brown. Internally it is ſometimes irideſcent. It is tranſparent, ſometimes ſemitranſparent. By looking acroſs one of the faces of the pyramid, and the oppoſite face of the priſm, double refraction is produced. Scratches glaſs, and gives ſparks with ſteel. Somewhat frangible; ſpec. grav. 2.650 to 2.888.

Chem. Char.—Entirely infuſible before the blowpipe.

Conſtituent Parts.	Bergman.
Silica	93
Alumina	6
Lime	1
	100

Phyſical Char.—It is ſometimes phoſphoreſcent; two cryſtals, by being rubbed together, exhibit a little light in the dark, and give out a peculiar odour, which is ſomewhat empyreumatic.

Localities, &c.—Rock-cryſtal is moſt commonly found in veins of primitive rocks, and particularly in granite; in druſes lining the cavities of theſe rocks. The fineſt cryſtals are now brought from Madagaſcar, but it is a very frequent mineral in moſt countries, as in the mountains of Switzerland, where it was formerly dug out of the faces of lofty precipices by the inhabitants. It is alſo found in Bohemia, Saxony, Hungary, and in Cornwall in England, and different parts of Scotland, as in the iſland of Arran, in the cavities of the granite mountains, and in Cairngorm in Aberdeenſhire, the two latter, which are well known by the name of Arran ſtones and Cairngorms, are uſually of a ſmoky colour, owing, it is ſuppoſed, to iron or mangaueſe; probably to the latter, for from ſome experiments which we have made, the colour entirely diſappears by expoſing the cryſtal to a ſtrong heat, and from other obſervations it appears that the colouring matter is alſo deſtroyed by the action of light.

Rock cryſtal ſometimes contains ſchorl, amianthus, actynolite, mica, and titanium. Cryſtals are alſo ſometimes met with in cavities containing a drop of water, and a ſmall quantity of air.

Uſes.—Rock cryſtal, on account of its luſtre and tranſparency, is employed in jewellery, and particularly when it is coloured, as thoſe from Cairngorm in the north of Scotland, many of which are held in high eſtimation.

Subſpecies 3. Rosy Red or Milky Quartz.

Roſy Red Quartz, Kirw. i. 245. *Quartz laiteux*, Brochant, i. 246. *Quartz-hyalin laiteux*, Haüy, ii. 420.

Exter. Char.—This mineral is always found maſſive. It is indeed ſaid by Emmerling, that it has been found cryſtallized, in ſmall ſix-ſided priſms, terminated by a ſix-ſided pyramed, at Rabenſtein in Bavaria. Internally, its luſtre is ſhining, rarely reſplendent; reſinous; fracture perfectly conchoidal, and fragments indeterminate. It varies between ſemitranſparent and tranſlucent.

Siliceous genus.

The colour is ſometimes milk white; but its principal colour, it is ſaid, is pale roſe red. In its other characters it agrees with rock cryſtal.

It is ſuſpected that this mineral is compoſed of ſilica and oxide of mangaueſe, to the latter of which the colour is owing.

Localities, &c.—Milk quartz forms beds in primitive mountains; at Rabenſtein in Bavaria it is met with in a large grained granite. It is alſo found in Finland, Greenland, Saxony, Siberia, and the weſtern part of Invernefsſhire in Scotland.

Uſes.—The ſemitranſparence, the fine colour, and the poliſh of which it is ſuſceptible, have introduced this mineral to be employed in jewellery.

Subſpecies 4. Common Quartz.

Quartz, Kirw. i. 242. *Le Quartz commune*, Brochant, i. 248. *Quartz hyalin amorphe*, Haüy, ii. 425.

Exter. Char.—Common quartz is found in various forms, maſſive, diſſeminated, in grains, and rounded pieces. It is ſometimes ſtalactitical, globular, kidney-form, tuberculated, cellular, perforated, and corroded; ſometimes alſo it is cryſtallized, and the cryſtals are either true, or ſuppoſititious. The true cryſtals are grouped together in reniform, rounded, or radiated maſſes; the form is the ſame as that of rock cryſtal. The pſeudo cryſtals derive their figure from the ſubſtances on which they are formed, as the cube from fluor ſpar, the octahedron from the ſame, the ſix-ſided table from barytes, the acute ſix-ſided pyramid from calcareous ſpar. The ſurface of the true cryſtals is ſimilar to that of rock cryſtal, but that of the pſeudo cryſtals is rough, and the luſtre is dull. Fracture of common quartz is ſmall, conchoidal; ſometimes large, ſplintery, and ſometimes imperfectly foliated, or fibrous, with large parallel fibres. Fragments indeterminate, with ſharp edges, very rarely rhomboidal. It is commonly tranſlucent, rarely ſemitranſparent. The colour is milk white, ſnow white, reddiſh white, and blood and fleſh red, with many ſhades of theſe colours. Scratches glaſs. Spec. grav. 2.640 to 2.654.

Chem. Char.—Infuſible before the blow-pipe. Silica forms the principal conſtituent part; but among the numerous varieties of common quartz, there are no doubt ſlight differences in the nature and quantity of the materials which enter into its compoſition. The different ſhades of colour are owing to different portions and different ſtates of metallic ſubſtances.

Localities, &c.—Common quartz is one of the ſubſtances of moſt frequent occurrence in all kinds of rocks, forming one of the chief component parts of primitive mountains, ſometimes in entire beds, or whole mountains, as in the iſlands of Iſla and Jura in Scotland. It is alſo frequent in veins, very common in ſtratiform rocks, where it conſtitutes the baſe of ſandſtone: in alluvial rocks it is met with in rounded pieces, or in the form of ſand.

Uſes.—Common quartz is employed in the manufacture of glaſs inſtead of ſand; in the fabrication of ſmalt, and as a flux for calcareous ores of iron.

A variety of this, called aventurine, is ſometimes held in conſiderable eſtimation. It is the quartz hyalin

Siliceous genus.

aventuriné of Haüy, and the natural aventuriné of De Lisle. It is of a deep red, gray, green, or blackish colour, marked with spots sometimes of a yellowish, and sometimes of a silvery appearance, which proceed from very thin pieces of pure quartz disseminated in the mass. It ought not to be confounded with quartz mixed with mica, or micaceous quartz, which is a compound rock. On the contrary, the diversity of colours seems to be owing to numerous fissures which are arranged nearly in the same direction.

Aventurine in found near Vasles, in the department of Deux Sevres in France, in the form of rounded stones, which are reddish; at Cape de Gates in Spain, of a whitish colour, with silvery spots; in Arragon, which affords several varieties; near Madrid, among rounded fragments of granite; at Facebay in Transylvania, where it is of a black colour, with very small golden spots; and in the neighbourhood of Catharineburg in Siberia.

The name aventurine is derived from the following circumstance. A workman having dropped by chance *par aventure*, some brass filings into a vitreous matter in the state of fusion, gave the mixture this name, of which was afterwards made vases and other ornamental objects. Mineralogists gave the same name to natural substances which have a striking resemblance to this artificial production. Haüy, ii. 422.

Subspecies 5. Prase.

Prasium, Kirw. i. 249. *La Prase*, Brochant, i. 252. *Quartz Hyalin Vert obscure*, ii. 419. *Quartz Prase*, Brongniart, i. 280.

Exter. Char.—This mineral possesses all the characters of quartz in general. It is most commonly found massive, and very rarely crystallized. The crystals, which are usually small, have the form of rock crystal.

The colour is usually leek green; the external surface is rough and glistening; the internal shining and vitreous; it is translucent; the fracture imperfectly conchoidal, and sometimes coarse splintery; fragments sharpe-edged. When it is massive, it is composed of distinct concretions, which are granulated prismatic, or cuneiform, the surface of which is rough and transversely striated.

Localities, &c.—Prase is found at Brietenbrunn near Schwartzenberg in Saxony, in a metallic vein, accompanied with magnetic pyrites, galena, blende, calcareous spar, and actynolite. It is also found in Bohemia, in Finland, near lake Onega, and in Siberia.

Uses.—As it is susceptible of a fine polish, prase is employed in jewellery.

This mineral ought not to be confounded with quartz coloured by means of chlorite, which latter is of a brighter green, but opaque.

Subspecies 6. Ferruginous Quartz, or *Iron Flint.*

Le Caillou Ferrugineux, Brochant, i. 248. *Quartz Rubigineux*, Brongniart, i. 281. *Quartz Hyalin hematoide*, Haüy, ii. 420. *Eisenkiesel* of the Germans.

Exter. Char.—The peculiar character of this mineral seems to be owing to a large proportion of oxide of iron, which renders it opaque. It is usually found massive, but it sometimes also assumes a crystalline form, which is a prism with six equal sides, acuminated at each extremity with three planes. The colour is of a yellowish brown, sometimes of a brownish red, and of a bright blood red. It is usually opaque, or only transparent at the edges. External lustre resplendent; internal shining and vitreous. Fracture imperfectly conchoidal; fragments angular, but not very sharp-edged. Concretions small-grained and distinct. It is harder than common jasper. Not very brittle.

Classification.

Localities.—This mineral is found in veins of ironstone in Saxony, and in England, where it is accompanied with sulphate of barytes.

Ferruginous quartz is distinguished from jasper, to the red variety of which it has a striking resemblance, by its shining fracture, which is also vitreous and conchoidal; its property of crystallizing; and according to Brongniart, by having no alumina in its composition, which he properly considers as an essential characteristic.

28. Species. Hornstone.

Hornstone, Kirw. i. 303. *La Pierre de Corne*, Brochant, i. 254. *Petrosilex*, Haüy, iv. 385.

This mineral is met with in masses and also in rounded balls. The colour is usually gray; it is translucent at the edges, the fracture splintery or conchoidal; it has little lustre; is so hard as to scratch glass, and give fire with steel; and its spec. grav. is from 2.699 to 2.708.

The diversity of fracture which has been observed in hornstone, has led to the subdivision of this species into three subspecies, viz. splintery hornstone, conchoidal hornstone, and woodstone.

Subspecies 1. Splintery Hornstone.

Hornstone Ecailleux, Brochant, i. 255. *Petrosilex Squamosus*, Wallerius, i. 280.

Exter. Char.—This mineral is found massive, or in rounded pieces. It has scarcely any lustre; the fracture is fine, splintery; fragments sharp-edged; translucent at the edges. It is scarcely so hard as quartz; it is brittle.

The colour is bluish gray, smoke and pearl gray, sometimes greenish and yellowish gray, more rarely olive and mountain green. Sometimes there is a mixture of these colours, arranged in spots and stripes. Spec. grav. 2.654. Kirw.

Chem. Char.—According to some mineralogists, this variety of hornstone is fusible before the blow-pipe, but according to others it is infusible without the addition of borax.

The following are the constituent parts of a hornstone analyzed by Kirwan.

Silica	72
Alumina	22
Carbonate of Lime	6
	100

Localities, &c.—This variety of hornstone is chiefly found in veins in primitive mountains. It is also found in rounded pieces in alluvial rocks, and it constitutes the chief basis of hornstone porphyry, as at Dannemora and Garpenberg in Sweden. It is met with in veins at Freyberg, Schneeberg, Johann-Georgenstadt, and Gersdorf in Saxony.

Subspecies

Classification.

Subspecies 2. CONCHOIDAL HORNSTONE.

Petrosilex Equabilis, Wallerius i. 281. *Le Hornstein Conchoide*, Brochant, i. 258.

Exter. Char.—This mineral is always found massive, and seems to approach in its characters very nearly to the preceding variety or subspecies, excepting in the fracture, which is perfectly conchoidal.

Localities, &c.—This subspecies is found in beds and veins, when it is sometimes accompanied with agate. It has been found accompanying gneis at Goldberg in Saxony, and fine specimens of both subspecies are met with in the island of Rona near Sky in Scotland, where it seems to form a considerable vein, traversing a gneis rock.

Subspecies 3. WOODSTONE, or *Petrified Wood.*

Woodstone, Kirw. i. 215. *Le Holzstein*, Brochant i. 259. *Quartz Agathe Hyloide*, Hauy, ii. 439.

This subspecies possesses more distinctive characters than the former; and as it seems to be wood, retaining its original texture, converted into hornstone by some petrifying process, it is usually found in insulated masses, or in rounded pieces. It has the external appearance of wood, for the surface is rough and uneven, or longitudinally striated; internally it is glistening, but sometimes dull, having a vitreous lustre. The fracture most frequently exhibits the fibrous texture of the wood. The cross fracture is sometimes splintery or imperfectly conchoidal. The fragments are indeterminate, and slightly sharp-edged. The most common colour is dark gray, ash gray, grayish white, and sometimes cochineal and blood red. Different colours appear in the same mineral, forming spots, clouds, or stripes. It is commonly translucent at the edges, sometimes entirely translucent, and sometimes opaque. It is hard and brittle.

Localities.—Woodstone is met with in Bohemia, Saxony, and Siberia, and on the banks of Loch Neagh in the north of Ireland, particularly, as we have been informed, near places where some of the rivers discharge their waters into the lake.

Uses.—This mineral is generally susceptible of a fine polish, and is therefore employed in jewellery.

29. Species. FLINTY SLATE, or *Siliceous Schistus.*

This species is divided into two subspecies or varieties, viz. common siliceous schistus, and Lydian stone.

Subspecies 1. COMMON SILICEOUS SCHISTUS.

Siliceous schistus, Kirw. i. 306. *Schiste silicieux commun*, Brochant, i. 283.

Exter. Char.—This mineral is found in masses or rounded pieces, and it is frequently transversed by veins of quartz of a grayish white, or coloured red by means of iron. This, it is said, is a distinguishing characteristic of siliceous schistus which it rarely wants (Brochant). Internally it is dull, very rarely a little glimmering. The fracture in the small is compact, sometimes splintery, and sometimes imperfectly conchoidal; but in the great or large masses it is slaty, a character which almost always disappears in the small fragments. The fragments are sharp edged. The colour is blackish, greenish, or smoke gray. It is commonly opaque, rarely translucent at the edges. It is hard and brittle.

Siliceous genus.

Chem. Char.—Before the blow-pipe, gray siliceous schistus becomes white and friable; the black assumes a darker colour, and is a little vitrified at the edges.

Constituent Parts.	Wiegleb.
Silica	75
Magnesia	4.58
Lime	10.
Iron	3.54
Inflammable matters	5.02
Loss	1.86
	100.00

Localities, &c.—Siliceous schistus is met with in Bohemia, Saxony, Switzerland, and Siberia; at Leadhills in Scotland, and also at Carlops, near the termination of the great coal field to the south of Edinburgh.

The geological position of this stone is not precisely determined. In Scotland it is connected with those rocks which come under the denomination of transition rocks; but according to different descriptions it seems to have been confounded with argillaceous schistus, with which indeed it possesses some common properties; and some mineralogists regard it as an argillaceous schistus, having a larger proportion of siliceous earth. In support of this opinion, siliceous schistus has been found in situations where it is subordinate to argillaceous schistus.

Subspecies 2. LYDIAN STONE.

Basanite, Kirw. i. 307. *La Pierre de Lydie*, Brochant, i. 286. *Roche Corneenne*, Hauy, iv. 434.

This stone, which is of a grayish, bluish, or velvet black, is found in masses, and in rounded pieces of a trapezoidal form, which are also traversed with veins of whitish quartz. The external surface is smooth and weakly shining; the internal is glimmering. The fracture is even, sometimes slightly conchoidal or uneven, rarely splintery; in large masses it is slaty. The fragments are sharp-edged, and sometimes assume a cubical form. It is commonly opaque, and rarely translucent at the edges. It is scratched by quartz; brittle. Spec. grav. 2.415 to 2.880.

Localities.—Lydian stone is found in similar places with the former variety.

Uses.—This stone has been long known under the name of *touchstone*, because it is employed to ascertain the purity of gold. From this use it obtained the name of βασανος or the *trier*, and it was called Lydian stone, because it was found in Lydia. When it is employed as a touchstone, the gold to be tried is rubbed on its polished surface; on the metallic trace which remains nitric acid is poured, and the quantity of alloy is judged of by the degree of change which takes place, this being compared with traces made and treated in the same way with needles differently alloyed and prepared for the purpose. This test, it is to be observed, is not perfectly accurate, but is sufficiently so for those who are much employed in the use of it. The property which renders this mineral fit for the above purpose depends on its degree of hardness, while it presents at the same time a smooth and even fracture without being perfectly smooth. Other stones possessing similar properties,

ties, such as several varieties of basalt, are conveniently employed for the same purpose.

30. Species. Flint.

Flint, Kirw. i. 301. *Pierre à fusil*, Brochant, i. 263. *Quartz-Agathe Pyromaque*, Hauy, ii. 427.

Exter. Char.—Flint is found massive, disseminated, in angular fragments, in globular masses, tuberculated, and perforated. The surface is sometimes rough, sometimes uneven, and sometimes smooth. The white crust with which it is often covered, is considered by some mineralogists as an incipient decomposition. The external lustre is dull or a little glimmering; the internal is weakly shining; the fracture is perfectly conchoidal, the fragments sharp edged. The colour is usually gray, smoke gray, sometimes perfectly black. Various colours appear in the same mineral, presenting spots, stripes, and clouds. Commonly translucent at the edges; scratches quartz: spec. grav. 2.58 to 2.99.

Chem. Char.—Entirely infusible before the blowpipe.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica	98.	97
Lime	.50	
Alumina	.25 }	1
Oxide of iron	.25 }	
	99.00	98

Physical Char.—Two pieces of flint rubbed together in the dark, give out, like quartz, a phosphoric light.

Localities, &c.—Flint is never found in primitive mountains, excepting in very small quantity, and very rarely, in some veins; in alluvial rocks it is sometimes met with in rounded pieces; but it is most abundant in stratified mountains, particularly in beds of limestone, marl and chalk, in which it is disposed in parallel layers. It is met with in Saxony, Denmark, Sweden, Poland, and Spain, and is very abundant in chalk beds in the north of France, and also in different parts of England. It is also met with distributed in layers in the white limestone rocks, on the north coast of Ireland. In the department of Jura in France, globular masses of flint have been found with cavities containing sulphur.

19 Formation of flints,

The singular geological relations of this mineral have greatly puzzled naturalists, who are fond of such speculations, and are never satisfied till they have accounted for every thing, however scanty and defective the data may be on which their hypotheses are formed. It is on this account that the theories which have been proposed, to explain the formation of flint, offer nothing more than the silliest and most groundless conjectures; and indeed the same remark is equally applicable to theories of the earth in general. It has been already observed that flint is regularly disposed in layers, in the beds of chalk or limestone in which it is found. In an insulated mass of white limestone near Port Rush on the north coast of Ireland, which we had an opportunity of examining, the balls of flint were disposed in this way with great regularity. When the bed of limestone is of no great thickness, it contains only one layer of flints, but in thicker beds there are two layers of flints, the one near the top, and the other near the bottom of the bed. Those layers of flint, too, it is to be observed, have exactly the same inclination as the strata of limestone.

20 by fire,

According to one set of theorists, the flint being in a state of fusion, was ejected from the bowels of the earth, and deposited in the places where it is now found. This opinion carries along with it its own absurdity; for admitting that the flinty matter has been in a state of fusion, it is impossible to suppose that it could be deposited with so much uniformity and regularity, by being projected according to the conjecture of the philosophers who maintain this opinion. Had this been the mode of its formation, masses of flint would have been found throughout every part of the chalk or limestone beds, and not in regular layers, as is really the case.

21 by water,

According to another opinion, by which the formation of flint is proposed to be accounted for, cavities were produced, while the chalk and limestone were yet in a soft state, in consequence of the air extricated during the evaporation of the water; and the flinty matter in solution was introduced into these cavities by infiltration from above. But the same argument is equally forcible against this opinion. It is impossible to conceive that the cavities could be so regularly and uniformly produced by the extrication of the air. They would have been found through every part of the beds of chalk and limestone where flint is met with. And besides, even allowing that this flinty matter was held in solution by water, it might naturally be asked, why the greatest proportion of it was not deposited near the surface, when it first came in contact with the chalk or limestone, rather than to have continued to pass through the different beds, and form masses of solid flints at the greatest depths, in as great quantity as near the surface.

22 by marine animals.

A third opinion, which some imagine to be less improbable than either of the former, supposes that flints have been entirely produced by marine animals deposited during the formation of the strata in which they are contained. This opinion seems to derive some support from the remains of marine animals, which are not unfrequently found included in nodules of flint. It is no rare occurrence to meet with shells thus attached to these nodules, and converted into flinty matter, but at the same time retaining their original form and appearance in the most perfect manner.

Uses.—The extensive use of this mineral, in consequence of its property of striking fire with steel, as gun flints, is well known. Flints are employed also as a substitute for quartz in the manufacture of glass and porcelain, and in the fabrication of smalt. The coarser kinds, or such as are perforated and carious, are applied to the purposes of building and millstones. Sometimes the colours and the polish of flint are so fine as to have brought it into use in jewellery.

23 Manufacture of gun flints.

As flints are found in greatest abundance in France and England, the principal manufactures of gun flints are carried on in these countries. A particular account of this manufacture in France has been given by Dolomieu and Salivet, *Jour. des Mines*, N° 33, pp. 693 and 713. The whole process, which according to the description of Dolomieu is divided into four stages, is very simple.

1. After having fixed upon a mass of stone fit for

Classification.

for the purpose, the first part of the operation is to break the stone into pieces of convenient size. With this view the workman, seated on the ground, places the stone on his left thigh, and strikes it with small strokes, to divide it into pieces of a pound or a pound and a half weight, having large surfaces and smooth fractures, and at the same time he avoids splitting or shaking the stone by too feeble or too violent strokes.

2. In the next part of the operation the nicest management and dexterity of hand are required; for by repeated strokes splinters of the proper size to form gun flints are detached; one is separated at every stroke. During this operation he holds the mass of stone in his left hand. The splinters are about $1\frac{1}{2}$ inch broad, $2\frac{1}{2}$ long, and two lines thick in the middle. They are slightly convex above, and concave below; thick at one edge, and thin at the opposite edge.

3. The flint is brought to a regular shape during this part of the operation; and,

4. The edge of the gun flint which strikes fire, is brought to a straight line by placing it on a sharp iron instrument, and giving it five or six small strokes with a circular hammer (roulette). This finishes the operation, and the whole time of making a flint is not equal to a minute. With masses of stone that work easily, an expert workman will prepare 1000 good splinters in a day. It requires another day to bring to the proper shape 500; so that in three days he can split off from the mass and completely finish 1000 gun flints.

31. Species. CALCEDONY.

This species has been divided into two subspecies or varieties; common calcedony and carnelian.

Subspecies 1. Common CALCEDONY.

Id. Kirw. i. 298. *La Calcedoine Commune*, Brochant, i. 268. *Quartz Agathe Calcedoine*, Haüy, ii. 425.

Exter. Char.—This mineral is found massive, in rounded pieces, which are globular, reniform, botryoidal, stalactitical, cellular; and sometimes also it is crystallized in the form of a cube, rhomboid, a simple pyramid with three and six faces; but these are supposed to be pseudo crystals, or merely a crust of calcedony on the crystals of other substances. The external surface is most commonly uneven, sometimes rough, and rarely smooth. External lustre is accidental; internal glimmering, rarely a little shining; fracture even, sometimes imperfectly conchoidal or splintery; fragments sharp-edged.

Colour white, grayish or bluish white, yellowish or blackish: various colours appear in spots, clouds, stripes, and veins. Sometimes when it is cut it is iridescent; commonly translucent, rarely semitransparent. Harder than flint. Brittle. Spec. grav. 2.600 to 2.700.

Chem. Char.—Before the blow-pipe it is infusible.

Constituent Parts.

	Bergman.
Silica	84
Alumina	16
A trace of iron	—
	100

Siliceous genus.

Localities, &c.—Calcedony is most usually met with in globular masses in amygdaloid, as at Oberstein, in the duchy of Deux Ponts. It is found also in Saxony, Silesia, and Siberia, in Iceland and the Faro islands; in the north of Ireland; and in several of the western islands of Scotland. The cavities of the balls of calcedony are often lined with crystals of quartz and amethyst.

Uses.—Calcedony takes a fine polish, and is therefore employed in jewellery.

2. Subspecies. CARNELIAN.

Id. Kirw. i. 300. *La Cornaline*, Brochant, i. 272. *Quartz-Agathe Cornaline*, Haüy, ii. 425.

This mineral is found in masses, or disseminated, but most frequently in rounded pieces of a globular, kidney form, or stalactitical shape. External surface rough and uneven; internal lustre glimmering, or slightly shining; fracture perfectly conchoidal; fragments very sharp-edged; most common colour blood red of various shades, and sometimes reddish brown or wax and honey yellow; semitransparent, hard, and brittle. Spec. grav. 2.59 to 2.73.

Chem. Char.—Carnelian is infusible before the blow-pipe, but loses its colour, and becomes white.

Localities, &c.—Carnelian is found in similar circumstances, and in similar places with common calcedony, but is of less frequent occurrence. The finest carnelians are brought from the east, and thence they are denominated oriental.

Uses.—The carnelian is employed for the same purposes as common calcedony.

Observations on Agate.—As common calcedony and carnelian, along with jasper, constitute the base of the greater number of agates, it may be here proper to introduce a few remarks on the mineral substances which are included under this name, and on the theories of their formation.

24 Varieties of agate.

The term agate is of very general application, comprehending numerous varieties, which are chiefly distinguished by the arrangement and disposition of the colours with which they are marked, and from which they have derived particular names. The following are some of the principal varieties of agate. 1. *Fortification* agate, in which the different coloured stripes are arranged in a zigzag manner, presenting something of the appearance of a fortified town. 2. *Landscape* agate, in which the colours and shades are so arranged as to exhibit the appearance of a landscape. 3. *Band* or *ribbon* agate, in which the various colours are disposed in stripes or zones, which are usually in straight lines, but sometimes concentric. To this variety of agate, when the zones or stripes are arranged parallel to each other, and distinctly marked, the name of onyx was given by the ancients. The name *onyx*, which signifies the nail of the finger, is derived from the whitish colour resembling that part of the body. They also gave the name of *sarde* to a variety of the same stone, of a flesh colour, and afterwards the compound name *sardonyx* was given to another variety, in which a whitish layer of the onyx, having some degree of transparency, covered another layer of a flesh red, the colour of which latter appeared through the former in the same manner as the colour of the flesh appears through the nail. But

in

Siliceous genus.

in the end, the name of onyx ſeems to have been applied to all ſtones formed of layers of different colours. 4. *Moſs* agate. In ſome varieties of agate filaments of a greeniſh or other colour, having the appearance of ſome ſpecies of confervæ or muſci, are obſerved, and theſe have been denominated *moſs agates*. Some have ſuppoſed that theſe filaments have been real moſſes or confervæ, enveloped by the ſiliceous matter. In ſome alſo delineations of a brown or black colour, exhibit the appearance of trees or ſhrubs. This dendritical appearance is aſcribed by ſome to the infiltration of iron or mangameſe into the natural fiſſures of the ſtone. The fineſt agates of this variety, it is ſaid, are brought from Arabia, by the way of Mocha, on the coaſt of the Red ſea; and hence they are known by the name of *Mocha ſtones*. Beſide theſe varieties, there are ſeveral others, as *tubular* agate, when it is compoſed of calcedony, which ſeems to have been in the form of ſtalactites, and afterwards filled up with a different mineral ſubſtance, or at leaſt of a different colour; *clouded* agate, preſenting the appearance of clouds; *radiated* or *ſtellated*, when the different colours are arranged in rays; *breccia agate*, compoſed of fragments of different kinds of agate, and cemented together by ſiliceous matter, and conſtituting a real breccia; *ſpotted agate*, when the colours are diſpoſed in points or ſpots; *petrified agate*, which ſeems to have been wood penetrated with the matter of agate; *coral agate*, having the appearance of coralloid; *jaſper agate*, in which the predominant part of its compoſition is jaſper.

25 Formation of agate,

The formation of agate has been the ſubject of much controverſy among contending theoriſts; for while one party conceives that it affords the ſtrongeſt proofs of being produced by means of heat, or from a ſtate of fuſion, another party ſeems to be equally convinced that it ſupplies them with the moſt certain evidence of having been formed from an aqueous ſolution.

26 by fuſion,

Beſide other ſtrong objections that might be urged againſt the opinion of agate being formed from a ſtate of fuſion, the uniformity and regularity in the arrangement of the different kinds of matter of which it is compoſed, ſeem quite hoſtile to it, and, excepting to thoſe who are previouſly prepoſſeſſed with ſuch an opinion, will, we preſume, appear altogether inſurmountable; for it is inconceivable, that in a maſs of melted matter, whether it have been in a ſtate of fuſion in the place where it is now found, or projected from the bowels of the earth into the ſtrata which are now its repoſitory, while in a ſoft ſtate, could arrange itſelf into layers, ſome of them often extremely thin, and diſpoſed in ſtripes, concentric circles, ſpots, while theſe various kinds of matter exhibit very ſlight ſhades of difference in their conſtituent parts. It cannot even be imagined that all this could have been effected, even by the ſloweſt and moſt gradual proceſs of cooling.

27 by aqueous infiltration.

In accounting for the formation of agate by ſolution in water, it is ſaid that the cavities in the rocks which contain agate, were formed in conſequence of the evolution and extrication of air, while thoſe rocks were in a ſtate of ſoftneſs; and that the matter of which agate is compoſed, was introduced in the ſtate of an aqueous ſolution by means of infiltration. But objections, equally inſurmountable, might eaſily be adduced againſt this theory; and one of the firſt that preſents itſelf is derived from the diverſity of matter depoſited in maſſes of agate. This objection, indeed, is attempted to be obviated by ſuppoſing that the agate compoſed of different kinds of matter was derived from different kinds of ſucceſſive ſolutions: but this is only removing the difficulty a ſtep farther; for, can it eaſily be conceived, that a very thin layer of one kind of matter being depoſited, and this, let it be ſuppoſed, of a white colour, the ſolution was changed, from which proceeded another thin layer; that the ſolution was again changed, and depoſited a third kind of matter; and after another change, a fourth kind, or perhaps that the depoſition of the firſt kind of matter again commenced. But if infiltration from an aqueous ſolution have really been the mode of formation of this mineral, how comes it, it may be fairly aſked, that the depoſitions from the different kinds of ſolution have not been arranged, at leaſt in the larger cavities, in ſtrata or zones parallel to the horizon; becauſe it ſeems natural to ſuppoſe that the depoſition of ſtony matter, from a ſtate of ſolution in water, would be influenced by gravitation, and thus be horizontally arranged? We are aware, indeed, of an objection which may be made to this obſervation. It will be ſaid, that the influence of gravity has in this caſe been counteracted by the action of affinity between the ſtony matter in ſolution, and the ſides of the cavity in which the agate is formed; but whatever effect this might have in the ſmaller cavities, its influence would be diminiſhed in thoſe of larger capacity.

Claſſification.

To what we have now ſaid on this ſubject, which, it muſt be acknowledged, is more curious than uſeful, we ſhall only add a circumſtance which, ſo far as we know, has not been noticed by geologiſts; but it ſeems to be of conſiderable importance in the eſtabliſhment or ſubverſion of the theory of the formation of agate by means of infiltration in the ſtate of aqueous ſolution. It will be allowed, we preſume, that all agates found in the ſame horizontal poſition, or at the ſame depth from the ſurface, from which the aqueous ſolution is underſtood to have proceeded, were formed from the ſame ſolutions; at leaſt thoſe agates which are contiguous to each other, that is, within the ſpace of a few yards, or even of a ſingle yard. Now, if this be admitted, all the agates which have derived their materials from the ſame ſolutions, ought to be exactly of the ſame kind, becauſe their origin is cotemporaneous, and it is derived from the ſame ſolutions. To aſcertain this point with preciſion, it will be neceſſary to examine agates in their native repoſitories; and although we ſhall not pretend confidently to decide the queſtion, becauſe our obſervations with this view have not been ſufficiently varied and extenſive, yet we ſtrongly ſuſpect, that it will appear, from future inveſtigations, that agates, and even ſuch as are almoſt contiguous to each other, have been formed of very different materials, or of ſimilar materials arranged in a very different manner. To thoſe who are fond of ſuch ſpeculations we recommend this as a ſubject of inveſtigation.

Localities.—Agates are found in great abundance in different parts of the world. They are ſometimes diſtributed indiſcriminately with the rocks which contain them, ſometimes in beds or layers, in interrupted maſſes, and ſometimes in thin beds, where there is ſcarcely any interruption of continuity. This laſt mode of arrangement, however, is rare. Agates are ſometimes found in metallic veins, or are mixed with metallic ſubſtances,

2 as

Classification. as the sulphurets of lead and silver. It would appear, too, that agates also exist in primitive rocks. Saussure has observed them in granite, containing nodules of the same granite, and penetrated with iron pyrites. He has observed also at the same place, near Vienne, in the department of Isere, thin layers of calcedony alternating with gneis; but porphyries and similar rocks are the usual repositories of agate. These stones are found in great variety and abundance at Oberstein, in the department of Mont-Tonerre, in France, in a rock of amygdaloid of a peculiar nature, and full of cavities of all sizes. This rock is considered by Dolomieu as a volcanic tufa; but according to other mineralogists, and particularly Faujas de St Fond, who has given a minute description of it *, it is considered as a porphyry or amygdaloid, with a basis of trap, which is very subject to decomposition. The globular masses of agate are disposed in this rock without any order, and are usually enveloped with a peculiar greenish earth, but which contains no copper. In the geodes of agate found at Oberstein, jasper, amethyst, carbonate of lime in crystals, chabasie, a species of zeolite, and some portion of titanium, have been observed; but not the least trace of any organized body. Digging, polishing, and forming into a great variety of ornamental objects, constitute the chief employment of the inhabitants of Oberstein.

* *An. du Museum D'Hist. Nat.* III. 53.

Agates are found in abundance in different parts of Scotland: but the largest and finest are met with in the neighbourhood of Montrose and Stonehaven; in the rocks near Dunbar on the east coast, and in the rocks about Dunure, on the shore of Carrick in Ayrshire.

32. Species. Hyalite.

Id. Kirw. i. 296. *Muller's glass* of the Germans. *Lava glass* of many.

Exter. Char.—This substance is found in grains or masses, or in thin layers on other minerals. It has much the appearance of gum, and is usually cracked. The lustre is shining and vitreous; fracture conchoidal, sometimes foliated; fragments sharp edged.

Colour grayish white or yellowish; and, according to Kirwan, pure white. Translucent, sometimes semitransparent; has considerable hardness, and is brittle. Spec. grav. 2.110.

Chem. Char. Infusible at 150° Wedgwood, but melts with soda.

Constituent Parts.

Silica	57
Alumina	18
Lime	15
With some traces of iron	

Localities, &c. Hyalite is found in rocks of amygdaloid, or wacken, near Franckfort on the Maine.

33. Species. Opal.

This species is divided into four subspecies or varieties.

Subspecies 1. *Precious Opal.*

Opal, Kirw. i. 289. *L'Opale Noble*, Brochant, i. 341. *Quartz-resinite Opalin*, Hauy, ii. 434.

Siliceous genus. *Exter. Char.*—This mineral is found massive or disseminated, and sometimes in veins; internal lustre splendent and vitreous; fracture perfectly conchoidal; fragments sharp-edged.

Colour milk-white, clear or pale, and sometimes bluish gray; and by holding it in different lights, a very bright and varied play of colours, the principal of which are golden yellow, scarlet red, bright blue, green and gray, is seen. It is commonly translucent, rarely semitransparent; pretty hard and brittle. Spec. grav, 2. 114.

Chem. Char.—The precious opal treated with the blow-pipe splits and cracks, and loses its transparency, but is not melted.

Constituent Parts. Klaproth.

Silica,	90
Water,	10
	100

Localities. The finest opals are found at Czerwenitza not far from Caschau in Upper Hungary, in an argillaceous decomposed porphyry, which according to some mineralogists is a gray stone (graustein of the Germans), and are disposed in veins, nests, and grains. When the opal adheres in small particles closely together in the stone, it forms what is called *mother* of opal. It is found in the same manner in a kind of breccia of this decomposed porphyry. (Townson's Travels in Hungary, p. 307.) It is found also at Eeibenstock, Johann-Georgenstadt, and Freyberg in Saxony. At this latter place the repository of the opal is porphyry. The opal also is met with in Iceland.

The opal mines described by Dr Townson are situated in a hill of some miles in extent not far from the village of Czerwenitza. This hill has been opened in several places, but in three with the greatest success. Guards are placed upon it to prevent any person from digging this precious stone; for as it is situated in part of the royal domain, the peasants who were formerly permitted to search for it on their own account are now prohibited by the emperor. But even at the time Dr Townson visited the mines the work had been discontinued for three or four years as unprofitable. The usual mode of conducting the operations in searching for the opal is by quarrying to the depth of three or four yards, rarely deeper. The rock is thus thrown out, broken to pieces, and afterwards examined. In one place the search had been made by mining; but the gallery was only a few yards in length. From this account it appears that the rock containing the opal lies near the surface, and seldom, it is said, extends deeper than a few fathoms. The opals denominated *oriental* by the lapidaries, a term expressive of their value rather than of their origin, are supposed to be from these mines, in which, according to records still in existence, 300 men were employed not less than 400 years ago.

Uses. On account of the fine play of colours, the opal is held in great estimation for the purposes of jewellery, and the opals which reflect green colours in most abundance are most highly valued. The finest opals are called oriental; but this epithet is given by the lapidaries to the more perfect precious stones, and is not to be understood as denoting that they have been brought from eastern countries.

Siliceous genus.

The ancients, it would appear from the account of Pliny, attached an immenfe value to this ftone; for he informs us that a fenator called Nonius rather fubmitted to banifhment than give up an opal which he had in his poffeffion to Mark Anthony. This opal was eftimated at 20,000 fefterces. Lib. xxxvii. cap. 6.

Subfpecies 2. *Common Opal.*

Semi opal, Kirwan i. 290. *L'Opale Commune*, Brochant i. 344. *Quartz refinite Hydrophane* et *Quartz-refinite Girafol*, Hauy ii. 433.

Exter. Char.—Common opal is found in maffes, or diffeminated, fometimes in rounded or angular pieces, and fometimes kidney-fhaped or botryoidal. Internal luftre fplendent, and intermediate between vitreous and refinous. Fracture conchoidal, but fometimes uneven. Fragments fharp edged.

Colour milk white, and varieties of this colour held in certain directions appear of a wine yellow. The other fhades of colour are yellowifh or reddifh white, and wax or honey yellow. Semitranfparent and fometimes tranfparent. Specific gravity from 1.958 to 2.015. In other characters the fame as the precious opal.

Chem. Char.—Infufible before the blow-pipe, but melts with borax, and without fwelling up.

Conftituent Parts. Klaproth.

From Kozemutz.		From Telkobanya.	
Silica	98.75	Silica	93.50
Alumina	0.10	Oxide of iron	1.00
Oxide of iron	0.10	Water	5.00
Lofs	1.05	Lofs	-
	100.00		100.00

Localities, &c. The common opal is found in veins, chiefly in amygdaloid rocks, and fometimes alfo, it is faid, in granites and porphyries. It is of moft frequent occurrence in Bohemia; in Saxony, as at Freyberg, Eibenftock, &c.; in Hungary, in Poland, in Scotland, and the Faroe iflands. The amygdaloid rocks in the vicinity of the Giants Caufeway in the north of Ireland alfo afford a repofitory for this mineral.

Ufes.—It is employed as well as the former for the purpofes of jewellery, but is efteemed of inferior value.

It has been obferved of fome varieties of common opal that they are hydrophanous, that is, they poffefs the property of becoming tranfparent when immerfed in water, a property which it is fuppofed depends on the abforption of the water in the pores of the opal. When fimilar varieties of opal are dipped in melted wax, they are impregnated with it, and become in like manner tranfparent, but on cooling refume their opacity. To fuch varieties De Born has given the name of *Pyrophane.*

Subfpecies 3. SEMI-OPAL.

Id. Kirwan i. 290. *La Demi-opale*, Brochant i. 347. *Quartz Refinite Commune, et Menilite*, Hauy ii. 433.

Exter. Char.—This mineral is found in maffes or diffeminated, in angular fragments, ftalactitical, botryoidal, or in fuperficial layers. Luftre glimmering or fhining, and intermediate between vitreous and refinous. Fracture conchoidal, and frequently even. Fragments fharp edged.

Classification.

Colours extremely various, but in general duller and lefs vivid than common opal. The moft predominant are yellowifh, grayifh and reddifh white, more rarely milk white. Various colours are fometimes difpofed in fpots, ftripes, and clouds. Tranflucent at the edges, and fometimes, but rarely, femitranfparent. Pretty hard and brittle. Spec. grav. 2.540.

Chem. Char.—Infufible before the blow-pipe, but melts with borax and without frothing up.

Conftituent Parts. Klaproth.

Silica	43.50
Oxide of iron	47.00
Water	7.50
Lofs	2.00
	100.00

Localities, &c. The femi-opal is found in the fame places and in fimilar rocks with the common opal, as in bafalt and amygdaloid, but chiefly in granite and porphyry, and particularly in the veins of fuch rocks containing filver.

Some varieties of pitch ftone have been ranked with femi-opal by mineralogifts; and menilite, a mineral to be afterwards defcribed, has been alfo confidered merely as a variety of it.

Subfpecies 4. WOOD OPAL.

Ligniform Opal, Kirwan i. 295. *Opale Ligniforme*, Brochant i. 350. *Quartz refinite Xyloide*, Hauy ii. 439.

Exter. Char.—This variety of opal is found in maffes of different fizes, retaining the form and texture of the wood which is fuppofed to be penetrated with the ftony opaline matter. Luftre internally weakly fhining, between vitreous and refinous. Tranfverfe fracture conchoidal, longitudinal fracture fhows the woody texture. Fragments fharp-edged.

Colours grayifh and yellowifh white, yellowifh brown and ochre yellow. Different colours are fometimes arranged in concentric circles, in fpots, and ftripes. Often opake, but rarely tranflucent except at the edges. Intermediate between hard and femi-hard. Brittle. Spec. grav. 2.600.

Localities, &c. The wood opal is found at Pornick near Schemnitz in Hungary, and at Telkobanya in the fame country.

34. Species. MENILITE.

Pitchftone, Kirwan i. 292. Variety of *flint* of fome, and *Semi-opal* of Klaproth.

Exter. Char.—This mineral is found in tuberofe maffes, which have a fmooth ribbed furface, and are fometimes covered with a whitifh cruft. Internal luftre weakly fhining. Tranfverfe fracture flat, conchoidal; longitudinal, coarfe, fplintery. Fragments fharp edged.

Chefnut brown colour, and marked with alternating ftripes of pearl gray and reddifh brown. Tranflucent. Pretty hard and brittle. Spec. gr. 2.185.

Conftituent

Classification.

Constituent Parts. Klaproth.

Silica	85.50
Alumina	1.
Oxide of iron	.50
Lime	.50
Water and carbonaceous matter	11.50
Loss	1.
	100.00

Localities, &c. This mineral is found at Menil-Montant, from which it derives its name, near Paris, in nodules disposed in interrupted strata, in the middle of a foliated, argillaceous schistus, which is interposed between the beds of gypsum.

35. Species. JASPER.

Jasper has been divided into six subspecies, 1. Egyptian; 2. Striped; 3. Porcelain; 4. Common; 5. Agate, and 6. Opal.

Subspecies 1. EGYPTIAN JASPER.

Egyptian Pebble, Kirwan i. 312. *Le Jaspe Egyptien*, Brochant i. 332.

Exter. Char.—This variety of jasper is found in rounded pieces, which are generally spherical, and have a rough surface. External lustre glimmering or weakly shining; internal weakly shining. Fracture perfect conchoidal; fragments sharp-edged.

The colours of this variety are disposed in zones or irregular stripes, which are nearly concentric. These colours are yellowish brown on a ground of chesnut brown; usually opaque, or slightly translucent at the edges. Spec. grav. 2.56 to 2.6.

Chem. Char.—Infusible before the blow-pipe.

Localities, &c.—This mineral, as its name imports, is brought from Egypt, where, as was observed by Cordier, it constitutes part of a breccia which is entirely composed of fragments of siliceous stones, immense strata of which are found in that country, and the deserts of Africa in the vicinity. The masses of jasper are found among the sand which has been derived from the decomposition of this breccia, and particularly near Suez.

Uses.—This variety, on account of its hardness and beautiful colours, is in considerable estimation for ornamental purposes.

Subspecies 2. STRIPED JASPER.

Id. Kirw. i. 312. *Le Jaspe Rubané*, Broch. i. 334. *Quartz-Jaspe Onyx*, Haüy, ii. 430.

Exter. Char.—This variety of jasper is found massive, and sometimes forms entire beds. It has no lustre, except from the mixture of extraneous substances. Fracture conchoidal, sometimes splintery or earthy. Fragments sharp-edged.

To the variety of colours of this mineral it owes its name. These are pearl gray, yellowish and greenish gray, with shades of red and blue, and these different colours are arranged in straight or curved lines; generally opaque, translucent only at the edges.

Siliceous genus.

Localities, &c.—This variety of jasper abounds in Siberia: it is found also in Saxony, in the Hartz, where it reposes on gray wacken; in Sicily; and in the hills in the vicinity of Edinburgh.

Subspecies 3. PORCELAIN JASPER.

Porcellanite, Kirw. i. 313. *Le Jaspe Porcelaine*, Broch. i. 336. *Thermantide Porcellanite*, Haüy, iv. 510.

Exter. Char.—Usually found in masses or angular pieces, in which rents or fissures are often observed, and also in whole beds. Internal lustre glimmering or weakly shining; resinous. Fracture imperfect conchoidal or uneven. Fragments sharp-edged.

The colour exhibits great variety; pearl, ash, yellowish and bluish gray, with shades of yellow, red, and rarely green. The colour is generally uniformly the same, but sometimes it is striped and dotted, flamed and clouded; impressions of vegetables of a red colour are observed on the blue varieties, and the rents or fissures are of a red colour in the grayish specimens; is entirely opaque; pretty hard, and easily frangible.

Chem. Char.—Melts before the blow-pipe into a black slag.

Constituent Parts. Rose.

Silica,	60.75
Alumina,	27.27
Magnesia,	3.
Potash,	3.66
Oxide of iron,	2.50
	97.18
Loss,	2.82
	100.00

Localities, &c.—This mineral is abundant in different parts of Bohemia; it is met with also in Saxony, in the rocks in the vicinity of Edinburgh, and on the coast of Fife near Dysart in Scotland.

This jasper derives its name from its fracture, which resembles that of porcelain; and as it is frequently found in places where subterraneous fires have existed, such as beds of coal which have been kindled by accident, it is ascribed to their action; and according to Werner, it is nothing more than a slaty clay altered by fire.

Subspecies 4. COMMON JASPER.

Id. Kirw. i. 310. *Jaspe Commun*, Broch. i. 338.

Exter. Char.—This variety is usually found massive, sometimes disseminated, or alternating in thin layers with other stones. Lustre glimmering or shining, between vitreous and resinous. Fracture more or less perfectly conchoidal, sometimes splintery or earthy. Fragments sharp-edged.

Colours extremely various, exhibiting different shades of red, yellow, and black; and several of these are united together, presenting clouds, spots, and stripes. Usually opaque, or slightly translucent at the edges. Is scratched by quartz. Easily frangible. Spec. grav. 2.3 to 2.7.

Chem. Char.—Entirely infusible before the blow-pipe.

Siliceous genus.

pipe. Its conſtituent parts are extremely variable. The following were obtained by the analyſis of Kirwan.

Silica,	75
Alumina,	20
Oxide of iron,	5
	100

Localities, &c.—This jaſper is very common in different parts of the world; in Saxony, Bohemia, Hungary, France, Spain, Italy, Siberia, and alſo in Scotland, as among the baſaltic rocks at Dunbar. It is uſually found in veins, eſpecially ſuch as contain ores of iron. It is often traverſed with veins of quartz, or mixed with pyrites, lithomarga, ſemiopal, brown ſpar, native and vitreous ſilver. It has been taken for the baſis of ſome porphyries, but theſe turn out to be indurated clay, pitch ſtone, and horn ſtone.

Subſpecies 5. Jasper Agate.

Exter. Char.—This variety ſeems to be the ſame as that already mentioned under the name of *agate jaſper*, in ſpeaking of agates at the end of the deſcription of calcedony. It is found maſſive, and poſſeſſes no luſtre. Fracture conchoidal, generally opaque, pretty hard, and ſometimes adheres to the tongue. The colours are yellowiſh or reddiſh white, which are diſpoſed in ſtripes and circles.

Localities, &c.—It is met with in many places in agate balls, in amygdaloid rocks.

Subſpecies 6. Opal Jasper.

Exter. Char.—This variety of jaſper ſeems to poſſeſs many common characters with ſome varieties of opal. It is found maſſive. Internal luſtre between vitreous and reſinous, is ſhining or reſplendent. Fracture conchoidal. Fragments very ſharp edged.

Colours ſcarlet red, blood red, browniſh red, more rarely yellow. Colours diſpoſed in veins, ſpots, and clouds. Opaque, or tranſlucent at the edges. Brittle, and eaſily frangible.

Localities, &c.—This mineral is found in Hungary, in Siberia, and other places, and is uſually in neſts in porphyry.

Beſide the localities of the different varieties of jaſper already mentioned, we may notice that it is met with in Siberia of a white and bluiſh colour. The hill on which the fortreſs of Orſkaia ſtands on the left bank of the river Jaik, in the government of Orembourg, is entirely compoſed of a pale green and deep red jaſper, diſpoſed in inclined beds; and on the moſt elevated parts of the Altaian mountains, near the ſource of the river Korgou, a jaſper has been diſcovered of an ivory white colour, which is remarkable for being penetrated with black dendrites.

Uſes of Jaſper.—It is valued according to its hardneſs, the degree of poliſh of which it is ſuſceptible, and the beauty and variety of its colours; and it is employed in forming vaſes, handles for ſwords and knives, and other ſmaller ornamental purpoſes.

36. Species. Heliotrope, or *Bloodſtone.*

Heliotropium, Kirw. i. 314. *L'Heliotrope*, Broch. i. 276. *Quartz-jaſpe Sanguin*, Haüy, ii. 436.

Claſſification.

Exter. Char.—Heliotrope is found maſſive or in angular pieces; external luſtre glimmering or ſhining, and reſinous; fracture conchoidal, ſometimes uneven. Fragments very ſharp-edged.

Colour chiefly deep green, but of various ſhades, with ſpots of olive and yellow, but moſt frequently ſcarlet or blood red: tranſlucent at the edges: hard, eaſily frangible. Spec. grav. 2.62 to 2.7.

Chem. Char.—Entirely infuſible before the blow pipe.

Localities, &c.—This mineral was originally brought from the eaſt, but it has ſince been found in Siberia, in Bohemia, where it is met with in a vein, and in Iceland.

Uſes.—It is employed for ſimilar purpoſes with jaſper or agate.

By many mineralogiſts this mineral is conſidered as a variety of jaſper; hence it has been called oriental jaſper; and it is ſuppoſed by ſome to be a calcedony penetrated with green earth.

37. Species. Chrysoprase.

Chryſopraſium, Kirw. i. 284. *La Chryſopraſe*, Broch. i. 280. *Quartz-Agathe Praſe*, Haüy ii. 426.

Exter. Char.—This mineral is found maſſive, or in angular fragments: internal luſtre rarely glimmering; fracture even, ſometimes ſplintery; fragments ſharp-edged.

Colour apple-green, greeniſh gray, or leek-green; tranſlucent, ſometimes ſemitranſparent; leſs hard than calcedony and flint. Spec. grav. 2.25.

Chem. Char.—Infuſible before the blow-pipe, but loſes its tranſparency, and becomes white.

Conſtituent Parts.	Klaproth.
Silica,	96.16
Alumina,	.08
Lime,	.82
Oxide of iron,	.08
Oxide of nickel,	1.00
Loſs,	1.86
	100.00

Localities, &c.—Chryſopraſe is found at Koſemutz, in Upper Sileſia, in a mountain compoſed of ſerpentine, aſbeſtus, indurated talc, and lithomarga.

Uſes.—It is employed for ſimilar purpoſes as jaſper, and it is greatly eſteemed when it is of a fine apple-green colour. It is ſaid that ſome varieties of this mineral loſe their colour by being expoſed to moiſture, ſo that the jewellers, before uſing them, put them to the teſt, by keeping them for ſome time in a moiſt place.

38. Species. Plasma.

Id. Broch. i. 278. *Silex Plaſme*, Brongniart, ii. 398.

Exter. Char.—This mineral is found diſſeminated, in rounded pieces, and alſo in angular pieces. Internal luſtre glimmering or weakly ſhining; reſinous. Fracture conchoidal, even, and ſometimes ſplintery. Tranſlucent, and ſometimes even tranſparent in thin pieces.

Colour, various ſhades of green; and ſometimes different colours are diſpoſed in ſpots, ſtripes, and points. Nearly

Classification.

Nearly equally hard with calcedony. Brittle, and easily frangible.

Chem. Char.—It is infusible before the blow-pipe, but becomes white.

Localities, &c.—It is said by some, that this mineral has only been found among the ruins of Rome, but according to Brongniart and others, it has been found in the Levant, in Upper Hungary, and in Moravia, in a mountain of serpentine, where it is accompanied with flint.

Uses.—It appears that this mineral was much employed by the ancients for ornamental purposes.

39. Species. Cat's Eye.

Id. Kirw. i. 301. *L'Oeil de Chat*, Brochant, i. 292. *Quartz-Agathe Chatoyant*, Haüy, ii. 427.

Exter. Char.—This mineral, as it is brought from its native country, is usually cut and polished, so that its natural form is unknown; but it is supposed that it is met with in grains or rounded pieces. A mass described by Klaproth, which seemed to be in its natural state, had a quadrangular form, a rough surface, and considerable brilliancy. The lustre is resplendent and resinous. The cross fracture is uneven, the longitudinal fracture imperfectly foliated. Fragments more or less sharp-edged.

The colour is greenish yellowish and smoke gray, of various shades, and sometimes, but rarely, grayish or silvery white. It is translucent, rarely semitransparent. When it is cut, it reflects different rays of light by changing its position, a character, by which it is easily known. This is ascribed to small parallel fibres which appear in the interior of the stone. It is hard, easily frangible. Spec. grav. 2.625 to 2.660.

Chem. Char.—It melts with great difficulty by the action of the blow-pipe. Klaproth subjected it to the heat of a porcelain furnace, but it was not melted; it only lost its hardness, lustre, and transparency, and the colour became of a pale gray.

Constituent Parts.		Klaproth.
Silica	95.00	94.50
Alumina	1.75	2.00
Lime	1.50	1.50
Oxide of iron	0.25	0.25
Loss	1.50	1.75
	100.00	100.00

Localities.—Cats eye is brought from Ceylon and the Malabar coast, and also, it is said, from Egypt and Arabia; but always in the polished state. The only one known in its natural state was that above mentioned, which was presented to Klaproth by Mr Greville of London.

Uses.—This mineral is in great estimation as a precious stone, and it is usually cut for ring-stones.

The name is derived from its possessing the property of reflecting the light similar to the eye of the cat, and hence the term *chatoyant* among jewellers, which is expressive of this effect.

49. Species. Obsidian.

Id. Kirwan, i. 265. *Iceland agate* vulgo. *L'Obsidienne*, Brochant, i. 288. *Lave vitreuse Obsidienne*, Hauy, iv. 594.

Siliceous genus.

Exter. Char.—This mineral is found in masses, and sometimes in rounded pieces. Lustre resplendent, vitreous; fracture perfectly conchoidal; fragments very sharp-edged.

The most common colour of obsidian is perfectly black, sometimes greenish and grayish, black, blueish, greenish and smoke gray, and yellow and red, according to Humboldt; most commonly opaque, but sometimes translucent on the edges. It is hard and easily frangible. Spec. grav. 2.348.

Chem. Char.—Before the blow pipe obsidian melts into an opaque porous glass, of a grayish white colour.

Constituent Parts.

	Bergman.	Abilgaard.
Silica	69	74
Alumina	22	12
Oxide of iron	9	14
	100	100

	Descotils.	Drappier.	
Silica	72.0	74.	71.0
Alumina	12.5	14.	13.4
Lime		1.2	1.6
Oxide of iron and manganese	2.0	3.0	4.0
Potash and soda	10.0	3.3	4.0
Loss	3.5	4.5	6.0
	100.0	100.0	100.0

Localities, &c.—This mineral is found in Iceland, in Siberia, in the Lipari islands, in Hungary, in Madagascar, the island of Teneriffe, in Mexico, Peru, and some of the South sea islands. Humboldt discovered a variety of obsidian in New Spain, which was *chatoyant* in a considerable degree. The obsidian from Hungary is found in insulated pieces among detatched masses of granite, gneiss and decomposed porphyry. Obsidian was long supposed to have a volcanic origin; but it appears from the accounts of those who have visited Iceland, that it is not only found in the vicinity of Hecla, but everywhere, distributed like quartz and flint; and besides it is not unfrequent in countries where volcanoes were never known to exist.

Uses.—The fine colour and hardness of this stone have brought it into use for ornamental purposes. Among the ancient Mexicans and Peruvians it was employed as mirrors, some of which, it is said, are sometimes still found in the tombs of their ancient sovereigns (*Faujas Miner. des Volcans*, p. 308); and also for cutting instruments as knives and even razors. Hernandez saw the Mexican cutlers make a hundred knives of obsidian in the course of an hour. Obsidian, it is said, has also been used as mirrors for telescopes.

41. Species. Pitchstone.

Id. Kirwan, i. 292. *La pierre de poix*, Brochant, i. 353. *Petrosilex resiniforme*, Hauy, iv. 386.

Exter Char.—Pitchstone, which has received its name

Siliceous genus.

name from its resemblance to pitch, is found massive; sometimes in extensive beds and veins, and also forming entire mountains. Internal lustre shining and resinous. Fragments sharp-edged. In coarse and frequently small granular distinct concretions which have a smooth surface.

The colours are various shades of black, green, brown, red, and gray. Translucent, but commonly at the edges only. Brittle, and rather easily frangible. Spec. grav. of pitchstone from Saxony, 2.314; of black pitchstone from Arran 2.338; of pitchstone from Meissen, 1.645, Klaproth.

Chem. Char.—Fusible by the blow-pipe, and is converted into a white porous enamel.

Constituent Parts of pitchstone from Meissen of an olive green colour. Klaproth, Transl. ii. 207.

Silica	73
Alumina	14.50
Lime	1
Oxide of iron	1
Oxide of manganese	0.10
Soda	1.75
Water	8.50
Loss	1.5
	100.00

Localities, &c.—Pitchstone is found in great abundance in Saxony, in Hungary, and also in Siberia. It abounds also in Scotland, particularly in the island of Arran, where it is met with in beds, but chiefly in veins traversing the strata in the less elevated parts of the island. Pitchstone also forms the basis of a porphyry.

42. Species. Pearlstone.

Obsidienne Perlée, Brongniart, ii. 340. *Lave Vitreuse Perlée*, Haüy, iv. 495. *Volcanic Zeolite*, Fichtel. *Zeolitic Pitchstone* of others. See Klaproth, Transl. ii. 263.

Exter. Char.—Pearlstone almost always forms the ground or basis of a species of porphyry which contains roundish or longish vesicular cavities. Lustre pearly. Fracture seems imperfectly conchoidal; but is not very perceptible. Fragments blunt-edged.

Colour bluish, ash, greenish gray. Translucent at the edges. When breathed upon gives out the argillaceous odour. Not brittle, but easily frangible. Soft. Spec. grav. 2.340 to 2.548.

Chem. Char.—Before the blow-pipe froths up like zeolite, but is not fused.

Constituent Parts. Klaproth, ii. 267.

Silica	75.25
Alumina	12.
Oxide of iron	1.60
Lime	.50
Potash	4.50
Water	4.50
Loss	1.65
	100.00

Localities, &c.—Pearlstone is found near Tokay in Hungary, in strata alternating with those of argillaceous porphyry, and containing in its vesicles nodules of obsidian; it is also met with in the north of Ireland.

Classification.

43. Species, Pumice.

Id. Kirwan, i. 415. *La Pierre ponce*, Brochant, i. 443. *Ponce*, Brongniart, i. 332. *Lave vitreuse pumicée*, Haüy, iv. 495.

Exter. Char.—This mineral is found massive or disseminated, and it is always of a porous or vesicular texture.

Lustre glimmering, or a little shining and silky. Fracture fibrous; fragments blunt-edged.

Colour grayish white, bluish, or yellowish gray. Opaque, rarely translucent at the edges, sometimes semihard, but generally soft, very brittle, and very easily frangible. Spec. grav. 0.914.

Chem. Char.—Fusible before the blow-pipe, and is converted into a white glass.

Constituent Parts. Klaproth, ii. 208.

Silica	77.50
Alumina	17.50
Oxide of iron	1.75
Soda of potash	3.
Loss	.25
	100.00

Localities, &c.—Pumicestone has been supposed to be a volcanic production, because it is found in the vicinity of volcanoes; the Lipari islands are almost entirely composed of it, and there it is accompanied with obsidian. It is also found in Iceland and Teneriffe; in Hungary; and on the banks of the Rhine between Andernach and Coblentz.

Uses.—Pumice is very much employed in polishing stones, metals, glass, ivory, and in the preparation of parchment.

A rare variety of pumice is described by Brongniart in the form of vitreous filaments as fine as hair; the colour is a deep bottle green, and it melts by heat into a white enamel. This pumice is supposed to be projected from the volcano in the isle of Bourbon.

44. Species, Prehnite.

Id. Kirwan, i. 274. *La Prehnite*, Brochant, i. 295. *Prehnite*, Haüy, iii. 67.

Essen. Char.—Divisible by one distinct line only, and pretty clean; electric by heat.

Exter. Char.—Prehnite is found either massive or crystallized. The principal form of its crystals is a four-sided rhomboidal table, which is either perfect or truncated on all its edges, or a table with six faces, and an equal angle, or a large rectangular prism terminated by a bevelment which is somewhat obtuse. The crystals are usually grouped together, and united by their lateral faces; face of the crystals smooth; external lustre shining; internal weakly shining and pearly; principal fracture foliated, cross fracture fine-grained uneven; fragments but little sharp-edged.

Colour

Classification.

Colour green, olive green, mountain green, and greenish white; semitransparent, and sometimes transparent. Scratches glass slightly. Brittle, and easily frangible. Spec. grav. 2.609 to 2.696.

Chem. Char.—Fusible before the blow-pipe, into a white porous enamel.

Constituent Parts.

	Hassenfratz.	Klaproth.
Silica	50.	43.83
Alumina	20.4	30.33
Lime	23.3	18.33
Oxide of iron	4.9	5.66
Water	.9	1.83
Magnesia	.5	—
Loss	—	0.02
	100.0	100.00

Localities.—Prehnite was brought first from the Cape of Good Hope, by Colonel Prehn, whose name it now bears. It is also found in France, as in Dauphiny, where it exists in veins. It is not unfrequent in different parts of Scotland, as among the porphyry rocks six miles to the south of Paisley; in the neighbourhood of Dunbarton; and in the rocks round Edinburgh.

45. Species. Zeolite.

This species has been divided into four subspecies.

Subspecies 1. Mealy Zeolite.

Zeolite, Kirwan, i. 278. *La Zeolite Farineuse*, Brochant, i. 298. *Mesotype*, Haüy, iii. 151.

Exter. Char.—This variety is found massive or disseminated, and sometimes it is branched or coralloidal, and sometimes also it envelopes other zeolites with a thin crust. It is dull; fracture earthy; fragments blunt-edged.

Colour usually reddish or yellowish white, or flesh red, opaque, very brittle; does not adhere to the tongue. When scratched with the finger nail it gives out a dull sound.

Constituent Parts.	Pelletier.
Silica	50
Alumina	20
Lime	8
Water	22
	100

Localities, &c.—This variety of zeolite is found in Ireland, the Faro islands, and Sweden. It is frequent in different parts of Scotland, as at Dunbar, and several of the Western islands.

Subspecies 2. Fibrous Zeolite.

Zeolithe Fibreuse, Brochant, i. 299. *Mesotype*, Haüy, i. 151.

Exter. Char.—This variety is found massive, and sometimes in rounded pieces, composed of capillary crystals, divergent and radiating; internal lustre glimmering, or weakly shining, pearly or silky; fracture fibrous; fibres divergent; fragments wedge-shaped.

Siliceous genus.

Colour yellowish white, yellowish brown, snow white, and sometimes honey yellow, translucent; semihard, brittle, and easily frangible. Light.

Constituent Parts.	Meyer.
Silica	41
Alumina	31
Lime	11
Water	15
Loss	2
	100

Subspecies 3. Radiated Zeolite.

Zeolithe Rayonnée, Brochant, i. 301. *Mesotype*, Hauy, iii. 151.

Essen. Char.—Divisible parallel to the faces of a rectangular prism; electric by heat in two opposite points.

Exter. Char.—This variety is found massive, but most frequently crystallized: the primitive form is a rectangular prism with square bases; its common forms are a rectangular prism, truncated at each extremity by a four-sided pyramid, corresponding to the lateral faces; a four-sided rectangular prism with two broad and two narrow sides, and also terminated by four-sided pyramids, or a four-sided prism, nearly rhomboidal, the two sharp lateral edges of which, as well as the two obtuse terminal angles, are truncated. The crystals are united together in bundles; so that the acuminations only can be seen; the crystals are commonly smooth and shining; the internal lustre is weakly shining and pearly; fracture radiated: the rays broad or narrow; fragments wedge-shaped.

Colour yellowish, grayish, reddish, and snow-white; translucent, sometimes transparent; semihard; scratches calcareous spar; brittle, and easily frangible. Spec. grav. 2.0833.

Chem. Char.—Before the blow-pipe it froths up, gives out a phosphorescent light, and is converted into a porous enamel. With acids it forms a gelatinous substance.

Constituent Parts.	Vauquelin.
Silica,	50.24
Alumina,	29.30
Lime,	9.46
Water,	10.
Loss,	1.
	100.00

Subspecies 4. Foliated Zeolite.

Zeolithe Lamelleuse, Brochant, i. 302. *Stilbite*, Hauy, iii. 161.

Essen. Char.—Fusible into a spongy enamel, but not electric by heat.

Exter. Char.—This variety of zeolite is usually found in amygdaloidal or globular pieces, and also crystallized; primitive form of its crystals is a rectangular prism with rectangular bases; the usual forms of its crystals are,

Siliceous genus.

are, a ſhort equiangular ſix-ſided priſm with two broad, two narrower, and two very narrow faces; a table with ſix equal faces, and a rhomboidal priſm. Surface of the cryſtals ſmooth and ſhining; internal luſtre ſhining and pearly; fracture foliated; the plates moſt frequently curved with a ſimple cleavage.

Colour ſimilar to the former; it is tranſlucent or ſemitranſparent; ſemihard, and eaſily frangible. Spec. grav. 2.5.

Chem. Char.—Froths up and phoſphoreſces, under the blow-pipe; placed on hot coals, it becomes white and is eaſily reduced to powder. It is not converted into a jelly by acids.

Conſtituent Parts.	Vauquelin.
Silica,	52.
Alumina,	17.5
Lime,	9.
Water,	18.5
Loſs,	3.
	100.0

Localities, &c.—The different varieties of zeolite are uſually found in amygdaloid rocks, baſalts, porphyry, ſlate, wacken, and green ſtone. They often line the ſides of fiſſures paſſing through theſe rocks, and are accompanied with calcareous ſpar, calcedony, ſometimes with native copper and native ſilver, as in Iceland. The fineſt zeolites are brought from the iſlands of Faroe, Iceland, Ædelfors in Sweden. The different varieties are not unfrequent in Scotland. The fibrous and radiated kinds are met with extremely beautiful in the iſlands of Cannay and Skye; the foliated or ſtilbite in the iſland of Staffa, in Skye, and in the lead veins at Strontian.

46. Species. Cubizite.

La Zeolithe Cubique, Brochant, i. 304. *Analcime, &* *Chabaſie*, Hauy, iii. 180.

Eſſen. Char.—Original forms of the cube, fuſible into a glaſs.

Exter. Char.—This mineral is found maſſive or cryſtallized; the form of the cryſtals is a perfect cube, which is its primitive form. This is ſometimes truncated on all its angles by three ſmall triangular faces, or with twenty-four equal and ſimilar trapezoids like the garnet. The external luſtre is reſplendent, vitreous, or pearly. Internal ſhining or weakly ſhining. Fracture imperfectly foliated, almoſt uneven. Fragments imperfect cubes.

Colour white, yellowiſh, grayiſh, or reddiſh white. It is tranſlucent or opaque. Semihard. Spec. grav. about 2 (Hauy). Difficult to produce any ſigns of electricity; hence the name *analcime*, ſignifying want of power, given to it by Hauy.

Chem. Char.—Froths up before the blow-pipe, and melts into a porous glaſs.

Localities, &c.—Cubizite is found in Skye, in Staffa, and in the Saliſbury rocks near Edinburgh. Fine ſpecimens of cubizite are abundant at the Giants cauſeway in the north of Ireland. Chabaſie is found alſo at Oberſtein in Germany.

Claſſification.

By many mineralogiſts chabaſie and analcime are conſidered as one ſpecies; but more nearly inveſtigated, as has been done by Hauy and others, they muſt appear very different. The preceding deſcription refers chiefly to analcime. We ſhall ſhortly ſtate the principal characters of chabaſie from Hauy, iii. 176.

Eſſen. Char.—Diviſible into a rhomboid ſlightly obtuſe, and eaſily fuſible hy heat.

Exter. Char.—Chabaſie is commonly cryſtallized. Primitive form of the cryſtals is a ſlightly obtuſe rhomboid, whoſe plane angle at the ſummit is about $93\frac{1}{2}°$, ſo that it approaches nearly to the cube; integrant molecule the ſame. Six of the edges are truncated, the truncations uniting three and three at the two oppoſite angles, and the remaining ſix angles are alſo truncated. It appears alſo in the form of double ſix-ſided pyramids applied baſe to baſe, having the ſix angles at the baſe, and the three acute edges of each pyramid truncated.

Colour whitiſh, ſometimes reddiſh, but this ſeems to be owing to a ſuperficial cruſt. Luſtre ſhining or reſplendent and vitreous. Tranſparent or tranſlucent.

Chem. Char.—Is eaſily fuſible before the blow-pipe, and melts into a whitiſh ſpongy maſs.

47. Species. Cross stone.

Staurolite, Kirwan, i. 282. *Pierre Cruciforme*, Brochant i. 311. *Harmotome*, Hauy iii. 191.

Eſſen. Char.—Diviſible into a rectangular octahedron, which may be ſubdivided on the angles contiguous to the ſummits.

Exter. Char.—This mineral is always cryſtallized. Its uſual forms are, a double cryſtal compoſed of two broad priſms, with four rectangular faces, and terminated at each extremity by a four-ſided obtuſe pyramid placed on the lateral edges. Theſe two priſms croſs each other by their broader faces, ſo that the faces of the acumination meet together, and the double cryſtal thus formed having four right-angled re-entering angles, reſembles a croſs. The cryſtals are obliquely ſtreaked. External luſtre ſhining and reſplendent, vitreous. Internal weakly ſhining. Fracture foliated.

Colour grayiſh or milky white, tranſlucent, ſometimes ſemi-tranſparent. Semi-hard, ſcratches glaſs ſlightly. Spec. grav. 2.333 to 3.61.

Chem. Char.—Before the blow-pipe it is fuſible, and froths up. The powder thrown on hot coals is phoſphoreſcent, giving out a greeniſh yellow light.

Conſtituent Parts.

	Klaproth.	Taſſaert.
Silica	49	47.5
Barytes	18	16.
Alumina	16	19.5
Water	15	13.5
Loſs	2	3.5
	100	100.0

Localities. This mineral has been found in veins at Andreaſberg in the Hartz, accompanied by carbonate of lime, from which it is ſometimes called *andreolite*. It is alſo found in the lead veins at Strontian in Scotland, and in balls of agate at Oberſtein. In the latter place, cryſtals are ſingle.

48. Species.

48. Species. LAUMONITE.

Zeolithe Efflorescente, Hauy, iv. 410. *Id.* Brochant, ii. 530.

Exter. Char.—This mineral is found in masses which are composed of irregular groups of crystals crossing each other in all directions. Form of the crystals is a four-sided prism, nearly rectangular, and terminated by a base inclined to one of the lateral edges under an angle of 133°; frequently the acute angle is truncated, and thus terminating in a bevelment placed on the acute lateral edges. The lateral faces are longitudinally streaked, and the lustre is shining. The faces of the summit are also shining, but smooth. Fracture foliated, and parallel to the lateral faces.

Colour grayish white, somewhat pearly. Is translucent, rather soft; sectile, and easily frangible.

But all these characters are considerably different by the action of the air. The whole mass is gradually separated, and the crystals become opaque, falling into friable folia, which are in a short time reduced to a snow-white powder, from which it derives the name given to it by Hauy.

Chem. Char.—Fusible before the blow-pipe, without frothing up, into a white enamel, and forms a jelly with acids.

Localities.—This mineral was found in 1788 by Gillet Laumont, in the lead mines of Huelgoët in Brittany in France, and from him it derives its name. It forms a small vein contiguous to the vein of galena. We have collected specimens of a mineral, whose characters in general correspond with laumonite, in a vein traversing a basaltic rock in the island of Skye. It seems, however, to be less liable to disintegration by exposure to the air.

49. Species. DIPYRE.

Id. Brochant, ii. 508. *Id.* Hauy, iii. 242.

Essen. Char.—Divisible parallel to the faces of a regular 6-sided prism. Fusible with intumescence.

Exter. Char.—This mineral is found in small fascicular masses or crystals. Lustre shining, vitreous. Longitudinal fracture foliated.

Colour grayish or reddish white, and sometimes pale rose red. Semi-hard; scratches glass, and is easily frangible. Spec. grav. 2.630.

Chem. Char.—Fusible. The powder thrown on hot coals produces phosphorescence.

Constituent Parts.	Vauquelin.
Silica	60
Alumina	24
Lime	10
Water	2
Loss	4
	100

Localities, &c.—This mineral has only been found at Mauleon, in the Pyrenees, in a rock of steatites. It was discovered by Lelievre and Gillet Laumont, in 1786.

50. Species. NATROLITE.

Id. Klaproth. *Id.* Brongniart, i. 370.

Exter. Char.—This mineral is found in masses, in a rock of amygdaloid. External surface somewhat rough; internal lustre glimmering; fracture fibrous and radiated.

Colour brownish yellow, inclining to olive, and different colours appear in parallel and waved zones; is translucent at the edges; scarcely scratches glass; is easily frangible. Sp. grav. 2.16.

Chem. Char.—Is reduced by the blow-pipe to a white glass. Nitric acid produces no effervescence, but converts it in a few hours to a thick jelly.

Constituent Parts.	Klaproth.
Silica	48
Alumina	24
Soda	16
Water	9
Oxide of iron	1.75
Loss	1.75
	100.00

Localities, &c.—Natrolite has been found only at Roegau, near the lake of Constance in Switzerland, in the cavities of an amygdaloid rock. The name is derived from natron or soda, of which it contains so large a proportion.

51. Species. AZURITE.

Lazulite, Klaproth, Analyt. Essays, i. 170. *Le Lazulithe*, Broch. i. 315.

Exter Char.—This mineral has been found disseminated, massive, and crystallized in rectangular four-sided prisms. Lustre glimmering and shining. Fracture imperfectly conchoidal.

Colour indigo, Prussian, or deep smalt blue; streak lighter blue; nearly opaque, or translucent at the edges; hardness, nearly that of quartz. Brittle and easily frangible.

Chem. Char.—Infusible before the blow-pipe, but loses its colour, becomes earthy, and of a clear gray. With borax it produces a bright yellow glass. Acids have a very feeble action upon it. Klaproth ascertained that it is composed of silica, alumina, and oxide of iron; but the quantity which he operated on was too small to ascertain the proportions.

Localities, &c.—This mineral has been found at Vorau in Styria, in a rock of micaceous schistus, where it forms, along with grayish quartz and silvery white mica, a vein of about half an inch thick.

52. Species. LAZULITE.

Lapis Lazuli, Kirw. i. 283. *La Pierre d'Azure*, Broch. i. 313. *Lazulite*, Hauy, iii. 145.

Exter. Char.—This mineral is found massive, disseminated, and in rounded fragments; internally dull, and rarely glimmering. Fracture earthy, or fine-grained uneven; fragments sharp-edged.

Siliceous genus.

Colour azure blue; opaque, or translucent on the edges; hard, or semihard; brittle and easily frangible. Spec. grav. 2.76, to 2.94.

Chem. Char.—It retains its colour at the temperature of 100° Wedgwood; but with a stronger heat froths up into a yellowish hard coloured mass. By increasing the heat, it changes to a white enamel; with acids after calcination, forms a jelly.

Constituent Parts.

	Klaproth. *Analyt. Ess.* i. 169.
Silica	46
Alumina	14.5
Carbonate of lime	28
Sulphate of lime	6.5
Oxide of iron	3
Water	2
	100.0

Localities, &c.—This mineral is found in Persia, Natolia, and China, and it is supposed that its repository is among granite. It has been found also in Siberia, near the lake Baikal, where it forms a vein along with garnets, feldspar, and pyrites. It is frequently mixed with pyrites, and a grayish white feldspar.

Uses.—This stone, when it is of a fine blue colour, and free from white spots, is held in great estimation for various ornamental purposes; but it derives its greatest value from its use in painting. The colour which it furnishes is called *ultramarine.* To prepare it, the stone is first calcined, and then reduced to an impalpable powder, which is mixed with a paste composed of resinous matters, of wax and linseed oil. From this mixture a powder is obtained by washing, which being dried affords the colouring matter. This colour, when used in painting, is not susceptible of change.

53. Species. Hydrargillite.

Wavellite of Dr Babington and others.

Exter. Char.—This mineral is found crystallized. The crystals are very minute, and are attached to quartz, in tufts or bundles, which diverge from a common centre. It is also found closely compacted together, in the form of mammillary protuberances of the size of small peas, and adhering to each other. The crystals, when magnified, appear to be four-sided, and, when broken, the section seems to be rhomboidal. The crystals have sometimes the appearance of fine down, and sometimes are of the size of a hair. Lustre silky.

The colour is white, with a shade of gray or green; usually opaque, and sometimes semitransparent. The texture is loose; but the small fragments are so hard as to scratch agate. Spec. grav. 2.25 to 2.70.

Chem. Char.—Infusible before the blow-pipe; but the crystals, exposed suddenly to strong heat, decrepitate.

Classification.

Constituent Parts.

	Davy, Nich. Jour. xi. 153.	Gregor. ibid. xiii. 247.
Alumina,	70.	58.70
Silica,	–	6.12
Lime	1.4	.37
Oxide of iron,	–	.19
Water,	26.2	30.75
A portion of fluoric acid,		
	97.6	96.13

Localities, &c.—This mineral was first discovered by Dr Wavell, in a quarry near Barnstaple. Mr Hatchett found it, in 1796, filling the cavities and veins of a soft argillaceous schistus. It has since been found in Stenna-Gwyn mine, in the parish of St Stephen's, Cornwall, where it is accompanied with sulphuret of tin, copper, and iron.

54. Species. Andalusite.

Adamantine Spar, Kirwan, i. 337. *Spath Adamantin*, Bournon, Jour. de Phys. 1789. *Feldspath Apyre*, Haüy, iv. 362.

Exter. Char.—This mineral is found massive, and crystallized in rectangular four-sided prisms, the summits of which are obliterated. Lustre weakly shining and resinous. Longitudinal fracture foliated. Cross fracture a little splintery. Colour reddish brown or violet; translucent at the edges. Very hard; scratches quartz, and sometimes even spinelle. Difficultly frangible. Spec. grav. 3.165.

Chem. Char.—Infusible before the blow-pipe.

Localities, &c.—This mineral was first discovered by Bournon in the granitic rocks of Forez, where it occupies a vein of common feldspar. It has been found also in Spain, where it enters into the composition of a granite, and frequently contains scales of mica. When first discovered, it was supposed to be a variety of adamantine spar or corundum; but its inferior spec. grav. and the difference in the structure of its crystals, afford sufficient characteristic differences.

55. Species. Feldspar.

This species is divided into the five following subspecies: 1. Adularia. 2. Labradore stone. 3. Common feldspar. 4. Compact feldspar. 5. Hollow spar.

Subspecies 1. Adularia.

Moonstone, Kirwan, i. 322. *L'Adulaire*, Brochant, i. 371. *Feldspath Nacré*, Haüy, ii. 606.

Exter. Char.—This mineral is found massive or crystallized. The forms of its crystals are, 1. A four-sided rhomboidal prism. 2. A perfect rhomb, more or less oblique. 3. A rectangular four-sided table, with oblique terminal faces. 4. A six-sided prism. 5. A six-sided table. Surface of the crystals smooth or longitudinally streaked. Lustre shining or resplendent. Internal lustre resplendent, vitreous, or pearly. Fracture foliated. Cleavage double. Fragments rhomboidal.

Colour yellowish, greenish, or milk-white: is sometimes

Classification.

times chatoyant. Is always translucent; sometimes semitransparent. Hard; scratches common feldspar. Brittle, and easily frangible. Spec. grav. 2.500 to 2.561.

Chem. Char.—Adularia before the blow-pipe cracks and splits, and then melts into a white glass.

Constituent Parts.

	Vauquelin.	Westrumb.
Silica	64	62.50
Alumina	20	17.50
Lime	2	6.50
Potash	14	—
Magnesia	—	6.
Oxide of iron	—	1.40
Sulphate of barytes	—	2.
Water	—	.25
Loss	—	3.85
	100	100.00

Localities, &c.—This mineral was first found by Pini in one of the summits of St Gothard in Switzerland; this summit is called Adula, and from this it takes its name. It is said that it forms particular beds, interposed between micaceous schistus and gneis. It is accompanied with quartz, mica, and common feldspar.

Subspecies 2. LABRADORE STONE.

Id. Kirwan, i. 324. *La Pierre de Labrador*, Brochant, i. 369. *Feldspath Opalin*, Haüy, ii. 607.

Exter. Char.—This mineral is found massive, and in rounded pieces. Internal lustre shining, sometimes resplendent; pearly, or vitreous. Fracture perfectly foliated, with a double cleavage.

Colour, most commonly dark or deep ash gray; but by varying its position it reflects different colours, as blue, green, yellow, brown, and red; and these colours exhibit stripes, spots, and dots. It is strongly translucent. Spec. grav. 2.6 to 2.7.

Chem. Char.—Before the blow-pipe fusible into a white enamel.

Constituent Parts.	Bindheim.
Silica,	69.5
Alumina,	13.6
Sulphate of lime,	12.
Oxide of copper,	.7
Oxide of iron,	.3
Loss,	3.99
	100.00

Localities, &c.—This stone was first brought from the island of St Paul, near the coast of Labradore, whence its name. It has been since found in Bohemia, and near the lake Baikal in Siberia. It is rarely found in its native repository, but it is supposed to belong to primitive rocks; for it is accompanied with schorl, mica, and hornblende.

Uses.—The brilliancy of its colours, and particularly its chatoyant property, have brought it into use in jewellery.

Siliceous genus.

Subspecies 3. COMMON FELDSPAR.

Id. Kirwan, i. 316. *Le Feldspath Commun*, Brochant, i. 362. *Feldspath*, Haüy, ii. 590.

Exter. Char.—Feldspar is found massive, disseminated, in rounded pieces, or crystallized. Its forms are, 1. A broad six-sided prism with unequal angles, terminated at each extremity by an obtuse bevelment, whose faces are placed on the two lateral edges. 2. A four-sided rhomboidal prism. 3. A four-sided rectangular prism, having the lateral edges sometimes truncated; and 4. A six-sided table. Double crystals are sometimes met with. Lustre shining; internal lustre also shining, sometimes resplendent, vitreous or pearly. Fracture perfectly foliated; fragments rhomboidal.

Colours milk-white, yellowish, grayish, reddish, and greenish. Translucent; scratches glass; brittle, and easily frangible. Spec. grav. 2.437 to 2.704.

Chem. Char.—Before the blow-pipe melts into a white glass.

Constituent Parts.

	Vauquelin.	Kirwan.	Chenevix.
Silica,	62.83	67	64.
Alumina,	17.2	14	24.
Lime,	3.	—	6.25
Oxide of iron,	1.	—	2.
Potash,	13.	—	—
Barytes,	—	11	—
Magnesia,	—	8	—
Loss,	3.15	—	3.75
	100.00	100	100.00

Localities, &c.—Feldspar is one of the most common substances, and the most universally distributed in nature. It does not exist, however, in large masses. It forms one of the component parts of granite, gneis, syenite, and porphyry.

When exposed to the action of the air, it is very liable to decomposition, and then it is converted into a white earthy mass, which is employed in the manufacture of porcelain. This is the kaolin of the Chinese.

Subspecies 4. COMPACT FELDSPAR.

Continuous Feldspar, Kirw. i. 323. *Le Feldspath Compacte*, Broch. i. 367. *Feldspath Compacte Bleu*, Haüy, ii. 605.

Exter Char.—This variety is found massive, and also in rounded pieces. Lustre weakly shining, or only glimmering. Fracture imperfectly foliated, sometimes splintery. Fragments not very sharp edged.

Colour bluish white, greenish or yellowish; translucent, but sometimes only at the edges. Streak white; is scratched by quartz.

Chem. Char.—Fusible before the blow-pipe.

Localities, &c.—Compact feldspar is found in Saxony, and in the Tyrol. It is not uncommon in Scotland, as in the Grampian mountains, on the Pentland hills, and Salisbury rocks in the neighbourhood of Edinburgh. The crystals of feldspar observed in antique

tique green porphyry, are ſuppoſed to belong to this variety.

Species 5. Hollow Spar, or *Chiaſtolite.*

Macle, Broch. ii. 514. *Id.* Hauy, iii. 267.

Eſſen. Char.—Diviſions parallel to the faces of a priſm, ſlightly rhomboidal. A black ſubſtance ſurrounded by another of a whitiſh colour.

Exter. Char.—This mineral has been found only cryſtallized in four-ſided, nearly rectangular priſms. The ſummit is always broken, by which the arrangement of the two ſubſtances is obſerved. The white part is the outermoſt; the black matter forms in the centre a ſmall priſm, whoſe ſides correſpond with thoſe of the outer cryſtal. From the angles of the central priſm proceed four narrow lines, which extend to each of the angles of the outer priſm; and ſometimes this black ſubſtance forms at the extremity of theſe lines, or in the angles of the large priſm, a ſimilar ſmall priſm of black matter. The black matter is an argillaceous ſchiſtus, ſimilar to the repoſitory of the cryſtals. The white part is ſometimes weakly ſhining; internal luſtre glimmering, reſinous. The black part is nearly dull. Fracture foliated; the black part earthy.

The colour of the white part, yellowiſh, or grayiſh white; that of the black part, grayiſh, or bluiſh black. Opaque, or tranſlucent. Semihard, ſcratching glaſs when foliated. Streak white. Brittle; not very frangible. Spec. grav. 2.944. Communicates to ſealing wax, negative electricity by friction.

Chem. Char.—Before the blow-pipe, the white part melts into a whiter glaſs; the black part into a black glaſs.

Localities, &c.—This mineral has been found in Brittany in France, imbedded in argillaceous ſchiſtus; in the Pyrenees, in a ſimilar rock, lying immediately on granite, near St Jacques de Compoſtella in Spain; and in the mountains of Cumberland, alſo imbedded in argillaceous ſchiſtus.

The name *chiaſtolite* is derived from the appearance of the ſection of the cryſtal, which is ſuppoſed to have ſome reſemblance to the Greek letter χ.

56. Species. Scapolite.

Scapolithe, Brochant, ii. 526. *Id.* Haüy, iv. 393. *Rapidolithe*, Abilgaard.

Exter. Char.—This mineral has been found maſſive, but moſt frequently cryſtallized in rectangular, four-ſided priſms, having the lateral edges truncated. The cryſtals are ſmall, ſometimes acicular, commonly elongated and aggregated. Their ſurface is longitudinally ſtreaked and glimmering. Internal luſtre weakly ſhining, vitreous or reſinous. Fracture foliated.

Colour grayiſh white; tranſlucent, or rarely tranſparent. Scratches glaſs, and is brittle. Spec. grav. 3.68 to 3.70.

Chem. Char.—Froths up before the blow-pipe, and melts into a white enamel.

Localities, &c.—This mineral has been found in the mines of iron ore near Arendal in Norway. The cryſtals are mixed with mica and calcareous ſpar.

57. Species. Arctizite.

Wernerite, Haüy, iii. 119. *Id.* Brochant, ii. 529.

Eſſen. Char.—Spec. grav. 3.6. Phoſphoreſcent by heat, but not by percuſſion.

Exter. Char.—This mineral is found maſſive, or cryſtallized in four-ſided rectangular priſms, terminated by an obtuſe four-ſided pyramid. The lateral edges are truncated, ſo that the priſm appears to be eight-ſided. Cryſtals ſmall; luſtre reſplendent, ſometimes weakly ſhining, and pearly or reſinous. Fracture foliated. Folia curved in two directions.

Colour between piſtachio green and iſabella yellow. Tranſlucent. Scratches glaſs, and ſtrikes fire with ſteel. The powder thrown on hot coals phoſphoreſces in the dark.

Chem. Char.—Before the blow-pipe it froths up, and eaſily melts into an imperfect, white, and opaque enamel. Inſoluble in nitric acid.

Localities, &c.—This mineral is found in the iron mines of Northo and Ulrica in Sweden, Bouoen near Arendal in Norway, and at Campo Longo in Switzerland.

58. Species. Diaspore.

Id. Brochant, ii. 507. *Id.* Haüy, iv. 358.

Exter. Char.—This mineral is of a gray colour. Luſtre ſhining, pearly. Fracture foliated, with the folia a little curved; ſeparates into rhomboids, with angles about 130° and 50°; ſcratches glaſs. Spec. grav. 3.432.

Chem. Char.—A fragment of this ſtone heated for a little in the flame of a candle decrepitates and diſperſes in all directions; from this property it obtained its name, which ſignifies *to diſperſe*. Heated in a cloſe crucible to prevent the fragments from flying off, they were reduced to white ſhining particles, ſomewhat reſembling boracic acid.

Conſtituent parts.	Vauquelin.
Alumina	80
Oxide of iron	3
Water	17
	100

Localities, &c.—The repoſitory of this mineral is unknown. It was connected with an argillaceous ochrey rock.

This mineral approaches nearly to hydrargillite or wavellite, deſcribed above, in its conſtituent parts; but the proportions and ſome of the external characters are different.

59. Species. Spodumene.

Id. D'Andrada, Jour. de Phyſ. an 8. p. 240. *Triphane*, Haüy, iv. 407. *Id.* Brochant, ii. 528.

Exter. Char.—This mineral is found in ſmall maſſes, which preſent ſome appearances of cryſtallization. Luſtre ſhining, pearly. Fracture in the maſs radiated, of ſingle

Classification. Siliceous genus.

single crystals foliated and divisible in three directions, which sometimes afford an oblique angled prism of about 100° and 80°. Cross fracture dull, rough, and splintery. In larger masses the fracture is radiated. Lustre shining pearly. Scratches glass.

Colour greenish white or leek green. Translucent at the edges. Brittle. Spec. grav. 3.192 to 3.218.

Chem. Char.—Before the blow-pipe it separates at first into small yellowish plates, and then melts into a grayish white transparent glass.

Constituent Parts.	Vauquelin.
Silica	56.5
Alumina	24
Lime	5
Oxide of iron	5
Loss	9.5
	100.0

Localities, &c.—This mineral has been found in the mines of Utoe near Dalero in Sweden. Its repository seems to be a vein, where it is accompanied with quartz and black mica.

The name triphane has been given to this mineral by Hauy from its peculiar three-fold natural divisions. It received the name spodumene, which signifies *covered with ashes* from D'Andrada.

60. Species. MEIONITE.

Id. Hauy ii. 586. *Id.* Brochant ii. 519.

Essen. Char.—Divisible parallel to the faces of a prism with square bases. Easily fusible into a spongy white glass.

Exter. Char.—It is found crystallized in four-sided rectangular prisms whose lateral edges are always truncated. It is terminated by an obtuse four-sided pyramid set on the lateral edges. Sometimes the lateral edges are doubly truncated, thus forming a sixteen-sided prism. The crystals are small, adhering laterally and arranged in rows to the matrix. Lustre shining, vitreous. Longitudinal fracture foliated, and parallel to the four faces of the prism. Cross fracture slightly conchoidal.

Colour grayish white. Semi-transparent. Scratches glass.

Chem. Char.—Melts very easily before the blow-pipe with considerable intumescence accompanied with a hissing noise.

Localities, &c.—This mineral has only been found on Vesuvius near Mount Somma. The crystals are usually attached to fragments of foliated limestone.

61. Species. SOMMITE.

Nepheline, Hauy iii. 186. *Id.* Brochant, ii. 522.

Essen. Char.—Divisible parallel to the sides and bases of a regular six-sided prism. With difficulty scratches glass.

Exter. Char.—This mineral is found disseminated in grains or in small crystals, which are commonly perfect six sided prisms. The lateral faces are smooth and shining, with a vitreous lustre. Longitudinal fracture foliated. Cross fracture conchoidal and shining. Colour grayish white. Translucent, rarely semitransparent. The sharp points scratch glass, the others leave only a white trace. Easily frangible. Specific gravity 3.2441.

Chem. Char.—Fusible into a glass by long continued heat. Becomes opake in nitric acid, hence the name *nepheline*, signifying *cloudy*, given to it by Hauy.

Constituent Parts.	Vauquelin.
Silica	46
Alumina	49
Lime	2
Oxide of iron	1
Loss	2
	100

Localities, &c.—This mineral is found lining the cavities of rocks on Mount Somma, from whence its name *sommite*. It is accompanied with vesuvian and black schorl, all which are supposed by some to be ejected matters from Vesuvius.

62. Species. ICHTHYOPHTHALMITE.

Id. D'Andrada. *Ichthyophthalme*, Brochant, ii. 552. *Apophyllite*, Hauy. *Id.* Brongniart, i. 385.

Exter. Char.—This mineral is found massive, and crystallized in rhomboids which approach nearly to the cube; in thick six-sided tables, and in rectangular four-sided tables, with truncated edges. Lustre shining, pearly. Fracture foliated; cleavage single; cross fracture fine grained uneven, and weakly shining.

Colour yellowish or greenish white; translucent or semitransparent. Scratches glass; not easily frangible. Spec. grav. 2.46.

Chem. Char.—Exposed to the blow-pipe, is with difficulty reduced to a white enamel. In nitric and muriatic acids it forms a jelly.

Constituent Parts.	Fourcroy and Vauquelin.
Silica,	51
Lime,	28
Potash,	4
Water,	17
	100

Localities, &c.—This mineral is found in the iron mine of Utoe in Sweden, imbedded in a violet-coloured limestone, and accompanied with greenish hornblende and oxide of iron.

IV. ARGILLACEOUS GENUS.

1. Species. NATIVE ALUMINA.

Native Argil, Kirw. i. 175. *L'Alumine Pure*, Brochant, i. 318.

Exter. Char.—This mineral is found in kidney-form masses; it has no lustre; fracture earthy; fragments blunt edged.

Colours snow or yellowish white; opaque; stains a little; tender or friable; adheres a little to the tongue. feels meagre; gives out an earthy smell when breathed on. Spec. grav. 1.305 to 1.66.

Chem.

Argillaceous genus.

Chem. Char.—Before the blow-pipe is abſolutely infuſible, but diſſolves almoſt entirely in acids.

Conſtituent parts.	Fourcroy.
Alumina	45
Sulphate of lime	24
Water	27
Lime and ſilica	4
	100

But according to the analyſis of others, it is compoſed almoſt entirely of pure alumina, mixed only with a ſmall proportion of lime and ſilica.

Localities, &c.—It is found at Halle in Saxony, in part of the garden belonging to the college, immediately under the ſoil; but being only in ſmall quantity, and in the neighbourhood of a large laboratory, has led to the ſuppoſition that it is an artificial production. It is ſaid that it has been alſo found at Magdeburg in Lower Saxony, in Sileſia, near Verona, and in England.

2. Species. Porcelain Earth.

Porcelain clay, Kirw. i. 178. *La Terre Porcelaine*, Brochant, i. 320. *Argile Kaolin, et Feldſpath Argilliforme*, Haüy, ii. 616.

Exter. Char.—This mineral is found maſſive, or diſſeminated; has no luſtre; ſtains ſtrongly; has little coherence; adheres a little to the tongue.

Colour reddiſh, yellowiſh, or grayiſh white.

Chem. Char.—Infuſible in the ſtrongeſt heat of a furnace.

Conſtituent Parts.	Vauquelin.	
Silica	55.	71.15
Alumina	27.	15.86
Lime	2.	1.92
Oxide of iron	.5	
Water	14.	6.73
Loſs	1.5	4.34
	100.0	100.00

Localities, &c.—This mineral is found in conſiderable abundance in beds and veins, in granite and gneis, eſpecially when the proportion of feldſpar is conſiderable. It abounds in China and Japan, where it is known by the name of kaolin; in Bohemia, Saxony, Denmark, and particularly in many places of France, as at Limoges and Bayonne, and in Cornwall in England. In many caſes it ſeems to be owing to the decompoſition of granite.

Uſes.—Porcelain earth, as its name imports, is employed either as it is found native, or mixed in certain proportions with other earths, in the manufacture of porcelain. That from Limoges in France is employed without any addition.

3. Species. Common Clay.

This ſpecies is divided into five ſubſpecies: 1. loam; 2. pipe clay; 3. potters clay; 4. variegated clay; and 5. ſlaty clay.

Claſſification.

Subſpecies 1. Loam.

Exter. Char.—This mineral is found maſſive and in great abundance; has no luſtre; fracture uneven or fine earthy; fragments very blunt-edged; has little coherence; ſtains.

Colour yellowiſh-gray, or ſpotted with yellow and brown, feels ſomewhat greaſy, and adheres ſtrongly to the tongue.

Localities, &c.—Loam is found in great abundance every where, and perhaps it ought to be conſidered as a mixture of different ſubſtances, rather than as a ſimple mineral.

Subſpecies 2. Pipe Clay.

Exter. Char.—This variety is found in great maſſes; has ſcarcely any luſtre; fracture fine earthy, or fine grained uneven; fragments ſharp-edged; has ſome coherence.

Colour grayiſh or yellowiſh white; ſtreak ſhining; feels greaſy, adheres ſtrongly to the tongue, and is eaſily frangible.

Localities, &c.—It is very abundant in moſt countries, and is uſually found in alluvial land.

Subſpecies 3. Potters Clay.

Id. Kirw. i. 180. *Argile à Potier*, Brochant, i. 322.

Exter. Char.—This variety is alſo found maſſive, and in great abundance. It is intermediate between ſolid and friable; has no luſtre; fracture fine grained earthy, ſometimes coarſe grained uneven; fragments blunt-edged.

Colour yellowiſh, greeniſh, or grayiſh white; ſometimes reddiſh or ochrey yellow of various ſhades. It is opaque, ſtains a little; ſtreak a little ſhining; very brittle, and eaſily frangible; is ſomewhat ductile; adheres a little to the tongue, and feels greaſy.

Chem. Char.—Is differently affected by the blow-pipe, according to the proportion of the different ſubſtances of which it is compoſed; but in general is difficult of fuſion. Effervesces with acids when the proportion of lime is conſiderable.

Conſtituent Parts.	Vauquelin.
Silica	43.5
Alumina	33.2
Lime	3.5
Oxide of iron	1.
Water	18.
Loſs	.8
	100.0

The proportions of ſilica and lime vary conſiderably; the ſilica is very often the predominant ingredient. Kirwan examined a potters clay, in which he found 63 parts of ſilica.

Localities, &c.—Potters clay is found in great abundance in moſt countries, and in ſimilar ſituations with the former. It often forms thick beds in alluvial land, alternating with beds of ſand.

Subſpecies 4. Variegated Clay.

Exter. Char.—This mineral is found maſſive. Has an

Classification.

an earthy fracture, a shining streak, and is soft or friable.

The colour is white, red, or yellow, and these different colours are sometimes in stripes, veins and spots. Adheres a little to the tongue, and feels somewhat greasy. It is sectile and light.

As this variety of clay forms with water a less tenacious mass than some of the other varieties, it probably contains a greater proportion of siliceous earth.

Localities, &c.—This mineral is found in Upper Lusatia.

Subspecies 5. SLATY CLAY.

Slate Clay, *Shale*, Kirwan, i. 182. *L'Argile Schisteuse*, Brochant, i. 327. *Argile Schisteuse Impressionée*, Hauy iv. 448.

Exter. Char.—This subspecies is found massive; internally dull, when free from mica; fracture slaty or earthy; fragments in tables.

Colour grayish, yellowish, or blackish, sometimes reddish or brownish; opaque; soft, sectile, and easily frangible. Adheres to the tongue; feels meagre. Sp. grav. 2.6 to 2.68.

Localities, &c.—Usually accompanies coal, so that it abounds in all coal countries. It is sometimes mixed with sand, mica, and iron pyrites. It is known in this country under the name of *shale*, and in Scotland particularly by that of *till*, or described under the more general denomination of one of the coal metals. Slaty clay is still farther distinguished by impressions of ferns, reeds, or grasses. When it is of a black colour, it seems to be owing to a greater proportion of coaly matter.

4. Species. CLAY STONE, or INDURATED CLAY.

Indurated Clay, Kirwan, i. 181. *L'Argile Endurcie*, Brochant, i. 325.

Exter. Char.—Indurated clay is always found massive; it is dull; fracture compact, or fine earthy; but sometimes splintery or even, and also sometimes slaty. Fragments more or less sharp edged, and sometimes in tables.

Colour usually bluish, yellowish, or greenish gray, and sometimes pearl gray, grayish red, whitish, and brownish. These colours are often mixed, and are arranged in spots and stripes. Opaque, soft, rather brittle; easily frangible; adheres slightly to the tongue; feels greasy. Spec. grav. inconsiderable. Gradually falls to pieces in water, or crumbles into powder. Has but little ductility.

Localities, &c.—Indurated clay is very common. It is found in veins, and sometimes in very extensive beds. It constitutes the basis of many porphyries, especially in Saxony, where it is abundant. It is found in many parts of Scotland, as on the Pentland hills in the neighbourhood of Edinburgh.

Stourbridge clay, according to Mr Kirwan, may be included under this variety. It is of a gray colour; does not adhere to the tongue; part is soon diffused in water, and another part falls into powder. Mr Kirwan found it to contain 12.5 of moisture, 12 of a coarse white sand, 30 of a fine brownish sand, and even the remaining or argillaceous part was not entirely freed from sand but by boiling in acids.

Argillaceous genus.

5. Species. ADHESIVE SLATE.

Le Schiste à Polir, Brochant i. 376. *Schiste à Polir*, Hauy, iv. 449. *Polishing Slate*, Klaproth, i. 455. Analyt. Ess. Transl.

Exter. Char.—This mineral is found massive; is always internally dull; has a slaty or fine earthy fracture; fragments slaty or in tables.

Colour clear gray, whitish or reddish; opaque or slightly translucent at the edges; gives a shining streak; is sectile, soft, and very easily frangible; adheres strongly to the tongue; feels meagre. Specific gravity 2.08.

Chem. Char.—Immersed in water, adhesive slate absorbs it greedily, air bubbles being rapidly disengaged and with noise; but does not become tenacious. When reduced to powder and calcined, it loses about one-fifth of its weight. Exposed to strong heat, it is converted into a dark gray or yellowish and porous slag. (Brochant.)

Constituent Parts.	Klaproth.	
Silica	66.5	62.5
Alumina	1.	.7
Magnesia	1.5	8.
Lime	1.25	.3
Oxide of iron	2.5	4.
Carbone	22.	.7
Water and air	19.	22.
Loss	2.25	1.8
	100.00	100.0

Localities, &c.—Adhesive slate forms considerable beds at Menil-Montant near Paris. In these beds menilite already described is found.

6. Species. POLISHING SLATE.

Le Polierschiefer, Brochant, i. 376.

Exter. Char.—This mineral is found massive; internally it is dull. Fracture slaty, but in some directions earthy. Fragments slaty or in tables.

Colour yellowish gray or white; and different colours appear disposed in stripes; is soft; adheres to the tongue; feels meagre, and is rather light.

Localities, &c.—This mineral has been found only, it is said, in Bohemia, near pseudo volcanoes, and it is supposed, that it is nothing more than indurated coal ashes. It approaches so near in the characters that are given of it to the following, that it might be included under the same species, or considered as a variety of it.

7. Species. TRIPOLI.

Id. Kirw. ii. 202. *Le Tripoli*, Broch. i. 379. *Quartz Aluminifere Tripoléen*, Hauy, iv. 467.

Exter. Char.—This mineral is found massive; is dull internally; has a coarse earthy fracture, sometimes slaty; fragments blunt-edged.

Colour yellowish gray, and sometimes browish red. Is soft and somewhat friable; meagre to the feel, but does not adhere to the tongue.

Chem. Char.—It is almost infusible before the blowpipe.

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pipe. It melts with borax without frothing up. It does not form a paste with water.

Constituent Parts. Haasse.

Silica,	90
Alumina,	7
Oxide of iron,	3
	100

Localities, &c.—This substance was formerly brought to Europe from Tripoli; hence the name; but it has since been found in many other places, as in Bavaria, Saxony, and Bohemia; in Russia and in England. It is found in the neighbourhood of basalts, sometimes forming veins; at Potschappel it is disposed in beds among the strata of coal, and near those places where strata of coal have been on fire.

Uses.—Tripoli is employed in polishing metals, precious stones, and glasses for optical instruments.

8. Species. FLOATSONE.

Exter. Char.—This mineral has been found in tuberose porous masses; it is dull, has an earthy fracture, and blunt-edged fragments.

The colour is yellowish gray or grayish white. It is soft and brittle; rough to the feel, and gives out a creaking sound. It is very light, from which it has its name.

Localities, &c.—Has been only found at St Omers near Paris.

9. Species. ALUM STONE.

La Pierre Alumineuse, Broch. i, 381.

Exter. Char.—This stone is found massive; is generally dull, rarely a little glimmering; fracture uneven, sometimes splintery; fragments not very sharp edged.

Colour grayish or yellowish white: it is soft, and sometimes semihard; stains a little, and adheres to the tongue.

Chem. Char.—This mineral does not effervesce with acids; but after being heated and dissolved in water, it affords alum. According to Bergman it contains 43 of sulphur, 35 of alumina, and 22 of silica; but the following is the result of Vauquelin's analysis.

Constituent Parts.

Alumina,	43.92
Silica,	24.
Sulphurous acid,	25.
Sulphate of potash,	3.08
Water,	4.
	100.00

Localities, &c.—This mineral has been long known under the name of the *stone of Tolfa,* from the name of the place where it is found near Rome, and where it forms a mountain which is traversed by veins of whitish gray quartz. It is from this stone that the Roman alum, so celebrated in commerce, is manufactured; and it has

Classification.

been supposed that the excellence of the alum may be owing to the mineral containing within itself all the ingredients necessary in the formation of that triple salt.

10. Species. ALUMINOUS SCHISTUS.

This is divided into two varieties or subspecies; 1. common; and 2. shining.

Subspecies 1. COMMON ALUMINOUS SCHISTUS.

Le Schiste Alumineux, Broch. i. 386.

Exter. Char.—This mineral is found in masses, which often contain pieces of a globular form. It is sometimes glimmering, and sometimes dull; fracture commonly slaty, and sometimes a little earthy; fragments in tables; streak the same as the colour of the mineral, a little shining.

Colour grayish black or brownish; is soft; meagre to the feel, and easily frangible.

Chem. Char.—When exposed to the air for some time it separates, and yields alum by lixiviation.

Localities, &c.—Aluminous schistus is abundant in Saxony, Bohemia, France, England, and some parts of Scotland. It is disposed in beds among stratiform rocks, and in transition rocks, and it is often traversed by veins of quartz. Being mixed with pyrites, the decomposition is thus promoted when exposed to the air.

Uses.—This mineral is dug out for the purpose of extracting alum, first by exposing it to the air or heat, and then by lixiviation.

Subspecies 2. SHINING ALUMINOUS SCHISTUS.

Le Schiste Alumineux Eclatant, Broch. i. 388.

Exter. Char.—This mineral approaches very nearly to the former in most of its characters, but in the direction of its principal fracture the external surface is smooth; lustre shining, or resplendent, resinous, and even somewhat metallic; in the opposite directions it is dull. Fracture commonly slaty, and somewhat curved; fragments in tables.

Colour intermediate between bluish and grayish black, and sometimes iron black. Colours in the rents iridescent.

In other characters and circumstances it resembles the former.

11. Species. BITUMINOUS SCHISTUS.

Le Schiste Bitumineux, Broch. i. 289. *Bituminous Shale,* Kirw. i. 183.

Exter. Char.—This mineral is found massive; lustre glimmering; fracture most commonly thin, rarely thick; fragments in the form of tables, sometimes trapezoidal.

Colour brownish black, sometimes gray, or blackish brown; soft, and easily frangible; adheres slightly to the tongue; streak shining; feels greasy.

Chem. Char.—When placed on burning coals it gives out a pale flame with a sulphureous odour, becomes white, and loses a good deal of its weight.

Localities, &c.—This mineral is peculiar to coal countries, which it always accompanies, and alternates with

Classification.

with slaty clay and coal. It is not unfrequent in Bohemia, Poland, England, and Scotland.

12. Species. Drawing Slate.

Black Chalk, Kirwan, i. 195. *Le Schiste à Dessiner*, Broch. i. 391. *Argile Schisteuse Graphique*, Haüy, iv. 447.

Exter. Char.—This mineral is found massive, usually dull; but in the direction of the principal fracture a little glimmering; fracture in certain directions curved slaty; in others fine grained earthy; fragments splintery or tabular.

Colour grayish or bluish black; opaque; stains black; soft; meagre to the feel.

Chem. Char.—Before the blow-pipe it becomes covered with a kind of varnish.

Constituent Parts.	Wiegleb.
Silica	64.50
Alumina	11.25
Carbone	11.
Oxide of iron	2.75
Water	7.50
Loss	3.
	100.00

Localities, &c.—Drawing slate frequently accompanies aluminous schistus. It forms along with it beds which are subordinate to clay slate. It is found in Italy, where it is an object of commerce. It is also found in Spain, France, and some parts of Scotland.

Uses.—As its name indicates, it is employed like black chalk in drawing.

13. Species. Whet Slate.

Novaculite, Kirw. i. 238. *Le Schiste à Aiguiser*, Brochant, i. 393. *Argile Schisteuse Novaculaire*, Haüy, iv. 448.

Exter. Char.—This mineral is found massive; is scarcely glimmering; fracture in large masses slaty, in small pieces splintery; fragments tabular.

Colour commonly greenish gray, or smoke gray, sometimes mountain green: translucent at the edges; semihard, but varying between hard and soft; rather easily frangible; streak grayish white; feels greasy; does not adhere to the tongue. Specific gravity 2.722.

Chem. Char.—Does not effervesce with acids, and is infusible before the blow-pipe.

Localities, &c.—Whet slate is found in primitive mountains, where it forms beds which are subordinate to clay slate. It was originally brought from the Levant; but has since been discovered in Bohemia, Saxony, in Bayreuth, where it is wrought, and in Siberia. An efflorescence has been observed on the surface, which is found to be sulphate of magnesia; from which it is naturally supposed that the base of that salt forms one of its constituent parts.

Uses.—Whet slate, as its name imports, is cut and polished for the purpose of sharpening knives and other instruments; and, reduced to powder, is employed in polishing steel.

Argillaceous Genus.

14. Species. Clay Slate.

Argillite, or *Argillaceous Schistus*, or *Slate*, Kirwan, i. 234. *Le Schiste Argilleux*, Brochant, i. 395. *Argile Schisteuse Tegulaire*, Haüy, iv. 447.

Exter. Char.—Clay slate is found massive, or disseminated, or in rounded pieces; internally it is a little shining or glimmering; rarely dull; the more the structure is foliated, the greater is its lustre. Lustre sometimes silky, pearly, or semimetallic. Fracture more or less slaty, sometimes curved and waved, sometimes earthy or splintery; fragments tabular, rarely splintery; sometimes cubic or rhomboidal.

Colour chiefly gray of various shades; but sometimes it is reddish, brownish, or yellowish, or reddish brown. Different colours are so disposed as to appear striped, waved, spotted, or dendritic. It is in general soft; sometimes semihard, sectile, and easily frangible. Gives a grayish white streak; feels greasy. Spec. grav. 2.67 to 2.88.

According to Kirwan, clay slate is composed of silica, alumina, lime, magnesia, and iron, with some bituminous particles.

Localities, &c.—Clay slate belongs equally to the primitive, transition, and stratiform rocks, and frequently forms entire mountains. Primitive clay slate is sometimes mixed with quartz, mica, hornblende, garnets, limestone, pyrites, cinnabar as at Idria; in general it abounds with metallic ores, either in veins or in beds.

Clay slate is very abundant in most countries; it is not unfrequent in many parts of Scotland; but the slate of Easdale, and the contiguous islands on the west coast, has long maintained a decided superiority and preference to all others in this country.

Uses.—Clay slate is in extensive use for covering houses, and then it is known in this country by the single word *slate*. It is also employed in large plates for writing on, or tracing characters that are afterwards to be effaced.

15. Species. Lepidolite.

Id. Kirwan, i. 208. *Id.* Haüy, iv. 375. *La Lepidolithe*, Brochant, i. 399.

Exter. Char.—Lepidolite is found massive, and disseminated in small plates, which might be taken for mica. It is usually glimmering, rarely shining. Lustre semimetallic. Fracture fine grained uneven, rarely foliated. Fragments blunt edged.

Colour lilac blue, grayish and reddish brown; translucent. Semihard; sometimes soft; easily frangible; and feels meagre. Is easily scraped with the knife; but is with difficulty reduced to powder by trituration. The powder rubbed between the fingers has a greasy feel. Spec. grav. 2.816 to 2.854.

Chem. Char.—Froths up under the blow-pipe, and melts into a transparent colourless globule; but with the addition of a little nitre it becomes violet.

Constituent

Argillaceous genus.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica	54.5	54
Alumina	38.25	20
Potash	4.	18
Fluate of lime	–	4
Oxide of iron and manganese	.75	1
Water and loss	2.5	3
	100.00	100

Localities, &c.—This mineral was first discovered in the mountain Gradisko near Rosena in Moravia, where it is found in considerable masses included in blocks of granite. It is found also in Sweden. Sometimes it is disseminated in quartz rock.

The name, from λεπις, "a scale," is derived from its scaly structure. Lepidolite was at first taken for fluate of lime or zeolite. A red coloured variety of schorlite was also supposed to be crystallized lepidolite.

16. Species. Mica.

Id. Kirw. i. 21. *Id.* Broch. i. 402. *Id.* Hauy, iii. 208.

Exter. Char.—Mica is most commonly disseminated in thin tables, rarely massive or crystallized. The primitive form of its crystals is a rectangular prism, whose bases are rhombs with angles of 120° and 60°; the integrant molecule is the same. The usual forms of its crystals are, a six-sided table with equal angles, sometimes very thick, which produces a six-sided prism, and the want of two of the faces produces the table with four rhomboidal faces; but the most common form of mica is in thin plates or scales of no determinate figure. The lateral faces of the bases of the tables are smooth and resplendent; lustre metallic; fracture foliated, sometimes curved or waved, and sometimes radiated; fragments in the form of plates.

Colour usually gray, ash, yellowish, greenish, and blackish gray; in thin plates semitransparent, or even transparent; otherwise, only translucent on the edges; semihard, very easily frangible; flexible and elastic. Sp. grav. 2.79 to 2.93.

Physical Char.—Mica rubbed on Spanish wax communicates to it negative electricity.

Chem. Char.—Before the blow-pipe it is with difficulty fusible into a whitish gray or green enamel. Black mica yields a black enamel, which is attracted by the magnet.

Constituent Parts.

	Vauquelin.	Bergman. Muscovy glass.	Kirwan. Colourless Mica.
Silica	50.	40	38
Alumina	35.	45	28
Lime	1.33		
Magnesia	1.35	5	20
Oxide of iron	7.	9	14
Loss	5.32		
	100.00	100	100

Classification.

Localities, &c.—Mica is one of the most common minerals, forming one of the constituent parts of granite, gneis, micaceous schistus, and other primitive rocks, and in some of them sometimes forms particular small veins. Mica also enters into the composition of stratiform rocks, as green stone, basalt, wacken.

Cat gold and cat silver are varieties of mica of a gold or silver colour, which have a considerable lustre, but inferior to that of these metals. It may be easily distinguished by the streak, which in the mica affords a whitish powder without any lustre.

Uses.—When mica is obtained in large and thin plates, it is employed as a substitute for glass, and for this purpose it has been used for windows of men of war, as on account of its elasticity it is less subject to be broken from the concussion produced by the firing of cannon.

17. Species. Pinite.

Micarelle, Kirw. i. 212. *La Pinite*, Broch. i. 456.

Exter. Char.—This mineral has been usually found crystallized in six-sided prisms, having all the lateral edges truncated, or only three alternating edges, or in four-sided rhomboidal prisms. The surfaces of the crystals smooth and a little glimmering; internally it is dull, sometimes a little shining in the cross fracture; the fracture is fine grained, uneven, or small conchoidal; fragments blunt-edged.

Colour reddish or blackish brown; opaque; the brown variety is slightly transparent; so soft as to be cut with a knife, when it becomes of a bluish black; powder bright gray; adheres a little to the tongue; feels greasy; sp. grav. 2.98.

Constituent Parts. Klaproth.

Alumina	63.75
Silica	29.50
Oxide of iron	6.75
	100.00

Localities, &c.—Pinite is found only near Schneeberg in Saxony, in the mine called *Pini;* hence its name. It is accompanied by quartz, feldspar and mica, which constitute a small grained granite.

18. Species. Potstone.

Id. Kirw. i. 155. *La Pierre Ollaire*, Broch. i. 405. *Talc Ollaire*, Hauy, iii. 257.

Exter. Char.—Potstone is found massive; internally it is dull, sometimes glimmering or a little shining, pearly; fracture curved slaty, rarely foliated or waved; fragments blunt edged, in the form of tables or scales.

Colour greenish gray, sometimes reddish or yellowish; opaque, rarely translucent on the edges; soft, sectile, and mild; feels greasy; by being breathed upon it emits the argillaceous smell. Spec. grav. 2.76 to 2.86.

Chem. Char.—Infusible before the blow-pipe; some varieties absorb a little water.

Constituent

Conſtituent Parts. Wiegleb.

Silica	38.12
Magneſia	38.54
Alumina	6.66
Lime	.41
Oxide of iron	15.02
Fluoric acid?	.41
Loſs	.84
	100.00

Localities, &c.—Potſtone is found at Chiavenna, in the Valteline, from which the ſpecimen above analyzed was obtained; at Como, in Switzerland, hence called *Como ſtone*. It is alſo found in Saxony, Hungary, and on the banks of Loch Fine oppoſite to Inverary in Scotland. Potſtone forms entire beds, and is uſually accompanied by ſerpentine, or it is in neſts; it is rarely pure, but mixed with chlorite, talc, aſbeſtus, &c.

Uſes.—On account of the refractory nature of this ſtone, it is employed in the conſtruction of furnaces where great heat is required; and as it may be cut or turned on the lathe, it has been formed into utenſils for the kitchen, and hence the name *potſtone*.

19. Species. CHLORITE.

Id. Kirw. i. 147. *La Chlorite*, Broch. i. 408. *Talc Chlorite*, Hauy, iii. 257.

Chlorite is divided into four ſubſpecies: 1. earthy; 2. common; 3. foliated; 4. ſchiſtoſe or ſlaty.

Subſpecies 1. EARTHY CHLORITE.

Exter. Char.—This mineral is compoſed of ſmall, ſcaly, thin, and ſlightly glimmering particles, cohering together, rarely in the form of powder.

Colour intermediate between mountain green and dark leek green; ſometimes browniſh; does not ſtain; feels greaſy, but does not adhere to the tongue; gives an earthy ſmell by breathing on it.

Chem. Char.—Melts before the blow-pipe into a gray or black enamel.

Conſtituent Parts. Vauquelin.

Silica	26.
Alumina	18.50
Magneſia	8.
Muriate of ſoda	2.
Oxide of iron	43.
Water	2.
Loſs	.50
	100.00

Localities, &c.—Earthy chlorite is always found in primitive mountains, forming beds which are ſubordinate to clay ſlate. It is found in Saxony, Switzerland, Savoy, and in Scotland.

Subſpecies 2. COMMON CHLORITE.

Exter. Char.—This is found maſſive and diſſeminated, or in thin ſuperficial layers on other ſtones; internal luſtre ſlightly glimmering, reſinous; fracture earthy, or foliated; fragments blunt-edged; ſoft, ſometimes ſemi-hard.

Colour ſimilar to the former, and ſometimes grayiſh white; is opaque, eaſily frangible; gives a light green ſtreak without luſtre.

Conſtituent Parts. Hoepfner.

Silica	41
Magneſia	39
Alumina	6
Lime	1
Oxide of iron	10
Loſs	3
	100

Localities, &c.—Common chlorite is found in the ſame places with the former, and indeed it is ſuppoſed to be earthy chlorite indurated. At Altenberg in Saxony, it is mixed with pyrites of copper and arſenic, and common hornblende.

Subſpecies 3. FOLIATED CHLORITE.

Exter. Char.—This variety is found maſſive, diſſeminated, and cryſtallized in the form of a ſix-ſided table ſomewhat elongated; ſeveral of theſe tables being united together, frequently form globular, kidney-form, or botryoidal groups. External luſtre glimmering or weakly ſhining; internal ſhining, reſinous, or pearly; fracture foliated; folia curved; cleavage ſimple; fragments in tables.

Colour intermediate berween leek and dark green; opaque, or tranſlucent at the edges; ſtreak light green; is ſoft, ſectile, eaſily frangible, and feels a little greaſy.

Conſtituent Parts. Lampadius.

Silica	35.
Magneſia	29.9
Alumina	18.
Oxide of iron	9.7
Water	2.7
Loſs	4.7
	100.0

Localities, &c.—This mineral has been only found on St Gothard in Switzerland; it lines the ſides of a vein which traverſes micaceous ſchiſtus. It is accompanied by cryſtals of green mica, adularia, and quartz.

Brochant ſuggeſts that foliated chlorite may perhaps be nothing elſe than a cryſtallized mica.

Subſpecies 4. SCHISTOSE CHLORITE.

Exter. Char.—This variety is found maſſive; internal luſtre weakly ſhining, ſometimes ſhining, reſinous; fracture curved ſlaty, ſometimes waved, or a little ſplintery; fragments tabular.

Colour green; is ſoft, ſectile, and eaſily frangible; ſtreak light green; feels a little greaſy; gives the earthy ſmell by breathing.

Localities, &c.—Slaty chlorite is found in Norway, Sweden, Switzerland, in different parts of Scotland, as on the banks of Loch Lomond, and in the iſlands of

Argillaceous genus.

Bute and Arran. Sometimes it forms very extenſive beds in mountains of clay ſlate, to which it is ſubordinate; and it is frequently accompanied by garnets and magnetic iron, cryſtallized in octahedrons. The name is derived from the Greek word which ſignifies green.

20. Species. HORNBLENDE.

This is divided into four ſubſpecies; 1. common; 2. baſaltic; 3. labradore; and 4. ſchiſtoſe.

Subſpecies 1. COMMON HORNBLENDE.

Hornblende, Kirw. i. 163. *Hornblende Commune*, Broch. i. 415. *Amphibole*, Hauy, iii. 58.

Exter. Char.—Hornblende is found maſſive or diſſeminated, and ſometimes cryſtallized. The forms are a four-ſided priſm, of which the acute oppoſite lateral edges are ſtrongly truncated; a ſix-ſided priſm with four broad and two narrow faces, ſlightly truncated on the lateral edges; a ſimilar ſix-ſided priſm, ſhort, and having the extremities bevelled; an eight-ſided priſm, having at its extremities, a convex bevelment. Sometimes the cryſtals are acicular and in groups; internal luſtre ſhining, vitreous, or pearly; fracture foliated, ſometimes radiated, and ſometimes fibrous; ſurface of the fracture longitudinally ſtreaked; fragments ſharp-edged, ſometimes rhomboidal.

Colour deep black, greeniſh black, or greeniſh gray; uſually opaque. The green varieties tranſlucent at the edges. Soft or ſemihard; not eaſily frangible; ſtreak greeniſh gray; gives an earthy ſmell by breathing on it: ſp. grav. 3.6 to 3.88.

Chem. Char.—Before the blow-pipe it melts eaſily into a grayiſh black glaſs.

Conſtituent Parts.

	Kirwan.	Hermann.
Silica	37	37
Alumina	22	27
Magneſia	16	3
Lime	2	5
Oxide of iron	23	25
Loſs		3
	100	100

Localities, &c.—Hornblende is one of the conſtituent parts of primitive rocks, as in ſienite; and it ſeems alſo to be an accidental ſubſtance, as in gneis, primitive limeſtone, porphyries, and micaceous ſchiſtus. It is found alſo in maſſes or entire beds, as in Saxony; and is very common in moſt countries, as in Norway, Hungary, and Britain.

Uſes.—Sometimes employed as a flux for ores of iron.

Subſpecies 2. BASALTIC HORNBLENDE.

Baſaltine, Kirw. i. 219. *Hornblende Baſaltique*, Roch. i. 424.

Exter. Char.—This mineral is moſt frequently found cryſtallized in equal ſix-ſided priſms, variouſly modified or with equal ſides; having two narrow and four broad; or four narrow and two broad; or three broad and three narrow alternately. The cryſtals are imbedded, inſulated, or grouped. Surface ſmooth, ſhining; internal luſtre reſplendent, in the croſs fracture weakly ſhining, vitreous; fracture foliated; croſs fracture ſmall grained, uneven, or conchoidal. Fragments nearly rhomboidal.

Claſſification.

Colour velvet black, and ſometimes with a ſhade of green; opaque; ſtreak grayiſh white; ſemihard; earthy ſmell by expiration. Spec. grav. 3.22 to 3.33.

Chem. Char.—Before the blow-pipe melts leſs eaſily than the preceding, into a black glaſs.

Conſtituent Parts.	Bergman.
Silica	58
Alumina	27
Lime	4
Magneſia	1
Oxide of iron	9
Loſs	1
	100

Localities, &c.—This mineral, as its name imports, is uſually found in baſalt. It is alſo met with in wacken, and in the lava of Veſuvius. It it not uncommon in the baſaltic rocks of Sileſia, Saxony, and Bohemia, as well as in thoſe of this country. As it is leſs liable to decompoſition than the rocks which contain it, detached cryſtals are frequently found among decayed baſalt.

Subſpecies 3. LABRADORE HORNBLENDE.

La Hornblende du Labrador, Broch. i. 419.

Exter. Char.—This mineral is found maſſive, diſſeminated, in rounded pieces, and very rarely cryſtallized in four-ſided rectangular priſms. Internal luſtre ſhining, ſomewhat metallic; fracture foliated, ſometimes curved.

Colour blackiſh green, or greeniſh black; ſometimes bronze yellow; ſcarcely tranſlucent at the edges; ſemihard; not difficultly frangible; ſtreak greeniſh. Spec. grav. 3.38.

Localities, &c.—This mineral is found in the iſland of St Paul on the Labradore coaſt, but nothing is known of the nature of its repoſitory.

Subſpecies 4. SCHISTOSE HORNBLENDE.

Id. Kirw. i. 222. *La Hornblende Schiſteuſe*, Broch. i. 428.

Exter. Char.—This variety is found maſſive; internal luſtre weakly ſhining; fracture in maſſes ſlaty; in ſmall pieces radiated, ſometimes fibrous; fragments in plates.

Colour greeniſh, or grayiſh black; opaque; ſemihard; ſtreak greeniſh gray; rather difficultly frangible; breathed on, gives the earthy ſmell.

Localities, &c.—Schiſtoſe hornblende forms extenſive beds in primitive mountains, to which it is ſubordinate. It ſeems to be common hornblende more or leſs mixed with quartz. It is found in Bohemia, Norway, Sweden, in the iſle of Skye, and other places of Scotland.

21. Species. BASALT.

Figurate Trap, Trap, Whinſtone, &c. Kirw. i. 225.—233. *Le Baſalte*, Broch. i. 430. *La Lithoide Priſmatique*, Hauy, iv. 474.

Exter.

Exter. Char.—Basalt forms entire mountains, in the neighbourhood of which it is found in rounded pieces, or in large globular masses; internally it is dull; sometimes glimmering from a mixture of hornblende; fracture uneven, sometimes fine splintery or conchoidal; fragments not very sharp-edged. It is most frequently in distinct concretions, which are prismatic or columnar, more or less regular; sometimes also in globular distinct concretions.

Colour grayish or bluish black, sometimes brownish on the surface; opaque; semihard; brittle, and very difficultly frangible; streak light ash gray; gives a ringing sound under the hammer. Spec. grav. 2.86 to 3.

Chem. Char.—Melts very easily before the blow-pipe into an opaque black glass which acts on the magnet.

Physical Char.—Many basalts affect the magnetic needle, reversing the poles when it is brought near them. This is ascribed to the great proportion of iron which enters into their composition.

Localities, &c.—Basalt is not uncommon in every part of the globe, and in many places it is very abundant. It is found in regular columns in several of the Hebrides on the west coast of Scotland, as in Cannay, Eigg, the Schant isles, but particularly beautiful in Staffa. Pretty regular columns are observed also at Dunbar, and on the south-west side of Arthur's-seat near Edinburgh; but the Giant's causeway and the rocks about Fairhead on the north coast of Ireland, exhibit the finest and most extensive ranges of columnar basalt in the world.

Basalt, besides being in the columnar form, is often disposed in beds and veins; both of which are very common in different places in Scotland, particularly on the western coast, and in the western islands. See *Williams's Mineral Kingdom.*

No subject, in geological speculation, has produced more controversial discussion than the origin of basalt; one party asserting that it is the effect of fusion, while another contends that it must have been deposited from an aqueous solution. Our limits preclude us even from barely stating the arguments which have been proposed by naturalists in support of the theories which different parties have embraced. For an account of some of them, see GEOLOGY *Index;* and for the constituent parts of basalt, and some other facts connected with its natural history, see BASALT.

Uses.—Basalt is sometimes employed as a touchstone, as a flux for ores of iron, and in the manufacture of common bottles. It is also employed for millstones. The ancients employed it in sculpture, for it would appear that some of their vases and statues were formed of it.

22. Species. WACKEN.

Id. Kirw. i. 223. *La Wakke*, Broch. i. 434.

Exter. Char.—Wacken is found massive; it is frequently vesicular, and the cavities are often filled with other minerals; internal appearance dull; fracture even or earthy; fragments rather blunt edged.

Colour grayish green, grayish black, reddish, or brownish; opaque; streak a little shining; soft or semihard; easily frangible; feels a little greasy. Spec. grav. 2.53 to 2.89.

Chem. Char.—Fusible like basalt.

Localities, &c.—Wacken belongs to the stratiform rocks. It contains sometimes petrified wood, and the bones of animals. It constitutes beds sometimes in the middle of basalt, but is oftener in the form of veins, and is the basis of amygdaloid, the cavities of which are filled with green earth, calcareous spar, &c. Wacken is met with in Saxony, Bohemia, Sweden, aud many places of Scotland.

23. Species. PHONOLITE, or *Clinkstone.*

Id. Daubuisson, Jour. de Phys. lx. 74. *La Pierre Sonnante*, Broch. i. 437. *Klingstein* and *Porphyrschiefer* of the Germans.

Exter. Char.—This mineral is always found massive; internal lustre glimmering; fracture slaty, sometimes uneven or conchoidal; fragments sharp-edged; composed of distinct concretions, which are either in the form of tables, or are columnar, and somewhat regularly grouped together.

Colour gray, ash, greenish, or bluish gray; the colours sometimes have a dendritical appearance; opaque, or translucent at the edges; semihard, or hard; not difficultly frangible; in thin plates it emits a sound when struck with a hammer, and hence its name. Spec. grav. 2.575.

Chem. Char.—Melts before the blow-pipe into a colourless glass.

Constituent Parts.

	Klaproth.	Bergman.
Silica	57.25	58.
Alumina	23.5	24.5
Lime	2.75	3.5
Oxide of iron	3.25	4.5
——— manganese	.25	—
Soda	8.1	6.
Water	3.	2.
Loss	1.9	1.5
	100.00	100.0

The stone analyzed above by Bergman, was from Puy in Velay, in France, and is considered by Dolomieu as volcanic. The other by Klaproth, is from Bohemia. Excepting the small proportion of manganese detected in the latter, the coincidence of the two analyses is very striking.

Localities, &c.—Phonolite is not uncommon in many parts of the world. It is met with in Scotland, in the island of Lamlash near Arran; and it constitutes the greater part of Traprene Law in East Lothian; in both places it is columnar.

24. Species. LAVA.

Id. Kirw. i. 400. *La Lave*, Broch. i. 440. *La Scorifiee*, Haüy, iv. 497.

Exter. Char.—This mineral is generally of a porous texture, with cavities of different sizes; lustre glimmering.

Argillaceous genus.

ing or a little ſhining, vitreous; fracture imperfectly conchoidal; fragments not very ſharp-edged.

Colour blackiſh gray, perfect black, or browniſh black, ſometimes greeniſh, and rarely white; opaque; ſemihard; brittle; not difficultly frangible; light.

Chem. Char.—Lava is very fuſible, and yields a compact black glaſs.

Conſtituent Parts.	Bergman.
Silica	49
Alumina	35
Lime	4
Oxide of iron	12
	100

Localities, &c.—Lava being a volcanic product, is only found in the vicinity of volcanoes.

Uſes.—Lavas are employed for the purpoſes of building; their lightneſs, ariſing from the numerous cavities, renders them proper for the conſtruction of vaults.

25. Species. Green Earth.

Id. Kirw. i. 196. *La Terre Verte*, Brochant, i. 445. *Talc Chlorite Zographique*, Haüy, iii. 257.

Exter. Char.—Green earth is found maſſive, or diſſeminated, or in ſuperficial cruſts on balls of agate; internally it is dull; fracture earthy; fragments blunt-edged.

Colour celadon green, or blackiſh green; opaque; ſoft; feels ſlightly greaſy; adheres a little to the tongue; ſtreak weakly ſhining.

Chem. Char.—Before the blow-pipe it becomes black, but is infuſible. It is not acted on by acids, and abſorbs water.

Conſtituent Parts.	Klaproth.
Silica	53.
Alumina	12.
Lime	2.5
Magneſia	3.5
Oxide of iron	17.
Water	12.
Loſs	1.
	100.00

Localities, &c.—Green earth is found at Verona, where it is wrought, and conſtitutes an article of commerce; and it is met with in all amygdaloid rocks.

Uſes.—Green earth is employed as a colouring matter in painting.

26. Species. Lithomarga.

Id. Kirw. i. 187. *La Moelle de Pierre*, Brochant, i. 447. *Argile Lithomarge*, Haüy, iv. 444.

This is divided into two ſubſpecies, chiefly diſtinguiſhed by their coheſion. Theſe are, 1. friable; 2. indurated.

Subſpecies 1. Friable Lithomarga.

Exter. Char.—This is found maſſive or diſſeminated; is ſlightly glimmering; adheres ſtrongly to the tongue; feels greaſy.

Claſſification.

Colour yellowiſh white, ſnow white, ſometimes reddiſh; the particles have very little coheſion.

Subſpecies. 2. Indurated Lithomarga.

Exter. Char.—This is alſo found maſſive or diſſeminated; is dull; has a fine grained earthy fracture, ſometimes conchoidal; blunt-edged.

Colour white, yellowiſh, or reddiſh white; browniſh red, and ſeveral ſhades of yellow. Different colours are diſpoſed in ſpots, veins, dots, ſtripes, or clouds; opaque; very ſoft; ſtreak ſhining; adheres to the tongue; feels greaſy.

Chem. Char.—Infuſible before the blow-pipe; falls to pieces in water without forming a paſte. According to ſome analyſes, it contains a large proportion of magneſia.

Phyſical Char.—Some varieties when rubbed with a feather in the dark, give a little light.

Localities, &c.—Lithomarga or ſtone marrow, derives its name from its being found in nodules in amygdaloid rocks; it occupies veins or ſmall fiſſures in porphyry, gneis, and ſerpentine. It is found in Bohemia, Saxony, France, England, and at the Giant's cauſeway in Ireland. A variety of lithomarga, which exhibits many fine colours, particularly violet or lavender blue, is found in beds repoſing on coal at Planitz, near Zwickau in Saxony. It has been called, from its beautiful appearance, *wonder earth* of Saxony (Terra miraculoſa.)

27. Species. Mountain or Rock Soap.

Le Savon de Montagne, Brochant, i. 453.

Exter. Char.—This mineral is found maſſive; is dull internally; has an earthy, and ſometimes an imperfectly conchoidal fracture; fragments blunt-edged.

Colour browniſh black, ſpotted ochrey yellow. Opaque; very ſoft; eaſily frangible; ſtreak ſhining, and reſinous; ſtains and writes on paper; feels greaſy, and adheres ſtrongly to the tongue.

Localities, &c.—This mineral is rare; has been found at Olkutſch in Poland, and alſo, it is ſaid, in England.

28. Species. Umber.

Exter. Char.—This mineral is found maſſive; fracture conchoidal; fragments blunt-edged,

Colour browniſh, of various ſhades; ſoft; adheres a little to the tongue, and has a meagre feel.

Localities, &c.—Umber is found diſpoſed in beds, in the iſland of Cyprus; and it is employed as a pigment.

29. Species. Yellow Earth.

Id. Kirw. i. 194. *La Terre Jaune*, Broch. i. 455.

Exter. Char.—Yellow earth is found maſſive; it is dull, or in the principal fracture, which is ſlaty, glimmering; croſs fracture earthy; fragments very blunt-edged.

Colour ochrey yellow; very ſoft; ſtreak ſhining; feels greaſy, and adheres a little to the tongue.

Localities, &c.—It has only been found in ſmall beds in ſtratified mountains, at Wehraw in Upper Luſatia,

Classification.

ſatia, and it is ſaid, in the cavities of gray wacken, and in the fiſſures of a ſandſtone rock.

Uſes. It is employed in the arts as a pigment.

V. MAGNESIAN GENUS.

1. Species. NATIVE MAGNESIA.

Magneſie Native, Brochant, ii. 449.

Exter. Char.—Native magneſia is found maſſive, tuberous or carious. Surface uneven and dull. Fracture flat, conchoidal, ſplintery or earthy. Fragments ſharp edged.

Colour yellowiſh gray, with ſpots and dendritic delineations of black or blackiſh brown. Opaque, ſoft and eaſily frangible. Feels greaſy; adheres to the tongue, and is rather light.

Conſtituent Parts.

Carbonic acid	51.
Magneſia	47.4
A trace of iron	
Loſs	1.6
	100.0

Localities, &c.—This mineral was diſcovered by Dr Mitchell in a ſerpentine rock at Roubſchitz in Moravia.

A mineral in many reſpects ſimilar to this has been analyzed by Giobert *. It was long known under the name of *porcelain earth*, and was ſucceſsfully employed in that manufacture. Giobert ſuppoſes that the external characters, and particularly the colours, of the mineral found in Moravia, ſeem to indicate the exiſtence of other ſubſtances beſide thoſe detected by Dr Mitchell's analyſis.

* *Jour. de Phyſ.* lx. 249.

Exter. Char.—The mineral deſcribed by Giobert is found maſſive or in mammillary fragments, ſome of which are tuberculated. Surface dull. Fracture conchoidal or uneven.

Colour pure white. Opaque. Spec. grav. variable. Hard, ſometimes ſoft. Feels greaſy; adheres ſlightly to the tongue. The ſofter varieties abſorb water greedily and with a hiſſing noiſe.

Chem. Char.—Infuſible before the blow-pipe.

Conſtituent Parts.

Magneſia	68.
Carbonic acid	12.
Silica	15.6
Sulphate of lime	1.6
Water	3.
	100.2

Localities, &c.—This mineral is found at Baudiſſero, in a vein which traverſes a ſteatitic rock of which the mountain is compoſed.

2. Species. BOLE.

Id. Kirw. i. 190. *Le Bol*, Broch. i. 459. *Argile Ochreuſe*, Hauy, 445.

Exter. Char.—Found maſſive and diſſeminated; ſurface dull, ſometimes a little glimmering; fracture conchoidal; fragments ſharp-edged.

Magneſian genus.

Colour yellowiſh brown or reddiſh, with ſpots and dendritical figures of black; opaque, rarely tranſlucent at the edges; very ſoft; eaſily frangible; adheres to the tongue; feels greaſy; ſtreak ſhining: ſp. grav. 1.4 to 2.

Chem. Char.—Before the blow-pipe it becomes black or gray, and melts into a greeniſh gray ſlag. Falls to pieces in water with a crackling noiſe, and without forming a paſte.

Conſtituent Parts.	Bergman.
Silica	47.
Alumina	19.
Magneſia	6.2
Lime	5.4
Oxide of iron	5.4
Water	17.
	100.0.

Localities, &c.—The chief places which yield bole are the iſland of Lemnos, hence called *Lemnian earth;* Sienna in Italy, and Strigau in Sileſia, in which latter place it is depoſited on indurated clay; in Upper Luſatia it forms neſts in baſalt.

Uſes.—Bole and ſimilar earths were formerly employed in medicine; it is now only uſed in the preparation of colours.

CIMOLITE.

This is a mineral which in many of its characters is cloſely connected with the preceding.

Exter. Char.—It is found maſſive; fracture earthy uneven, or ſlaty; colour grayiſh white, pearl gray, and expoſed for ſome time to the air, reddiſh; opaque; does not ſtain; adheres ſtrongly to the tongue; is ſoft, and difficultly frangible: ſp. grav. 2.

Chem. Char.—Before the blow-pipe it becomes at firſt of a deep gray colour, but afterwards white.

Conſtituent Parts.	Klaproth.
Silica	63.
Alumina	23.
Oxide of iron	1.25
Water	12.
Loſs	.75
	100.00

Localities, &c.—This mineral was brought by Mr Hawkins from the iſland of Argentiers, formerly Cimolo, from whence it has its name. Olivier found a ſimilar ſubſtance in the iſland of Milo, but which was very friable.

Uſes.—This ſubſtance is employed in whitening woollen ſtuffs. It is deſcribed by Pliny under the name Cimolia, as being applied to the ſame purpoſe, and alſo as a medicine in his time.

It is to be obſerved that cimolite contains, according to the above analyſis, no magneſia.

3. Species. SEA FROTH.

Keffekill. Kirw. i. 144. *L'Ecume de Mer*, Broch. i. 462. *Argile glaiſe*, Hauy, iv. 443. *Meerſchaum* of the Germans.

Exter.

Magnesian genus.

Exter. Char.—This mineral is found maſſive, diſſeminated, or in ſuperficial layers. Surface dull. Fracture fine earthy, ſometimes ſlaty. Fragments ſharp-edged.

Colour yellowiſh white. Opaque. Very ſoft. Eaſily frangible. Streak ſhining. Feels greaſy; and adheres to the tongue. Sp. gr. 1.6

Chem. Char.—Infuſible before the blow-pipe.

Conſtituent Parts. Klaproth.

Silica	50.5	41.
Magneſia	17.25	18.25
Lime	·5	·5
Water	25.	39.
Carbonic acid	5.	
Loſs	1.75	1.25
	100.00	100.00

Localities, &c.—Sea froth is found in Natolia, in the Crimea, in Spain and ſome other places. It appears to be diſtributed in low grounds in thin beds; and it is ſaid to be in the ſtate of ſoft paſte which hardens in the air.

Uſes.—It is employed in Turkey, in the manufacture of the heads of tobacco pipes; and as a deterſive ſubſtance, like fullers earth, by the Tartars.

. Species. FULLERS EARTH.

Id. Kirw. i. 184. *La Terre à Foulon*, Broch. i. 464. *Argile Smectique*, Haüy, iv. 443.

Exter. Char.—Found maſſive. Surface dull. Fracture fine-grained earthy, conchoidal or ſlaty. Fragments blunt-edged.

Colour olive green, yellowiſh or reddiſh. Colours ſometimes mixed and diſpoſed in ſpots or ſtripes; opake; ſoft or friable. Streak ſomewhat ſhining. Sometimes adheres to the tongue; feels greaſy.

Chem. Char.—Does not effervеſce with acids; melts into a brown ſpongy clay; falls to pieces in water without forming a paſte, and does not froth up like ſoap.

Conſtituent Parts. Bergman.

Silica	51.8
Alumina	25.
Lime	3.3
Magneſia	·7
Oxide of iron	3.7
Water	15.5
	100.00

Localities, &c.—Fullers earth is found in Sweden, Saxony, and France, forming beds; but the beſt fullers earth is found between ſtrata of ſandſtone in Hampſhire and ſome other places of England.

Uſes.—Fullers earth is of great importance in woollen manufactures, on account of its deterſive properties. It is extenſively employed in the proceſs of fulling or cleanſing woollen ſtuffs from greaſy matters.

5. Species. STEATITES.

La Pierre de Lard, ou Steatite, Broch. i. 474. *Semi-indurated and Foliated Steatites*, Kirw. i. 151, and 154. *Talc Steatite*, Hauy, iii. 256.

2

Claſſification.

Exter. Char.—Steatites is found maſſive, diſſeminated, and cryſtallized. Forms of the cryſtals, a ſix-ſided priſm terminated by a ſix ſided pyramid; a rectangular and rhomboidal four-ſided priſm; and a double ſix-ſided pyramid. The cryſtals are ſmall, generally imbedded in the maſſive variety; but they are very rare; and it is ſuppoſed, with ſome probability, that they are pſeudo-cryſtals. Surface of the cryſtals ſmooth and ſhining. Internally dull; fracture coarſe ſplintery, rarely earthy or ſlaty. Fragments blunt-edged.

Colour greeniſh, yellowiſh, reddiſh or grayiſh. Colours ſometimes mixed, and ſpotted or dendritical. Tranſlucent at the edges. Soft, ſometimes friable. Streak ſhining. Feels greaſy. Sp. gr. 2.614.

Chem. Char.—Infuſible before the blow-pipe; but becomes white and very hard.

Conſtituent Parts. Klaproth.

	From Cornwall.	From Bayreuth.
Silica	48.	59.5
Magneſia	20.5	30.5
Alumina	14.	
Oxide of iron	1.	2.5
Water	15.5	5.5
Loſs	1.	2.
	100.0	100.0

Localities, &c.—Steatites is found in primitive mountains, forming beds and veins in ſerpentine rocks; ſometimes in metallic veins, as in the tin mines near Freyberg. It is alſo imbedded in wacken, as in the iſland of Skye, and in veins of ſerpentine at Portſoy in Scotland. Steatites is alſo found in Cornwall in England, and in Sweden, Norway, Saxony, and France.

Uſes.—Steatites is ſometimes employed in the manufacture of porcelain, and ſome varieties of it anſwer for the ſame purpoſe as fullers earth.

6. Species. FIGURE STONE.

La Pierre à Sculpture, Broch. i. 451. *Le Bildſtein* of the Germans.

Exter. Char.—This mineral is found maſſive. Internal luſtre ſometimes glimmering, ſometimes dull, greaſy. Fracture ſlaty; croſs fracture ſplintery.

Colour, olive green, greeniſh gray, yellowiſh brown, ſometimes reddiſh, and veined. Semitranſparent, or tranſlucent at the edges, and ſometimes opake. Soft; ſectile; feels greaſy. Sp. gr. 2.78 to 2.81.

Conſtituent Parts. Klaproth.

	Tranſlucent.	Opaque Figure ſtone.
Silica	54.	62.
Alumina	36.	24.
Lime	—	1.
Oxide of iron	·75	·5
Water	5.5	10.
Loſs	3.75	2.5
	100.00	100.0

Localities, &c.—This mineral is brought from China, and is always cut into various, often ſingular, figures; and hence the name *bildſtein*, or *ſculpture ſtone*.

7. Species.

Classification.

7. Species. NEPHRITE, or *Jade*.

Jade, Kirw. i. 171. *Le Nephrite*, Broch. i. 467. *Jade*, Haüy, iv. 368.

This ſpecies is divided into two ſubſpecies.

Subſpecies 1. COMMON NEPHRITE.

Exter. Char.—This variety is found maſſive, diſſeminated, or in rounded pieces. The ſurface is ſmooth, glimmering, and unctuous; internally it is dull; fracture ſlaty or coarſe ſplintery, rarely fibrous; fragments ſharp-edged.

Colour leek green, ſometimes inclining to blue, greeniſh or yellowiſh white; tranſlucent, ſometimes only at the edges; hard; very difficultly frangible; feels greaſy. Sp. grav. 2.97 to 4.38.

Chem. Char.—Fuſible before the blow-pipe, and melts into a ſemitranſparent white glaſs.

Conſtituent Parts.	Hoepfner.
Silica	47
Magneſia	38
Alumina	4
Lime	2
Oxide of iron	9
	100

Localities, &c.—The repoſitory of nephrite is unknown. It was originally brought from the Levant, Eaſt Indies, and China. It is found alſo in the Alps, in Switzerland, and in Piedmont. The water-worn pebbles which are collected on the banks of the lake of Geneva, often contain this mineral. It is found alſo in a ſimilar form at a particular place on the ſhores of Iona, one of the Hebrides, in Scotland.

Uſes.—Oriental nephrite, long known under the name of *Jade*, is held in conſiderable eſtimation on account of its hardneſs and tenacity. It is employed by the Turks for the handles of knives and ſabres, and frequently by others for various ornamental purpoſes.

The property of curing diſeaſes of the kidneys is aſcribed to this mineral by ancient authors, and hence the name *nephritic ſtone*, or *nephrite*.

Subſpecies 2. AXE STONE.

La Pierre de hache, Brochant, i. 470. *Beilſtein* of the Germans.

Exter. Char.—This is alſo found maſſive, but moſt frequently in rounded pieces; luſtre glimmering, or weakly ſhining; fracture in large maſſes, ſlaty; in ſmall, ſplintery; fragments in the form of plates.

Colour deep meadow-green, ſometimes olive green; tranſlucent; ſemihard, and ſometimes hard; not very brittle; more difficultly frangible than the preceding variety.

Localities, &c.—This mineral is found in China, the Eaſt Indies, and South America, on the banks of the river Amazons. It is found alſo in ſome of the iſlands in the South ſea, as well as in Corſica, Switzerland and Saxony.

Uſes.—Axe ſtone is employed as hatchets and other cutting inſtruments by the natives of thoſe countries where iron is little known.

Magneſian genus.

8. Species. SERPENTINE.

Id. Kirw. i. 156. *La Serpentine*, Brochant, i. 481. *Roche Serpentineuſe*, Haüy, iv. 436.

This ſpecies is divided into two ſubſpecies.

Subſpecies 1. COMMON SERPENTINE.

Exter. Char.—This mineral is found maſſive, very rarely diſſeminated; internal luſtre ſlightly glimmering, or only dull; fracture ſplintery, or fine grained uneven, rarely conchoidal; fragments ſharp-edged.

Colour blackiſh green, leek green, grayiſh, greeniſh, or bluiſh gray; in ſome varieties, red of various ſhades. Theſe colours are mixed and diſpoſed in ſpots, ſtripes, veins, and dots. Tranſlucent at the edges, or opaque; ſemihard; not difficultly frangible; feels greaſy. Spec. grav. 2.57 to 2.7.

Chem. Char.—Infuſible before the blow-pipe.

Conſtituent Parts.	Kirwan.
Silica	45
Alumina	18
Magneſia	22
Oxide of iron	3
Water	12
	100

Localities, &c.—Serpentine belongs to the claſs of primitive rocks, and it conſtitutes entire mountains. It is found in Saxony, Bohemia, Italy, Corſica, and Siberia; in Cornwall in England, where it contains native copper, and at Portſoy in the north of Scotland, where it is known by the name of *Portſoy marble*. Common ſerpentine is frequently mixed with ſteatites, talc, aſbeſtus, garnets, and magnetic iron, but never contains limeſtone. This variety, in the language of Werner, is of a newer formation than the following ſubſpecies.

Uſes.—Serpentine is ſuſceptible of a fine poliſh; on account of which, and its beautiful colours, it is employed for various ornamental purpoſes.

Subſpecies 2. PRECIOUS SERPENTINE.

Exter. Char.—This alſo is found maſſive or diſſeminated; internal luſtre glimmering, rarely weakly ſhining, reſinous; fracture conchoidal, even or ſplintery; fragments ſharp edged.

Colour dark leek green of various ſhades; tranſlucent; ſemi-hard; eaſily frangible; feels ſlightly greaſy.

Localities, &c.—This ſubſpecies is found in ſimilar places with the preceding. It is diſtinguiſhed from it by being always connected with limeſtone. The ſtones known in Italy by the name of *verde di Prato*, *verde Antico*, *verde di Suza*, which are very often accompanied by limeſtone, may be included under precious ſerpentine.

9. Species. SCHILLER STONE.

Schillerſpath, or *Spath Chatoyant*, Brochant, i. 421. *Schiller Spar*, Kirw. 221.

Magnesian genus.

Exter. Char.—This mineral is found disseminated in thin plates, which assume a crystallized form, as in that of a table with six sides, or a short six-sided prism; lustre shining, sometimes resplendent, and semi-metallic; fracture foliated.

Colour olive green, bronze yellow, or silvery white; soft; easily frangible; somewhat elastic; feels greasy.

Chem. Char.—Before the blow-pipe it melts with borax, into a glass which becomes opaque on cooling.

Constituent Parts.	Heyer.
Silica	52.
Alumina	23.33
Magnesia	6.
Lime	7.
Oxide of iron	11.67
	100.00

Localities, &c.—Schiller stone is found at Basta in the Hartz, in Moravia, the Tyrol, in Corsica, and in Cornwall. It is usually imbedded in serpentine, and is accompanied by quartz, mica, and copper pyrites. It is supposed by some to be crystallized serpentine.

10. Species. TALC.

This species is divided into three subspecies; 1. earthy, 2. common, and 3. indurated talc.

Subspecies 1. EARTHY TALC.

Talcite, Kirw. i. 149. *Le Talc Terreux*, Broch. i. 486. *Talc Granuleux*, Haüy, iii. 255.

Exter. Char.—Earthy talc is found disseminated in kidney-form masses, or in superficial layers; lustre glimmering, pearly; friable; the particles scaly, pulverulent, or slightly cohering.

Colour greenish, reddish, or silvery white; stains; feels greasy, and is light.

Localities, &c.—This mineral is found in Piedmont, Saxony, Bohemia, and in the western parts of Inverness-shire in Scotland, where it exists in veins or cavities of primitive rocks.

Subspecies 2. COMMON TALC.

Id. or *Venetian Talc*, Kirw. i. 150. *Le Talc Commun*, Broch. i. 487. *Talc Laminaire*, Haüy, iii. 255.

Exter. Char.—This mineral is found massive, disseminated, and rarely crystallized in very small six-sided tables; lustre shining or resplendent, pearly or metallic; fracture straight or curved foliated; fragments wedge-shaped.

Colour greenish white, pale apple green, reddish or yellowish white; translucent or semitransparent, in thin plates transparent; soft, flexible, but not elastic; feels greasy. Spec. grav. 2.7 to 2.8.

Chem. Char.—Infusible before the blow-pipe, which distinguishes it from chlorite; does not effervesce with acids.

Constituent Parts.	Hoepfner.
Silica,	50
Magnesia,	44
Alumina,	6
	100

Classification.

Localities, &c.—Common talc is always found in serpentine rocks, where it accompanies actynolite, steatites, and indurated talc. What is called Venetian talc is brought from the mountains of Saltzburg and the Tyrol.

Uses.—Talc is sometimes employed as a substitute for chalk, enters into the composition of crayons, and is mixed with some kinds of paint.

Subspecies 3. INDURATED TALC.

Le Talc Endurci, Broch. i. 489.

Exter. Char.—This is found massive, and sometimes, it is said, crystallized; lustre shining and resplendent, resinous or pearly; fracture curved foliated, or slaty; fragments blunt-edged, tabular.

Colour greenish white, snow white, or apple green; translucent; in thin plates semitransparent; very soft; smooth, and greasy to the feel.

Localities, &c.—Indurated talc forms beds in mountains of argillaceous schistus, gneis, and serpentine, in the Tyrol, Italy, and Switzerland, and also in the western parts of Scotland.

Uses.—It is applied to the same purposes as the preceding.

11 Species. ASBESTUS.

This is divided into four subspecies: 1. mountain cork; 2. amianthus; 3. common asbestus; and, 4. ligniform asbestus.

Subspecies 1. MOUNTAIN CORK.

Suber Montanum, Kirw. i. 163. *Le Liege de Montagne*, Broch. i. 492. *Asbeste Tressé*, Hauy, iii. 247.

Exter. Char.—This mineral is found massive, often in small plates, which are sometimes thin, and are then denominated *mineral paper*; sometimes thick, and then called *mineral leather*; more rarely in porous or cellular pieces, when they are denominated *mineral flesh*; sometimes it is marked with impressions; the lustre is weakly glimmering or dull; fracture to appearance compact and uneven, but it is fibrous, and the fibres are sometimes parallel, and sometimes interwoven; fragments very blunt edged.

Colour yellowish or grayish white; opaque; very soft, extremely difficult to break; in thin plates flexible and elastic; creaks when handled; feels meagre. Spec. grav. 0.68 to 0.993.

Chem. Char.—Melts before the blow-pipe with difficulty.

Constituent Parts.	Bergman.
Silica,	56.2
Magnesia,	26.1
Alumina,	2.
Lime,	12.7
Oxide of iron,	3.
	100.0

Localities, &c.—This mineral is found in thin veins in serpentine rocks: it is often mixed with quartz, talc, and silver ores, as in Saxony. It is also found in Sweden, Norway, Siberia, Hungary, and in the lead veins at Leadhills in Scotland.

Subspecies

Classification.

Subspecies 2. AMIANTHUS.

Id. Kirw. i. 161. *L'Amianthe*, Broch. i. 494. *Asbeste Flexible*, Haüy, iii. 247.

Exter. Char.—This variety is also found massive, more rarely disseminated, and in small detached bundles; lustre glimmering, or a little shining and silky; fracture fibrous straight or parallel.

Colour greenish or silvery white, yellowish white, or greenish gray; opaque; rarely translucent at the edges; very flexible, and even elastic in thin fibres; feels greasy.

Chem. Char.—Melts with difficulty before the blowpipe, into a white, gray, yellow, and sometimes black enamel.

Constituent Parts.	Bergman.		Chenevix.
Silica	64	64	59.
Magnesia	17.2	18.6	25.
Alumina	2.7	3.3	3.
Lime	13.9	6.9	9.25
Barytes		6.	
Oxide of iron	2.2	1.2	2.25
Loss			1.50
	100.0	100.0	100.00

Localities, &c.—Amianthus is usually found in primitive rocks, but particularly those of serpentine. It is found in Saxony, Bohemia, Italy, Spain, France, Sweden, and in the western parts of Scotland; but the finest specimens of amianthus are brought from the island of Corsica.

Uses.—On account of the flexibility of this substance it is spun into threads; for this purpose it is mixed with lint, to render the threads less brittle in working them into cloth, which is afterwards passed through the fire that the vegetable matter may be consumed, and the amianthus, which is infusible, remains; and thus an incombustible cloth is obtained. The ancients manufactured this cloth for the purpose of wrapping round their dead bodies, that their ashes might be preserved unmixed with the wood employed in burning them.

Subspecies 3. COMMON ASBESTUS.

Asbestus, Kirw. i. 159. *L'Asbeste Commune*, Brochant, i. 497. *Asbeste Dur*, Haüy, iii. 247.

Exter. Char.—This also is found massive; lustre shining and weakly shining, silky or resinous; surface fibrous, the fibres being parallel, straight or curved; the fibres are more strongly united than in amianthus, and hence sometimes a splintery fracture.

Colour leek green, greenish, or yellowish gray; translucent at the edges; soft, or semihard; rather easily frangible; little flexible; feels greasy; spec. grav. 2.54 to 2.99.

Chem. Char.—Melts with difficulty before the blowpipe, into a dark gray slag.

Constituent Parts.	Wiegleb.
Silica	46.66
Magnesia	48.45
Oxide of iron	4.79
Loss	.1
	100.00

Localities.—It is found in similar situations with the preceding, in Saxony, Russia, Sweden, and in the western parts of Scotland.

Magnesian genus.

Subspecies 4. LIGNIFORM ASBESTUS.

Id. Kirw. i. 161. *Le Bois de Montagne*, Brochant, i. 499. *Asbeste Ligniforme*, Haüy, iii. 248.

Exter. Char.—This also is found massive; lustre glimmering, silky; fracture in large masses, curved slaty; in small pieces fibrous, and having the appearance of a woody texture; fragments in elongated plates.

Colour yellowish brown of different shades; opaque; soft; not difficultly frangible; in thin fragments a little flexible, but not elastic; feels meagre; adheres to the tongue; streak shining.

Chem. Char.—Before the blow-pipe is only fusible at the edges.

Localities, &c.—This variety is found in the Tyrol, where it is accompanied by galena, black blende, and a grayish white quartz.

12. Species. CYANITE.

Id. Kirw. i. 209. *La Cyanite*, Brochant, i. 501. *Sappare*, *Sauss.* §. 1900. *Disthene*, Haüy, iii. 220.

Exter. Char.—This mineral is found massive, disseminated, or crystallized, in four-sided prisms, of which two are broad and two narrow, and having the four lateral edges, or only the two opposite edges, truncated. This prism is often so flattened, as to have the appearance of a table. The broad faces of the crystals are smooth and shining, the narrow faces streaked and only glimmering, almost dull. Internal lustre shining and pearly; fracture curved radiated; that of the crystals foliated; fragments tabular, sometimes splintery, or imperfectly rhomboidal.

Colour blue of various shades, sometimes bluish and pearl gray; and different colours are arranged in stripes, spots, or clouds; translucent, or when crystallized semitransparent, or transparent; semihard, and sometimes soft; easily frangible; feels greasy. Spec. grav. 3.51 to 3.62.

Chem. Char.—Entirely infusible before the blowpipe, on which account this mineral was employed by Saussure as a support for other substances in experiments with that instrument.

Constituent Parts.	Saussure.
Silica	29.2
Alumina	55.
Lime	2.25
Magnesia	2.
Oxide of iron	6.65
Water and loss	4.9
	100.00

Localities, &c.—Cyanite is found on St Gothard in Switzerland, in crystals mixed with quartz, garnets, and granite, and imbedded in indurated talc. It is also found in Spain, France, Carinthia, Bavaria, Siberia, and in the north of Scotland, and always in primitive mountains.

Magnesian genus.

13. Species. ACTYNOLITE.

This is divided into three subspecies; 1. asbestous, 2. common, and 3. glassy.

Subspecies 1. ASBESTOUS ACTYNOLITE.

Amianthinite, Kirw. i. 164. and *Metalliform Asbestoid*, ibid. 167. *La Rayonnante Asbestiforme*, Broch. i. 504. *Actinote Aciculaire*, Hauy, iii. 75.

Exter. Char.—This mineral is found massive, and rarely crystallized in rhomboidal six-sided prisms, two of which are about 124° 30′, and four about 117° 45′.; lustre glimmering; internal lustre weakly shining, sometimes shining, pearly; fracture radiated; fragments wedge-shaped.

Colour white, or greenish, reddish, or yellowish gray; commonly opaque; sometimes translucent at the edges; streak greenish white; soft, rarely semi-hard; rather difficultly frangible. Specific gravity 2.58 to 3.33.

Chem. Char.—Fusible before the blow-pipe into a black slag, or grayish white enamel.

Localities, &c.—Found in the neighbourhood of Bayreuth and the Bannat, in beds of serpentine and steatites.

Subspecies 2. COMMON ACTYNOLITE.

Asbestinite, *Common*, *Asbestoid*, and *Schorlaceous Actynolite*, Kirw. i. 165—168. *La Rayonnante Commune*, Broch. i. 507. *Actinote Hexaèdre*, Haüy, iii. 74.

Exter. Char.—Massive, disseminated, crystallized in elongated, very oblique, six-sided prisms, having the acute lateral edges truncated. The crystals are acicular, and longitudinally streaked; lustre shining and vitreous; fracture radiated, parallel or divergent, stellated; fragments rather blunt-edged.

Colour olive green, pistachio green, reddish brown; crystals translucent or semitransparent; semihard; difficultly frangible; rarely feels greasy. Spec. grav. 3 to 3.31.

Chem. Char.—Fusible before the blow-pipe into a black slag, a white transparent glass, or a grayish white enamel.

Constituent Parts.	Bergman.
Silica	64.
Magnesia	20.
Alumina	2.7
Lime	9.3
Oxide of iron	4.
	100.0

Localities, &c.—It is found in Saxony, Switzerland, Norway, and west side of Inverness-shire in Scotland. Its repository is in primitive mountains, where it is accompanied with ores of lead and iron, as well as with quartz and brown blende.

Subspecies 3. GLASSY ACTYNOLITE.

Id. Kirw. i. 168. *La Rayonnante Vitreuse*, Broch. i. 510. *Thallite*, Lametherie, ii. 319. *Epidote*, Hauy, iii. 102.

Classification.

Exter. Char.—Found massive or crystallized in thin six-sided prisms, whose surface is smooth and resplendent; internal lustre shining, vitreous; fracture radiated or wedge-shaped, fibrous; fragments splintery.

Colour olive green, leek green, and asparagus green; translucent, or semitransparent; semihard, or hard; very brittle, and very easily frangible. Spec. grav. 2.95 to 3.49.

Localities, &c.—This variety is found in similar repositories, and in similar places with the preceding.

14. Species. TREMOLITE.

This is also divided into three subspecies; 1. asbestous, 2. common, and 3. glassy.

Subspecies 1. ASBESTOUS TREMOLITE.

La Tremolithe Asbestiforme, Broch. i. 514. *Grammatite*, Hauy. iii. 227.

Exter Char.—Found massive, disseminated, and crystallized; and the crystals are capillary or acicular; lustre weakly shining, silky or pearly; fracture radiated or fibrous; fragments splintery and wedge-shaped.

Colour yellowish white, reddish, greenish, or grayish; opaque; translucent at the edges; very soft; easily frangible.

Subspecies 2. COMMON TREMOLITE.

La Tremolithe Commune, Broch. i. 515.

Exter. Char.—Massive, or crystallized in rhomboidal prisms, with angles of 126° 52′ 12″, and 53° 7′ 48″. The crystals are deeply striated longitudinally; external lustre resplendent; internal shining, pearly; fracture radiated, either parallel, divergent, or promiscuous: surfaces of the fracture longitudinally streaked; fragments splintery.

Colour greenish white, reddish, or yellowish; rarely pearl gray; always translucent; in crystals semitransparent; semihard; brittle; easily frangible; meagre to the feel.

Subspecies 3. GLOSSY TREMOLITE.

La Tremolithe Vitreuse, Broch. i. 516.

Exter. Char.—Massive, or crystallized in long needle or awl-shaped prisms; internal lustre shining, and sometimes resplendent; vitreous or pearly; fracture radiated; cross fracture even, and a little oblique; fragments splintery.

Colour greenish or yellowish white; translucent; crystals sometimes transparent; semihard; brittle; easily frangible; feels meagre. Spec. grav. 2.92 to 3.2, Hauy.

Chem. Char.—Before the blow-pipe it melts into a porous white slag.

Constituent

Conſtituent Parts.

	Klaproth.	Laugier. White.	Laugier. Gray tremolite.
Silica	65.	35.5	50
Lime	18.	26.5	18
Magneſia	10.33	16.5	25
Oxide of iron	.16		
Carbonic acid and water	6.5	23.	5
Loſs	.01	—	2
	100.00	101.5	100

Physical Char.—By percuſſion or friction in the dark, a reddiſh phoſphoreſcent light appears; and the powder thrown on burning coals yields a greeniſh light.

Localities, &c.—Tremolite is found imbedded in limeſtone, in primitive mountains. It was firſt diſcovered in the valley of Tremola by Pini, and hence its name. It is alſo found in Hungary, Bohemia, and Carinthia, and in the mountains ſix miles ſouth of Paiſley in Scotland, where it is accompanied with prehnite.

15. Species. SMARAGDITE.

Id. Sauſſure Voy. §. 1313. *Diallage*, Hauy, iii. 125. *Id.* Brochant, i. 423. and ii. 506.

Exter. Char.—Smaragdite has been found maſſive and diſſeminated. Internal luſtre ſhining. Fracture foliated. Cleavage ſingle. Fragments rather ſharp edged.

Colour, graſs or emerald green. Slightly tranſlucent. Semi-hard or ſoft. Brittle. Spec. grav. 3.

Chem. Char.—Before the blow-pipe melts into a gray or greeniſh enamel.

Conſtituent Parts.	Vauquelin.
Silica	50.
Alumina	11.
Lime	13.
Magneſia	6.
Oxide of iron	5.5
——— chromium	7.5
——— copper	1.5
Loſs	5.5
	100.0

Localities, &c.—This mineral was found by Sauſſure in the vicinity of Turin, imbedded in nephrite clouded white and blue. It has alſo been found near the lake of Geneva among the rounded pebbles, and in Corſica in primitive rocks. In Italy, tables and ornamental pieces of furniture are made of ſmaragdite; and the Italian marble-cutters call it *verde di Corſica*.

16. Species. SAHLITE.

Id. D'Andrada, Jour. de Phyſ. An 8. p. 241. *Malacolithe*, Hauy, iv. 379. *Id.* Brochant, ii. 518.

Exter. Char.—Found maſſive or cryſtallized in ſix-ſided priſms, having two oppoſite lateral edges truncated. Luſtre ſlightly glimmering, reſinous. Fracture foliated. Cleavage threefold. Fragments ſometimes rhomboidal.

Colour grayiſh green or bluiſh gray. In thin plates tranſlucent. Scarcely ſcratches glaſs. Very ſoft to the touch, from which it has the name *malacolite*. Spec. grav. 3.2307 to 3.2368.

Chem. Char.—Fuſible before the blow-pipe into a porous glaſs.

Conſtituent Parts.	Vauquelin.
Silica	53
Lime	20
Magneſia	19
Alumina	3
Iron and mangan eſe	4
Loſs	1
	100

Localities, &c.—This mineral was diſcovered by D'Andrada in the ſilver mines of Sahla in Sweden, and hence it derived its name. It was found by the ſame naturaliſt at Buſen in Norway.—It appears from the obſervations of Hauy that ſahlite and augite are very cloſely allied, not only in ſtructure and external characters in general, but alſo in their conſtituent principles; the only difference in their compoſition is in the proportions of the lime and magneſia, which are ſmaller in augite than in ſahlite; but the proportion of iron in the former is conſiderably greater than in the latter.

17. Species. SCHALSTONE, or TABULAR SPAR.

Exter. Char.—This mineral is found maſſive; luſtre ſhining and pearly; fracture foliated or ſplintery, and coarſe fibrous; conſiſts of ſeparate large-grained pieces implicated in each other; and according to Karſten, are very regular.

Colour milk white, yellowiſh or reddiſh white; tranſlucent; ſemi-hard; brittle.

Conſtituent Parts.	
Silica	50
Lime	45
Water	5
	100

Localities, &c.—This mineral was firſt noticed by Stutz. It is found in the bannat of Temeſwar, and is accompanied by cryſtallized garnets and calcareous ſpar.

VI. CALCAREOUS GENUS.

1. Species. AGARIC MINERAL, or *Mountain Milk*.

Id. Kirwan i. 76. *Id.* Brochant i. 519. *Chaux Carbonaté Spongieuſe*, Hauy, ii. 167.

Exter. Char.—This mineral is compoſed of fine pulverulent particles, ſlightly united together, and nearly friable.

Colour yellowiſh white, or ſnow white; ſtains ſtrongly;

Calcareous genus.

ly; feels meagre; does not adhere to the tongue; nearly floats on water.

Chem. Char.—Effervefces with acids, and is entirely diffolved, fo that it is chiefly compofed of lime and carbonic acid.

Localities, &c.—This mineral is found in the fiffures and cavities of calcareous mountains, and it is fuppofed that it originates from the deftruction of the rocks, the particles of which are carried down to the fiffures and cavities by rain water. Abundant in Switzerland.

2. Species. CHALK.

Id. Kirwan i. 71. *La Craie*, Brochant, i. 521. *Chaux Carbonaté Crayeufe*, Hauy, ii. 166.

Exter. Char.—Found maffive; has a dull appearance; fracture earthy, and fragments blunt edged.

Colour ufually fnow or yellowifh white, fometimes gray or brown; opaque; ftains and writes; very foft, and eafily frangible; feels meagre; adheres a little to the tongue. Spec. grav. 2.31 to 2.65.

Chem. Char.—Effervefces with acids; before the blow-pipe is calcined, and converted to quicklime. It is almoft entirely compofed of lime and carbonic acid, with a mixture of a little oxide of iron and fome other fubftances.

Localities, &c.—Chalk forms peculiar ftratiform mountains which contain many petrifactions, the matter of which is almoft always filiceous. They contain alfo flints arranged in regular ftrata. No metallic fubftances are found in chalk. A great body of chalk traverfes France from fouth to north, extending from Champagny to Calais, and continued to England, in the fouth of which it forms extenfive beds. Chalk is alfo found in the ifland of Zealand, in the Baltic, in Poland and many other places.

3. Species. LIMESTONE.

This is divided into four fubfpecies, which are, 1. compact, 2. foliated, 3. fibrous, and 4. pea ftone.

Subfpecies 1. COMPACT LIMESTONE.

This fubfpecies is again divided into two fections; the firft including common compact limeftone, and the fecond roe-ftone.

A. *COMMON COMPACT LIMESTONE.*

Id. Kirw. i. 82. *Id.* Broch. i. 523. *Chaux Carbonaté Compacte*, &c. Haüy, ii. 164.

Exter. Char.—Found maffive; external form frequently figured from the numerous petrifactions which it contains; internally dull; rarely glimmering; fracture compact, fplintery, uneven or earthy; fragments not very fharp edged.

Colour ufually gray, fometimes reddifh or yellowifh; different colours exhibit fpots, ftripes, veins, and dendritical figures; tranflucent at the edges; femihard; brittle; eafily frangible; feels meagre; gives a grayifh white ftreak. Spec. grav. 2.6 to 2.7.

Chem. Char.—Diffolves in acids with effervefcence.

Claffification.

Conftituent Parts.	Tennant.
Lime	29.5
Magnefia	20.3
Carbonic acid	47.2
Alumina and oxide of iron	.8
Lofs	2.2
	100.0

Localities, &c.—Forms very extenfive ftratiform mountains, and is ufually met with along with coal and fandftone. It is very abundant in Saxony, Bohemia, Sweden, France, Switzerland, and Britain.

Ufes.—The ufes of limeftone for the purpofes of building, and when reduced to the ftate of quicklime, to form the bafis of mortar, as well as in various arts, are well known.

This variety of limeftone, when fufceptible of a polifh, furnifhes many of thofe ftones which are known by the name of *marbles*; which name, although it be applied to very different ftones which are fufceptible of a polifh, and are fit for fculpture, or ornamental architecture, is frequently applied to limeftone of this defcription.

B. *OOLITE*, or *ROE STONE.*

Id. Brochant, i. 529. *Oviform Limeftone*, Kirw. i. 91. *Chaux Carbonaté Globuliforme*, Hauy, ii. 171.

Exter. Char.—This is found maffive; internally dull; fracture compact; fragments blunt-edged.

Colour yellowifh, fmoke gray, hair, or reddifh brown; opaque; rarely tranflucent at the edges; femihard; confifts of fmall, globular, diftinct concretions: the fize of the concretions very various. Spec. grav. 2.4 to 2.5.

Localities, &c.—Roe ftone is found in Sweden, Switzerland, Saxony, and in the fouth of England.

The ketton ftone of England, and the celebrated Portland ftone, belong to this variety. Of the latter fome of the principal public buildings in England and Ireland are conftructed.

Ufes.—It is employed as a building ftone; and when of a fine grain, it is polifhed and employed as marble.

Subfpecies 2. FOLIATED LIMESTONE.

Of this there are two varieties, granularly foliated, and calcareous fpar.

A. *GRANULARLY FOLIATED LIMESTONE.*

Pierre Calcaire Grenue, Broch. i. 531. *Chaux Carbonaté Saccharoïde*, Haüy, ii. 164.

Exter. Char.—Found only maffive; luftre fhining, or ftrongly glimmering; between pearly and vitreous; fracture ftraight foliated; fragments rather blunt-edged; in granular, diftinct concretions, fmall or fine grained.

Colour ufually fnow white, grayifh, yellowifh, greenifh, and rarely reddifh white, and fometimes it is fpotted, veined, or ftriped; ufually tranflucent; femihard; feels meagre; brittle, and eafily frangible. Spec. grav. 2.7 to 2.8.

Chem.

Classification.

Chem. Char.—Effervesces with acids, and is almost entirely dissolved. Some varieties, however, from an admixture of other substances, are very slowly acted on by acids.

Localities, &c.—Granularly foliated limestone belongs almost exclusively to the primitive and transition mountains, reposing on gneis, micaceous schistus, and clay slate, containing, beside other mineral substances, various metallic ores.

It is found in Italy, Saxony, Bohemia, Sweden, Norway, France, and Britain.

Uses.—This variety of limestone is applied to the same purposes as the former.

Of MARBLES.—In the language of the architect and statuary, all stones come under the name of marble which are harder than gypsum, are found in large masses, and are susceptible of a good polish.

On this principle many varieties of limestone, granite also and porphyry, serpentine, and even fine-grained basalts, are denominated marbles. But the word among mineralogists is taken in a more restricted sense, and confined to such varieties of dolomite, swinestone, and compact and granularly foliated limestone, as are capable of receiving a good polish. The most valuable of the calcareous marbles, for hardness, durability and colour, are brought from Italy, the Greek islands, and from Syria. When the ancient Romans were at the height of their civilized luxury, they obtained some varieties of marble from Numidia and other countries, which were very much esteemed.

The sculptors of ancient Greece and modern Europe have always held the white granularly foliated limestone in the highest estimation, both on account of its pure colour, delicate translucence, and granular texture, which make it much easier to work than compact limestone. The species called dolomite is softer, and of a finer grain, so that it is even more manageable under the chissel, and therefore many of the smaller works of the Greek sculptors are of this stone; but Paros and Carrara furnish Europe with the greatest quantity of statuary marble. The Parian marble, which consists almost entirely of carbonate of lime, is the purest, softest, and has some degree of transparency; that of Carrara is often mixed with granular quartz in considerable proportion. The following are the architectural marbles which are held in greatest estimation.

1. The marble called *bardiglio*, from Carrara, is of a deep blue colour, and seems to be the same with the white statuary marble of that place, with the addition of some colouring matter.

2. That variety of marble called *cipolin*, is statuary marble traversed by veins of mica.

3. *Lumachella marble.* This is a compact limestone of a brownish gray colour, containing shells which often retain the original pearly lustre. To this variety belongs the fire marble of Bleyberg in Carinthia, in which the imbedded shells are beautifully iridescent.

4. *Florentine marble.* This is a grayish, compact, argillaceous limestone, exhibiting designs of a yellowish brown colour, and resembling the ruins of houses: hence it is called *ruin marble.*

5. The marbles of Syria, Sienna, and Arragon, are of a yellow colour, and are in considerable estimation.

6. *Brocatello marble.* This is a breccia limestone, composed of fragments of a yellowish red and purple colour, which are cemented by semitransparent, white calcareous spar.

Calcareous genus.

7. The marbles known by the names of *verde antiche*, *verde di Corsica*, are composed of limestone, calcareous spar, serpentine, and asbestus.

8. The British islands afford many fine marbles, of which that of Tiree is the finest and most beautiful. It has often a delicate flesh coloured ground, spotted with green; but its colours, it is said, are apt to fade. Marbles have also been found in the island of Skye, and in the counties of Ross and Sutherland. For a particular account of these, see *William's Mineral Kingdom.* Marble is not uncommon in different parts of England; and in particular Devonshire and Derbyshire afford varieties which are held in considerable estimation on account of their beauty.

Elastic marble. Some varieties of granular limestone, when cut into thin plates, possess a certain degree of elasticity. The marble in which this property was observed, was in the Borghese palace at Rome. It was got from an ancient building. Dolomieu supposed that marble acquired this property by being deprived of moisture, and Fleuriau de Bellevue confirmed this opinion, by subjecting certain marbles to heat. He found also a natural elastic marble in Mount St Gothard.

B. *Calcareous Spar.*

Common Spar, Kirw. i. 86. *Le Spath Calcaire*, Broch. i. 536. *Chaux Carbonatée*, Hauy, ii. 127.

Essen. Char.—Divisible into a rhomboid of $101\frac{1}{2}°$ and $78\frac{1}{2}°$; soluble with effervescence in nitric acid.

Exter. Char.—Calcareous spar is found massive, or disseminated in various forms, as globular, kidneyform, cellular, and stalactitical; but it is most frequently crystallized. The primitive form of its crystals is an obtuse rhomboid, whose angles are 101° 32′ 13″ and, 78° 27′ 47″; integrant moleculc the same. The variety of forms of calcareous spar is very great. Werner reduces them to three principal or prevailing forms, and from these he deduces the variations and modifications which take place. His principal forms are, 1. The six sided pyramid; 2. The six-sided prism; and 3. The three-sided pyramid. But according to others following the same method, the principal forms are the five following: 1. The six-sided pyramid; 2. The six-sided prism; 3. The six-sided table; 4. The six-sided pyramid, and 5. The hexahedron, including the rhomboid and cube.

1. The six sided pyramid is either simple or double.

A. Simple. Simple pyramids are the summits of other pyramids, or of prisms, and they are variously modified in being equal sided, acute, or obtuse, having the angles at the base truncated, or having an obtuse three-sided summit slightly convex.

B. Double; in which two pyramids are obliquely united, and variously modified, by having the angles at the base truncated, or the faces of the summit a little convex.

2. The six-sided prism, is also variously modified, by having at each extremity a six-sided acute summit, or a second obtuse summit of three sides, placed alternately on three edges of the first.

3. A six-sided table, which is either perfect with equal or unequal sides, or rounded, or lenticular.

4. The

Calcareous genus.

4. The three-fided pyramid, which is either fimple or double, and is alfo varioufly modified.

5. The hexahedron, which includes the rhomboid, and this is either perfect, or has convex faces, or has fix obtufe edges truncated; and the cube, which is fomewhat rhomboidal. But for a full account of all the varieties and modifications in the cryftallization of calcareous fpar, the reader is referred to the treatifes of Hauy and Brochant.

The cryftals of calcareous fpar exhibit alfo a fimilarity of arrangement. The fimple fix-fided pyramids are frequently difpofed in a globular, fafcicular, or ftellated form. The fix-fided pyramids are difpofed in rows; the fix-fided prifms are often difpofed like fteps of ftairs, or are fafcicular, or kidney-form; fome acute three-fided pyramids of calcareous fpar have been found hollow, and in fome prifms the centre has been obferved of another colour. The furface of the cryftals commonly fmooth; luftre fhining or refplendent; internal luftre refplendent or fhining, vitreous, and fometimes pearly; fracture foliated; cleavage threefold; fragments always rhomboidal.

Colour ufually white, grayifh, reddifh, greenifh, or yellowifh white, rarely violet blue, or yellowifh brown. Various degrees of tranfparency; when perfectly tranfparent, refraction is double. It was in this fubftance that the property of double refraction was firft obferved, and hence it was called *double fpar*. This fingular property engaged the attention and mathematical fkill of Newton, Huygens, Buffon, and more lately the celebrated Hauy. Calcareous fpar is femihard, brittle, and eafily frangible. Sp. grav. about 2.7.

Chem. Char.—Soluble with effervefcence in nitric acid, and reduced by calcination to quicklime.

Conftituent Parts.

	Bergman.	Phillips.*
Lime	55	55.5
Carbonic acid	33	44.
Water	11	.5
	100	100.0

* Phil. Mag. xiv. 290.

Phyfical Char.—Some varieties of calcareous fpar, and particularly thofe from Derbyfhire, give out when heated, a phofphorefcent light.

Localities, &c.—Calcareous fpar is very common in all kinds of rocks, in veins and cavities, and particularly in mineral veins, accompanied with quartz, fluor fpar, heavy fpar, and metallic ore. The fineft fpecimens of rhomboidal fpar are brought from Iceland, Derbyfhire, the Hartz, as well as Saxony, France, and Spain.

The cryftallized fandftones of Fontainebleau are real rhomboidal cryftals of calcareous fpar, which, during the procefs of cryftallization, have been penetrated with particles of fand.

Subfpecies 3. Fibrous Limestone.

Id. Kirw. i. 88. *La Pierre Calcaire Fibreufe, ou la Stalactite Calcaire*, Broch. i. 549. *Chaux Carbonatée Concretionnée*, Hauy, ii. 168.

Of this fubfpecies two varieties have been formed, common fibrous, and calcareous finter.

Claffification.

A. *Common Fibrous Limestone.*

Exter. Char.—Found maffive; luftre weakly fhining and pearly; fracture fibrous, fometimes coarfe and delicate, ftraight or parallel, and fometimes radiated; fragments fplintery.

Colour ufually grayifh, reddifh, and yellowifh white; generally tranflucent; rarely femitranfparent.

Localities, &c—This variety is found in veins; and fome of it is fufceptible of a fine polifh, and was known to the ancients under the name of *calcareous alabafter*, to diftinguifh it from gypfeous alabafter.

Sattin fpar, a beautiful mineral, which is alfo fufceptible of a fine polifh, and has a filky luftre, from which it derives its name, belongs to this variety. It was firft difcovered in Cumberland, and has fince been found in other places in Britain.

B. *Calcareous Sinter.*

This variety is ufually found ftalactitical or tuberofe, and alfo fometimes kidney-fhaped, botryoidal, tubular, and coralloidal. Surface ufually rough, or drufy, rarely fmooth; internal luftre glimmering, fometimes weakly fhining, filky, or pearly; fracture fibrous, which is either ftraight, fcopiform, or ftellular; fragments wedge-fhaped and fplintery.

Colour fnow white, grayifh green, or yellowifh white, and thefe are fometimes arranged in ftripes or veins; tranflucent, fometimes only at the edges; rarely femitranfparent; between femihard and foft; brittle and eafily frangible. Sp. grav. 2.728.

Localities, &c.—This mineral feems to be a depofition of calcareous particles, formed by the gradual infiltration of water into the cavities and fiffures of limeftone mountains. They are either depofited in layers on the floor, or fufpended from the roof of thofe grottoes, and in this latter cafe they affume a great variety of imitative forms. It is found therefore, in the celebrated grottoes of Auxelles, Arcy, and Antiparos, and in the cavities of mineral veins at Leadhills.

The fingular mineral fubftance, known by the name of *flos ferri*, belongs to this variety. This is found in the cavities of veins of fpathofe iron ore, from which it has derived its name. It is of a branched or coralloidal form.

Subfpecies 4. Pisolite or *Pea-ftone*.

Oviform Limeftone, var. Kirw. i. 91. *La Pierre de Pois*, Broch. i. 555. *Chaux Carbonatée Globuliforme*, Hauy, ii. 171.

Exter. Char.—This mineral is found maffive, and in the cavities in which it is formed, the furface is kidney-fhaped; internally dull; fracture difficult to determine but appears even; fragments rather fharp-edged.

Colour white, fnow white, grayifh, reddifh or yellowifh white; opaque; rarely tranflucent at the edges; foft, and brittle.

Localities, &c.—Pifolite is found at Carlfbad in Bohemia, where it has been long known, and where an entire bed was difcovered in digging the foundations for a church. Each of the grains of pifolite contains for a nucleus a particle of fand. Thefe have been incrufted with the carbonate of lime held in folution by water,

Classification.

water, and particularly by the warm ſprings of Carlſbad. New concentric layers being depoſited, they at laſt fall to the bottom, and are there united into larger maſſes by new depoſitions of the ſame calcareous matter. Piſolites are alſo found in Hungary and in Sileſia.

4. Species. Calcareous Tufa.

Exter. Char.—This mineral has uſually the form of the ſubſtance on which the calcareous matter has been depoſited, as that of moſs which is moſt common, graſs or leaves; internally dull, or weakly glimmering; fracture uneven or earthy; fragments blunt-edged.

Colour yellowiſh gray of various ſhades; opaque, or tranſlucent at the edges; ſoft, ſectile, and eaſily frangible; light; almoſt ſwims on water.

Localities, &c.—This ſubſtance is found in all limeſtone countries, through the ſtrata of which water paſſes, thus forming ſprings impregnated with carbonate of lime, which is afterwards depoſited on plants or other ſubſtances. This mineral, therefore, is found in alluvial land, and the proceſs of its formation is conſtantly going on.

5. Species. Foam Earth.

Silvery Chalk, Kirw. i. 78. *L'Ecume de Terre*, Broch. i. 557.

Exter. Char.—This mineral is found maſſive, diſſeminated, or in ſcaly particles, which are ſomewhat friable; internal luſtre ſhining or ſemimetallic; the ſolid varieties have a curved foliated fracture; fragments blunt edged.

Colour yellowiſh or greeniſh white, ſometimes ſilvery white; opaque; ſtains; very ſoft or friable; feels a little greaſy or ſilky.

Chem. Char.—Effervesces and diſſolves in acids,

Conſtituent Parts.

Lime,	51.5
Carbonic acid,	39.
Silica,	5.7
Oxide of iron,	3.2
Water,	1.
	100.5

Localities, &c.—This mineral has been found in mountains of ſtratified limeſtone at Jena in Miſnia, and at Eiſleben in Thuringia.

This is conſidered by ſome as belonging to the following ſpecies, and by others as merely a variety of agaric mineral.

6. Species. Slaty Spar.

Argentine, Kirw. i. 105. *Le Spathe Schiſteux*, Broch. i. 558. *Schiefer Spath of the Germans*. *Id.* Phillips, Phil. Mag. xiv. 289, and 293.

Exter. Char.—Found maſſive or diſſeminated; internal luſtre ſhining, pearly; fracture curved foliated; fragments wedge-ſhaped, or blunt-edged.

Colour grayiſh, reddiſh, or yellowiſh white; tranſlucent; ſoft; brittle; feels greaſy. Spec. grav. 2.723.

Chem. Char.—Effervesces briſkly with acids.

Calcareous genus.

Conſtituent Parts.

Carbonate of lime,	98.11
Silica,	.05
Oxide of iron,	.8
Loſs,	1.04
	100.00

Localities, &c.—This mineral is found in Saxony, in a bed of limeſtone, where it is accompanied with galena; in Norway; and in Cornwall in England.

7. Species. Arragonite.

Arragon Spar. Kirw. i. 87. *L'Arragonite*, Broch. i. 576. *Id.* Haüy, iv. 337.

Exter. Char.—This mineral is always found cryſtallized in ſix-ſided equiangular priſms, or with two oppoſite faces broader, to which correſpond the two faces of an acute bevelment, which terminates the priſm. The edges of the bevelment are alſo truncated. The cryſtals are variouſly grouped, and commonly in the form of a croſs; cryſtals ſtreaked longitudinally; luſtre ſhining or reſplendent, vitreous; fracture foliated.

Colour grayiſh or greeniſh white; tranſlucent and ſemitranſparent; refraction double; hard, ſcratches calcareous ſpar; brittle, and eaſily frangible. Specific gravity 2.946.

Chem. Char.—Effervesces with acids, and is entirely diſſolved. The conſtituent parts, according to numerous and accurate analyſes, are the ſame as thoſe of calcareous ſpar; but its ſuperior hardneſs, diverſity of form, and other external characters, have long puzzled chemical philoſophers; and it ſtill remains undetermined to what that diverſity is owing in this mineral.

Localities, &c.—Arragonite was firſt found imbedded in foliated and fibrous gypſum, in the province of Arragon in Spain, from which it derives its name. It has been alſo found in France, the Pyrenees, in Saltzburg, ſometimes in an argillaceous ſchiſtus, and ſometimes in quartz, accompanied by calcareous ſpar and pyrites.

8. Species. Brown Spar.

Sidero Calcite, Kirw. i. 105. *Le Spath Bruniſſant*, Broch. i. 563. *Chaux Carbonatée Ferrifére Perlée*, Haüy, ii. 179.

Exter. Char.—Found maſſive or diſſeminated, or in kidney ſhaped, globular, or carious pieces; very often cryſtallized. The forms are lenſes or rhomboids, which latter have either convex or concave faces; double pyramids compoſed of two pyramids with three obtuſe faces: ſimple three-ſided pyramids, and oblique ſix-ſided pyramids. The ſurface of the cryſtals druſy, rarely ſmooth; luſtre weakly ſhining or ſhining; internal luſtre ſhining, pearly, or vitreous; fracture foliated; fragments rhomboidal.

Colour milk-white, grayiſh, yellowiſh, or reddiſh white; bright or browniſh red; tranſlucent at the edges;

Calcareous genus.

edges; femihard; brittle, eafily frangible; ftreak grayifh white. Spec. grav. 2.83.

Chem. Char.—Becomes black and hard before the blow-pipe, and unlefs reduced to powder, effervefces flowly with acids.

Conftituent Parts.	Bergman.
Carbonate of lime,	50
Oxide of iron,	22
Oxide of manganefe,	28
	100

Localities, &c.—Brown fpar is found in Bohemia, Saxony, France, Sweden, and Britain. It is ufually found in metallic veins.

9. Species. DOLOMITE.

Id. Kirw. i. 111. *Dolomie*, Brochant, i. 534. *Chaux Carbonatée Aluminifere*, Haüy, ii. 173.

Exter. Char.—Found maffive; fracture appears to be foliated; fragments blunt-edged.

Colour grayifh or yellowifh white; tranflucent on the edges; femihard; rather difficultly frangible; feels meagre. Spec. grav. 2.85.

Conftituent Parts.	Sauffure.
Lime	44.29
Alumina	5.86
Magnefia	1.4
Oxide of iron	.74
Carbonic acid	46.
Lofs	1.71
	100.00

Chem. Char.—Effervefces flowly in nitric acid.

Phys. Char.—Phofphorefces in the dark by the percuffion of a hard body.

Localities, &c.—This ftone was firft obferved by Dolomieu, among the ancient monuments of Rome; and afterwards he difcovered fimilar ftones in the mountains of the Tyrol, and the Alps. It is found abundantly on St Gothard and other primitive mountains. Dolomieu's attention was firft attracted to it by its fuperior hardnefs and flow effervefcence in acids, and analyfis fhews that it is different from limeftone in its compofition.

10. Species. RHOMB or BITTER SPAR.

Cryftallized Muricalcite, Kirw. i. 92. *Le Spath Magnefien*, Brochant, i. 560. *Chaux Carbonatée Magnefifere*, Haüy, ii. 187.

Exter. Char.—Found maffive or diffeminated in rhomboidal pieces, which have a cryftallized appearance; luftre fhining or refplendent, and vitreous or pearly; fracture foliated; cleavage threefold; fragments rhomboidal.

Colour grayifh white, yellowifh or reddifh brown; tranflucent at the edges; femihard; brittle; ftreak fnow-white. Spec. grav. 2.48.

Chem. Char.—Becomes gray or brown before the blow-pipe without fplitting or fufion. Effervefces a little with acids.

Claffification.

Conftituent Parts. Klaproth.		
Carbonate of lime	52	73
——— magnefia	45	25
Oxides of iron and manganefe	3	2
	100	100

Localities, &c.—Found in the Tyrol and Saltzburg, and in Sweden. It is always accompanied with afbeftus, talc, and tremolite, and imbedded in chlorite fchiftus, ferpentine, and indurated talc.

11. Species. SWINE STONE.

Id. Kirwan, i. 89. *La Pierre Puante*, Brochant, i. 567. *Chaux Carbonatée Fœtide*, Haüy, ii. 288.

Exter. Char.—Found maffive; internal luftre glimmering or dull; fracture fplintery, fometimes earthy or foliated; fragments fplintery.

Colour grayifh black, or blackifh brown; opaque, rarely tranflucent at the edges; ftreak grayifh white; femihard, fometimes foft; eafily frangible. Spec. grav. 2.71.

Phys. Char.—When rubbed with a hard body, it gives out a very fœtid odour of rotten eggs.

Chem. Char.—Soluble with effervefcence in nitric acid; before the blow-pipe is deprived of its odour, which is fuppofed to be owing to fulphurated hydrogen.

Localities, &c.—Forms entire beds in ftratiform limeftone rocks, as in France, Saxony, and Sweden.

12. Species. MARL.

This is divided into two fubfpecies; 1. earthy; and, 2. indurated.

Subfpecies 1. EARTHY MARL.

Id. Kirw. i. 74. *La Marne Terreufe*, Brochant, i. 569. *Argile Calcarifere*, Haüy, iv. 455.

Exter. Char.—This variety is compofed of loofe or flightly coherent particles; ftains a little; feels meagre and rough; is light; almoft fwims on water.

Colour yellowifh gray, or grayifh white.

Localities, &c.—Found in many places of France and Germany, as well as in different places of England and Scotland, forming beds in limeftone countries, and often immediately under the foil.

Ufes.—It is fometimes employed in the manufacture of pottery, but its principal ufe is for the purpofes of agriculture.

Subfpecies 2. INDURATED MARL.

Id. Kirw. i. 95. *La Marne Endurcie*, Brochant, i. 571.

Exter. Char.—Found maffive; dull, or flightly glimmering; fracture earthy, fplintery, or flaty; fragments blunt-edged.

Colour yellowifh, or fmoke gray; opaque; ftreak grayifh white; foft; not very brittle; eafily frangible. Spec. grav. 1.6 to 2.8.

Chem.

Classification.

Chem. Char.—Melts before the blow-pipe into a grayish black slag; effervesces briskly with acids.

Marl is considered as a mixture of carbonate of lime and alumina; and according to the different proportions of these ingredients, it is denominated calcareous marl or clay marl, and sometimes it is known in agriculture by the names of soft and hard marl.

Localities, &c.—Found in Bohemia, Saxony, Sweden, Italy, France, and Britain, in stratiform mountains, sometimes in extensive beds, frequently accompanying limestone, coal, and basalt.

Uses.—It is employed in agriculture for improving the soil, sometimes for building, and sometimes as a limestone. It serves also as a flux for some ores of iron.

13. Species. BITUMINOUS MARL SLATE.

Marno-bitumineux, Brochant, i. 574. *Chaux Carbonatée Bituminifere*, Haüy, ii. 189.

Exter. Char.—Found massive; surface rough, dull, rarely glimmering; or when divided into curved plates, smooth and shining; fracture slaty; straight or waved; fragments tabular.

Colour grayish or brownish black; opaque; streak shining; soft; easily frangible; feels rather meagre.

Chem. Char.—Effervesces with acids; inflames before the blow-pipe; gives out a bituminous odour, and then melts into a black slag.

Localities, &c.—Found in different places of Thuringia, in mountains of stratiform limestone, forming particular beds, which repose frequently on a species of sandstone. It is frequently mixed with different ores of copper, so that it is sometimes wrought as a copper ore. In this bituminous schistus, petrified fishes and marine plants are frequently found, disposed in regular order, from which some have conjectured that they must have died a violent death; or, according to others, that they have been poisoned by the copper with which it abounds.

14. Species. APATITE.

Phosphorite, Kirw. i. 128. *L'Apatite Commune*, Brochant, i. 580. *Chaux Phosphatée*, Hauy, ii. 234.

Exter Char.—Found almost always crystallized, rarely disseminated. The forms of its crystals are, 1. A regular six-sided prism; 2. The same prism truncated on its lateral edges; 3. Also on its angles and terminal edges; 4. Bevelled on each of the lateral edges; 5. With an obtuse and regular six-sided pyramid, and one or both extremities, the summit being slightly truncated; 6. A three-sided prism with the lateral edges bevelled, and the terminal edges truncated; 7. A six-sided table, having its terminal edges strongly, and the lateral edges slightly truncated. Lateral faces of the prisms longitudinally streaked; faces of the pyramid smooth; lustre shining and resplendent; internal lustre shining, between resinous and vitreous. Cross fracture foliated; in other directions fine grained, uneven, or conchoidal. Fragments rather sharp-edged.

Colour green of various shades, blue, sometimes pearl gray, and greenish gray; semitransparent, sometimes transparent, or only translucent; semihard; is scratched by fluor spar; brittle, and easily frangible. Spec. grav. 2.8 to 3.2.

Calcareous genus.

Chem. Char.—Thrown on hot coals it gives out a greenish phosphorescent light; infusible before the blow-pipe, but loses its colour. It is almost entirely soluble in nitric acid.

Constituent Parts.	Klaproth.
Lime,	55
Phosphoric acid,	45
	100

Phys. Char.—Becomes electric by friction, but not by heat.

Localities, &c.—Apatite is found in different places of Germany, chiefly in tin mines, where it is accompanied by fluor spar, quartz, and metallic ores. It is also found in Cornwall in similar circumstances.

15. Species. ASPARAGUS STONE.

La Pierre d'Asperge, Broch. i. 586. *Chaux Phosphatée*, Haüy, ii. 234.

Exter. Char.—This mineral has been only found crystallized in equiangular six-sided prisms, terminated by a slightly obtuse six-sided pyramid; lateral edges sometimes truncated; lateral faces longitudinally streaked, the others smooth; external lustre shining or resplendent; internal, resplendent and resinous; fracture foliated, cross fracture imperfectly conchoidal; fragments not very sharp-edged.

Colour asparagus green, greenish white; commonly transparent, often only semitransparent, or even translucent; semihard. Spec. grav. 3.09.

Chem. Char.—Infusible before the blow-pipe; soluble with effervescence in nitric acid, but thrown on hot coals does not phosphoresce.

Constituent Parts.	Vauquelin.
Lime,	53.32
Phosphoric acid,	45.72
Loss,	.96
	100.00

Localities, &c.—This stone has been found at Caprera, near Cape de Gates in Spain, and also, it is said, near Arendal in Norway.

16. Species. PHOSPHORITE.

L'Apatite Terreuse, Broch. i. 584. *Chaux Phosphatée Terreuse*, Haüy, ii. 239.

Exter. Char.—Found massive, and having little coherence; dull; fracture earthy, or fine grained uneven; fragments blunt-edged, sometimes wedge-shaped.

Colour yellowish or grayish white; opaque; semihard; often friable; easily frangible; feels meagre. Spec. grav. 2.82.

Chem. Char.—Before the blow-pipe it phosphoresces, and according to some, melts into a white glass, but according to others, infusible. Soluble in acids, and with sulphuric acid gives out white vapours.

Calcareous genus.

Classification.

Constituent Parts.	Pelletier.
Lime	59.
Silica	2.
Phosphoric acid	34.
Fluoric acid	2.5
Carbonic acid	1.
Muriatic acid	.5
Oxide of iron	1.
	100.0

Localities, &c.—This mineral is found in the province of Estremadura in Spain, where it forms an entire mountain. It is mixed with quartz; has been long known by the inhabitants of the country for its property of phosphorescing when thrown on hot coals.

17. Species. FLUOR.

This has been divided in to three subspecies: 1. earthy; 2. compact; and, 3. fluor spar.

Subspecies 1. EARTHY FLUOR.

Sandy or *Earthy Fluor*, Kirw. i. 126. *Le Fluor Terreux*, Broch. i. 593. *Chaux Fluatée Amorphe*, Haüy, ii. 260.

Exter. Char.—Is composed of particles which are slightly cohering; dull, or scarcely glimmering.

Colour greenish white, sometimes bluish green; stains a little; feels rough.

Chem. Char.—Thrown on hot coals, it gives out a bluish green light.

Localities, &c.—Has been found in Hungary, in a vein accompanied with quartz.

Subspecies 2. COMPACT FLUOR.

Id. Kirw. i. 127. *Id.* Broch. i. 594.

Exter. Char.—Is found massive; dull, lustre sometimes glimmering, vitreous; fracture even, conchoidal, and rarely splintery; fragments sharp-edged.

Colour greenish gray, or greenish white; sometimes different colours are disposed in spots; translucent; streak shining; hard, and brittle.

Chem. Char.—Phosphoresces on hot coals.

Localities, &c.—This mineral is found in the Hartz, in Sweden, and Siberia, always accompanying fluor spar.

Subspecies 3. FLUOR SPAR.

Foliated or *Sparry Fluor*, Kirw. i. 127. *Le Spath Fluor*, Broch. i. 595. *Chaux Fluatée*, Haüy, ii. 247.

Essen. Char.—Insoluble in water, and divisible into a regular octahedron.

Exter. Char.—Fluor spar is found massive or disseminated, but most frequently crystallized. Primitive form a regular octahedron, which is easily obtained by mechanical division; integrant molecule a regular tetrahedron. The usual forms are, 1. The cube, which is either perfect, or with truncated edges or truncated angles, or with the edges bevelled, having on each of its angles a three-sided pyramid, corresponding to the faces of the cube. 2. The octahedron, which is either perfect, or has it angles or its edges, or both, truncated. Surface of the crystals smooth, shining or resplendent, sometimes drusy; internal lustre shining, resplendent, and vitreous or pearly; fracture foliated, straight or curved; cleavage fourfold, in the direction of the faces of the regular octahedron; fragments tetrahedral, or rhomboidal.

Colours of fluor spar extremely various and beautiful. The principal are, greenish white, grayish, or yellowish; blue, green, brown, and red, of various shades; and different colours are sometimes arranged in stripes and spots. Most commonly translucent, sometimes transparent, or only translucent at the edges. Semi-hard; brittle; easily frangible. Spec. grav. 3.09 to 3.19.

Chem. Char.—Fusible before the blow-pipe into a transparent glass; decrepitates when heated. The powder thrown on hot coals gives out a bluish or greenish phosphorescent light; and two pieces rubbed against each other, shine in the dark.

Constituent Parts.	Scheele.
Lime	57
Fluoric acid	16
Water	27
	100

Localities, &c.—Fluor spar is sometimes found in beds, but most frequently in mineral veins. It is very common in many places of the world, particularly in Cornwall and Derbyshire, and also in the counties of Durham and Cumberland in England; at Chamouni in Savoy, the octahedral variety of a rose red colour is found. Fluor spar is found also in the interior part of Aberdeenshire in Scotland.

Uses.—This mineral is successfully employed as a flux for different metallic ores. As it is susceptible of a fine polish, it is cut and formed into a great variety of ornamental objects, as pyramids, vases, &c. which, on account of the beauty of the colours, are greatly esteemed.

18. Species. GYPSUM.

This species is divided into four subspecies: 1. earthy; 2. compact; 3. foliated; and, 4. fibrous.

Subspecies 1. EARTHY GYPSUM.

Farinaceous Gypsum, Kirw. i. 120. *Le Gypse Terreux*, Broch. i. 601. *Chaux Sulphatée Terreuse*, Hauy, ii. 278.

Exter. Char.—This is composed of particles which are more or less cohering; dull, in some places weakly glimmering; feels meagre and rough.

Colour white, gray, or yellowish.

Localities, &c.—This substance is rare; it is only found in the fissures and cavities of gypsum rocks, and is supposed to be a deposition of loose particles of gypsum, carried along by water. Found in Saxony, and Mont Martre near Paris.

Claſſification.

Subſpecies 2. Compact Gypsum.

Id. Kirw. i. 121. *Id.* Broch. i. 602. *Id.* Hauy, ii. 278.

Exter. Char.—Found maſſive; luſtre weakly glimmering, almoſt dull; fracture compact, even, or ſplintery; fragments blunt-edged.

Colour yellowiſh and grayiſh white, ſometimes reddiſh; and different colours exhibit ſtripes; tranſlucent at the edges; ſoft, and eaſily frangible. Spec. grav. about 2.3.

Localities, &c.—Found in Italy, Germany, France, Spain, and England.

Subſpecies 3. Foliated Gypsum.

Granularly Foliated Gypſum, Kirw. i. 123. *Id.* Broch. i. 606.

Exter. Char.—Found maſſive or diſſeminated, and ſometimes, it is ſaid, cryſtallized in ſix-ſided priſms, obtuſely bevelled at each extremity; luſtre glimmering or ſhining, between vitreous and pearly; fracture foliated, ſometimes radiated; fragments blunt edged.

Colour uſually ſnow white, grayiſh, yellowiſh, or reddiſh white; and ſeveral colours are arranged in ſpots, ſtripes, and veins. Tranſlucent, rarely ſemitranſparent; refraction double; very ſoft; eaſily frangible. Spec. grav. 2.27 to 2.31.

Foliated gypſum has ſome reſemblance to granular limeſtone, but may be readily diſtinguiſhed from it by its ſoftneſs.

Subſpecies 4. Fibrous Gypsum.

Id. Kirw. i. 122. *Id.* Broch. i. 604. *Id.* Hauy, ii. 278.

Exter. Char.—This is found maſſive, but in thin layers; luſtre ſhining, or weakly ſhining, pearly; fracture fibrous; in ſome varieties the longitudinal fracture is foliated; croſs fracture fibrous; fragments long, ſplintery.

Colour ſnow white, grayiſh, yellowiſh, or reddiſh white; tranſlucent; very ſoft; eaſily frangible.

Chem. Char.—The different varieties of gypſum poſſeſs nearly the ſame chemical characters. When pure, there is no efferveſcence with acids. Before the blow-pipe gypſum immediately becomes white, is converted into a white enamel, which, at the end of 24 hours, falls into powder.

Localities, &c.—Gypſum, in general, conſtitutes mountains or beds, which are ſubordinate to ſandſtone, or limeſtone. It is found in all kinds of rocks. Gypſum is found in great abundance in the neighbourhood of Paris, in ſeveral parts of England, but ſparingly in Scotland.

Uſes.—Gypſum is employed along with lime as a cement. It is alſo very extenſively employed under the name of plaſter of Paris, for making caſts and models. With this view it is expoſed to a ſtrong heat, to drive off the water of cryſtallization. It is then in the ſtate of powder, which being again mixed with water, is put into the mould in the form of paſte; and, from its ſtrong affinity for water, it ſoon becomes ſolid.

Calcareous genus.

19. Species. Selenite.

Broad Foliated Gypſum, Kirw. i. 123. *La Selenite*, Broch. i. 609. *Chaux Sulfatée*, Hauy, ii. 266.

Eſſen. Char.—Diviſible into ſmooth plates, which break under angles of 113° and 67°.

Exter. Char.—Selenite is found maſſive; and frequently alſo cryſtallized. The primitive form of its cryſtals is a four-ſided priſm, whoſe baſes are oblique parallelograms; the integrant molecule is the ſame. The uſual forms are, a ſix-ſided priſm, having two broad and two narrow faces, and terminated by an oblique bevelment, whoſe ſides correſpond to the broad ſides of the priſm; a ſimilar priſm terminated by a four-ſided pyramid; double cryſtals compoſed of two of the former united by their ſmaller lateral faces, ſo that the ſummits united form on one ſide a ſalient angle, and on the other a re-entering angle; another form is a ſpheroidal or conic lens. Theſe cryſtals are often grouped, divergent, faſcicular, or ſtellated; and of the ſix ſides of the priſm, the two oppoſite are ſmooth, and the four others longitudinally ſtreaked; luſtre reſplendent or ſhining, between vitreous and pearly; fracture foliated, ſtraight or curved; cleavage threefold; fragments rhomboidal, with two faces ſmooth and ſhining, and two others ſtreaked.

Colour uſually white, grayiſh, yellowiſh, or ſnow white, ſometimes irideſcent; tranſparent, ſometimes only tranſlucent; very ſoft; in thin plates, flexible, but not elaſtic; eaſily frangible. Spec. grav. 2.32.

Chem. Char.—Before the blow-pipe more eaſily fuſible than gypſum, and ſplits into thin plates.

Conſtituent Parts.	Bergman.
Lime	32
Sulphuric acid	46
Water	22
	100

Localities, &c.—Selenite is found among beds of gypſum, and particularly among thoſe which alternate with clay and ſand ſtone. It is alſo found in neſts in clay. It is not uncommon in many places, as among the gypſum rocks near Paris, in different parts of England, and at Lord Glaſgow's coal works in Scotland, where it is found among clay, and in the cavities or on the ſurface of the limeſtone which repoſes on the ſtrata of coal.

Uſes.—Selenite alſo, after calcination, is employed in modelling; but it is ſaid that it poſſeſſes leſs ſolidity than what is obtained from gypſum.

20. Species. Anhydrite.

Chaux Sulfatée Anhydre, Haüy, iv. 348.

Exter. Char.—This mineral is found maſſive; luſtre ſhining or weakly ſhining, and pearly; fracture curved foliated, ſometimes radiated, and fine ſplintery: fragments ſharp-edged; tranſlucent; ſemihard; not very brittle, rather eaſily frangible. Spec. grav. 2.964.

Chem. Char.—Before the blow-pipe it neither exfoliates nor becomes white, like ſelenite.

Conſtituent

Calcareous genus.

Constituent Parts.

	Vauquelin.	Klaproth.
Lime,	40	42.
Sulphuric acid,	60	57.
Oxide of iron,	–	.1
Silica,	–	.25
Loss,	–	.65
	100	100.00

Localities, &c.—This mineral has been found in Switzerland, in the salt pits in the canton of Berne.

21. Species. CUBE SPAR.

Chaux Sulfatée Anhydre, Hauy, iv. 348. *Soude Muriatée Gypsifere*, Id. ii. 365. *Muriacite*, Klaproth.

Exter. Char.—This mineral is found massive, and also crystallized, in four-sided prisms, which are nearly cubical; two of the opposite lateral faces are broader than the other two. The lateral edges are sometimes truncated, and hence arises an eight-sided prism: sometimes also the truncations are so great as to destroy the narrow lateral faces, and form again a six-sided prism. External lustre of the broad faces resplendent and pearly; of the narrow, shining. Internal lustre shining and pearly; fracture foliated; cleavage threefold; fragments cubical.

Colour milk-white, grayish, yellowish, and reddish white; sometimes pearl gray; translucent; semihard. Spec. grav. 2.92 to 2.96.

Constituent Parts.	Klaproth.
Sulphate of lime,	57.8
Carbonate of lime,	11.
Muriate of soda,	31.2
	100.0

Localities, &c.—Found in the salt pits at Halle in the Tyrol, where it is called *splintery gypsum*.

22. Species. DATHOLITE.

Chaux Datholite, Brongniart, ii. 397. *Chaux Boratée Siliceuse*, Hauy.

Exter. Char.—This mineral has only been found crystallized; the primitive form is a rectangular prism, with rhomboidal bases, whose angles are 109° 18′ and 70° 42′; lustre shining, vitreous; fragments conchoidal.

Colour grayish or greenish white; translucent; scratches fluor spar. Spec. grav. 2.98.

Chem. Char.—In the flame of a candle it becomes dull white, and is easily reduced to powder. Before the blow-pipe it melts into a glass of a pale rose-red colour.

Constituent Parts.	Klaproth.
Lime,	35.5
Silica,	36.5
Boracic acid,	24.
Water,	4.
	100.00

1

Classification.

Localities, &c.—Found near Arendal in Norway, and some specimens are accompanied by greenish-coloured, foliated talc.

VII. BARYTIC GENUS.

1. Species. WITHERITE, or *Carbonate of Barytes*.

Barolite, or *Aerated Barytes*, Kirw. i. 134. *La Witherite*, Brochant, i. 613. *Baryte Carbonatée*, Haüy, ii. 308.

Essen. Char.—Forming a white precipitate in weak nitric acid before solution.

Exter. Char.—Found massive, or disseminated, rarely crystallized; forms of its crystals are, a six-sided prism, with a six-sided pyramid set on the lateral faces; the same prism having all the angles truncated; a double six-sided pyramid. The crystals, which are small, are usually imbedded in the mineral itself; sometimes grouped in bundles, or crossing each other. Surface smooth; lustre of the principal fracture shining, or weakly shining, resinous; fracture between radiated and foliated; cross fracture fine grained uneven; fragments wedge-shaped.

Colour yellowish gray, grayish, or yellowish white; translucent, or semitransparent; semihard, or soft; brittle; easily frangible. Spec. grav. 4.3 to 4.33.

Chem. Char.—Infusible according to Hauy, before the blow-pipe; but according to Brochant, melts before the blow-pipe to a white enamel.

Constituent Parts.

	Pelletier.	Vauquelin.
Barytes,	62	74.5
Carbonic acid,	22	25.5
Water,	16	–
	100	100.0

Constituent Parts according to Klaproth.

Carbonate of barytes,	98.246
Carbonate of strontites,	1.703
Alumina iron,	.043
Carbonate of copper,	.008
	100.000

Localities, &c.—This mineral was discovered by Dr Withering at Anglesark in Lancashire, in lead veins, which traverse the coal strata, and it is accompanied with heavy spar and blende.

Uses.—Barytes acts as a strong poison on the animal economy. It has been long employed at Anglesark for the purpose of destroying rats. It has also been tried as a medicine in scrofula, but seemingly with little effect; and it ought to be had recourse to with extreme caution.

2. Species. HEAVY SPAR, or *Sulphate of Barytes*.

This species has been divided in eight subspecies; earthy, compact, granular, foliated, common, columnar, prismatic, and bolognian.

Subspecies 1. EARTHY HEAVY SPAR.

Earthy Baroselenite, Kirw. i. 138. *Le Spath Pesant Terreux*, Brochant, i. 617.

Exter.

Claffification.

Exter. Char.—Found maffive; luftre fcarcely glimmering, or dull; confifts of earthy particles, which are flightly cohering; ftains a little; feels meagre.

Colour fnow white, grayifh, yellowifh, or reddifh white.

Localities. &c.—This a rare mineral. It has been found in Saxony, covering maffes of heavy fpar, and alfo in Derbyfhire and Staffordfhire in England.

Subfpecies 2. COMPACT HEAVY SPAR.

Compact Barofelenite, Kirw. i. 138. *Baryte Sulfatée Compacte*, Hauy, ii. 303. *Id.* Broch. i. 618.

Exter. Char.—Found maffive, fometimes in kidneyform or globular pieces, with cubical impreffions; luftre glimmering, fometimes dull, and fometimes weakly fhining; fracture coarfe earthy, fometimes uneven; fragments not very fharp-edged.

Colour yellowifh, grayifh white, fometimes pale flefh red; opaque, or tranflucent at the edges; foft; not very brittle; eafily frangible; feels meagre.

Localities, &c.—Found in mineral veins in Saxony, and in England; in clay flate, in Savoy; and we have found it in fand ftone in Northumberland.

Subfpecies 3. GRANULAR HEAVY SPAR.

Exter. Char.—This alfo is found maffive; luftre glimmering, nearly fhining, and pearly; fracture foliated, or fplintery; fragments blunt-edged.

Colour fnow-white, milk-white, yellowifh, or reddifh; tranflucent; foft; not very brittle; eafily frangible. Spec. grav. 3.8.

Conftituent Parts.	Klaproth.
Barytes,	60
Sulphuric acid,	30
Silica,	16
	100

Localities, &c.—Found in mineral veins in Saxony, along with galena, and in Siberia, accompanied by copper and filver ores.

Subfpecies 4. FOLIATED HEAVY SPAR.

Exter. Char.—Found maffive, and in kidney-fhaped, globular and cellular pieces, compofed of four-fided tables, or lenfes, with a drufy furface; luftre glimmering or fhining, between pearly and vitreous; fracture curved foliated, fometimes fplintery; fragments not very fharp-edged, fometimes wedge-fhaped.

Colour yellowifh, reddifh, or grayifh white, fometimes flefh or brownifh red; tranflucent; foft; not very brittle; eafily frangible.

Localities, &c.—Is not uncommon in mineral veins; fometimes alfo in beds, in many countries. It is alfo found in Britain.

Subfpecies 5. COMMON HEAVY SPAR.

Foliated Barofelenite, Kirw. i. 140. Broch. i. 624.

Exter. Char.—This mineral is found in maffes, or differminated, and very often cryftallized. Its principal forms are; 1. A double four-fided pyramid; 2. A four-fided prifm, rectangular or oblique; 3. A four-fided table, rectangular or oblique; 4. A fix-fided prifm; 5. A fix-fided table; and 6. A long eight-fided table. Thefe forms are varioufly modified by truncations and bevelments, and they are differently grouped together; the prifms crofs one another; the tables are attached by their lateral faces, and form globular or kidney-fhaped groups; furfaces fmooth, fometimes rough and drufy. Luftre refplendent, fhining, glimmering, or only dull: internal luftre fhining or refplendent, between pearly and refinous: fracture ftraight foliated; cleavage threefold; fragments fomewhat rhomboidal.

Barytic genus.

Colour commonly white, fnow-white, milk-white, grayifh, yellowifh, or reddifh; in maffes tranflucent; in cryftals tranfparent or femitranfparent; refraction double; foft; brittle. Spec. grav. 4.29 to 4.47, and 4.5.

Chem. Char.—Fufible before the blow-pipe into a folid white enamel, which being moiftened, gives out the odour of fulphurated hydrogen. Does not effervefce with acids.

Conftituent Parts.

	Withering.	Bergman.
Barytes,	67.2	84
Sulphuric acid,	32 8	13
Water,	–	3
	100.0	100

Localities, &c.—This is a very common mineral, and particularly in metallic veins that traverfe primitive mountains. It accompanies ores of filver, copper, lead, and cobalt, as well as fluor fpar, calcareous fpar, and quartz.

Subfpecies 6. COLUMNAR HEAVY SPAR.

Le Spath Pefant en Barres, Broch. i. 631. *Baryte Sulphatée Bacillaire*, Haüy, ii. 302,

Exter. Char.—Found always cryftallized: 1. In oblique four-fided prifms; 2. The fame prifm terminated by an acute bevelment; 3. The fame prifm terminated by a four-fided pyramid placed on the lateral edges; and 4. A fix-fided prifm bevelled at the extremity. The cryftals are acicular, and are grouped together in bundles; furface fhining, or weakly fhining; internal luftre fhining; longitudinal fracture radiated; crofs fracture even. Fragments rhomboidal.

Colour filvery, grayifh, or greenifh white; tranflucent; foft, and brittle.

Localities, &c.—Found in Saxony, and Derbyfhire in England, accompanied by other varieties of heavy fpar, quartz, and fluor fpar.

Subfpecies 7. PRISMATIC HEAVY SPAR.

Exter. Char.—Found maffive, and frequently cryftallized. The ufual forms are, 1. An oblique four-fided prifm, bevelled at the extremities; 2. An oblique four-fided prifm, terminated by a four-fided pyramid placed on the lateral edges; 3. An elongated octahedron; and 4. A fix-fided prifm. Luftre fhining or refplendent, between refinous and pearly; fracture foliated; cleavage threefold.

Colour

Strontian genus.

Colour yellowiſh, greeniſh, or pearl gray, ſometimes pale blue, and rarely fleſh red; tranſlucent; when cryſtallized, tranſparent; ſoft, and not very brittle; very eaſily frangible.

Localities, &c.—Sometimes found in mineral veins, as in Saxony.

Subſpecies 8. Bolognian Heavy Spar.

Le Spath de Bologne, Brochant, i. 633. *Striated* or *fibrous heavy ſpar*, Kirwan, i. 141. *Baryte ſulfatée radiée*, Hauy ii. 302.

Exter. Char.—This is found in rounded pieces; external ſurface uneven, dull, or glimmering; internal luſtre ſhining, or weakly ſhining, between adamantine and pearly; fracture radiated, parallel, diverging, or fibrous, ſometimes foliated; fragments ſplintery, ſometimes rhomboidal.

Colour, ſmoke or yellowiſh gray; tranſlucent, ſoft, very brittle, and eaſily frangible.

Chem. Char.—This mineral has been long known by its property of ſhining in the dark, after being heated. Other heavy ſpars, indeed, have a ſimilar property.

Conſtituent Parts.	Arvidſon.
Sulphate of barytes	62.
Silica	15.
Alumina	14.75
Gypſum	6.
Oxide of iron	.25
Water	2.
	100.00

Localities, &c.—This mineral is found at Monte Paterno near Bologna in Italy, in rounded maſſes, which have an uneven ſurface: they are imbedded in an argillaceous or marly rock, which is a kind of amygdaloid, and from which they are detached by the action of the waters.

VIII. STRONTIAN Genus.

1. Species. Strontites, *Carbonate*.

La Strontianite, Brochant, i. 637. *Id.* Kirw. i. 332. *Strontiane Carbonatée*, Hauy, ii. 327.

Eſſen. Char.—Soluble in nitric acid with effervescence; paper dipped in the ſolution, and dried, burns with a purple flame.

Exter. Char.—Found maſſive, and ſometimes cryſtallized in needles, which are grouped together; form of the cryſtals a regular ſix-ſided priſm; luſtre weakly ſhining, or only glimmering; internal luſtre ſhining, and weakly ſhining, between reſinous and pearly; fracture radiated, ſtraight, diverging, or fibrous; croſs fracture fine grained, uneven, or ſplintery; fragments wedge-ſhaped, or ſharp edged.

Colour aſparagus green, greeniſh, whitiſh, or yellowiſh gray; tranſlucent; ſemihard, brittle and eaſily frangible; feels a little greaſy. Spec. grav. 3.4 to 3.67.

Chem. Char.—Before the blow-pipe whitens without fuſion, and afterwards expoſed to the air, falls to powder.

Claſſification.

Conſtituent Parts.

	Klaproth.	Pelletier.
Strontites	69.5	62
Carbonic acid	30.	30
Water	.5	8
	100.0	100

Localities, &c.—This mineral has been hitherto found only at Strontian in Scotland, in a lead vein which traverſes a gneiſs rock. It is ſaid alſo to have been found at Leadhills.

2. Species. Celestine, *Sulphate of Strontites.*

La Celeſtine, Brochant, i. 640. *Strontiane ſulfatée*, Hauy, ii. 313.

Eſſen. Char.—Diviſible into a rhomboidal priſm, with angles of about 105° and 75°; gives a light red colour to the blue part of the flame produced by the blow-pipe.

Exter. Char.—Primitive form of its cryſtals a rectangular priſm, whoſe baſes are rhombs; integrant molecule a triangular priſm with ſquare baſes. The forms under which it generally appears are four or ſix-ſided priſms, which are terminated by a two ſided bevelment, a four-ſided, or an eight-ſided pyramid.

This ſpecies has been divided into two ſubſpecies: 1. fibrous; and, 2. foliated.

Subſpecies 1. Fibrous Celestine.

Exter. Char.—Found maſſive or cryſtallized; luſtre of the longitudinal fracture ſhining; that of the croſs fracture, weakly ſhining between pearly and reſinous. Longitudinal fracture foliated; croſs fracture fibrous, curved; fragments ſplintery; rather blunt-edged.

Colour indigo blue, bluiſh gray, and ſometimes with whitiſh bands, or with yellowiſh brown ſpots; tranſlucent; ſoft, and eaſily frangible. Spec. grav. 3.83.

Conſtituent Parts.	Klaproth.
Strontites	58
Sulphuric acid and oxide of iron	42
	100

Localities, &c.—Has been found in Pennſylvania in America, and near Toul in France.

Subſpecies 2. Foliated Celestine.

Exter. Char.—This is alſo found maſſive and cryſtallized; luſtre weakly ſhining, or ſhining; that of the cryſtals reſplendent; fracture foliated, ſtraight, or radiated; cleavage three-fold.

Colour milk-white, grayiſh, and bluiſh-white; ſemitranſparent, or tranſlucent; ſemi-hard; very eaſily frangible.

The following are the conſtituent parts of a variety of ſulphate of ſtrontites, which is found at Mont Martre near Paris.

Sulphate of ſtrontites	91.42
Carbonate of lime	8.33
Oxide of iron	.25
	100.00 *

* *Vauquelin, Jour. de Mines*, No. 53. p. 355.

Localities,

Classification.

Localities, &c.—This variety is found in great abundance near Bristol in England, where the sulphate of strontites was first discovered by Mr Clayfield. It has been since found in Sicily, where it is accompanied with fibrous gypsum and native sulphur.

SECOND CLASS. *SALTS*.

I. Genus. SULPHATES.

1. Species. Native Vitriol.

Mixed vitriol, or *sulphate of iron, copper and zinc.* Kirwan, ii. 24. *Vitriol Natif*, Brochant, ii. 2.

Exter. Char.—This mineral is found massive or disseminated, and also in a stalactitical, cylindrical, and capillary form; internal lustre shining, or weakly shining, between silky and vitreous; external surface rough and uneven; fracture usually fibrous, sometimes foliated.

Colour grayish, or yellowish white, sometimes different shades of sky blue; the colour varies by exposure to the air. Soft; semi-transparent or translucent; taste sour and astringent.

Chem. Char.—These are different, according to the proportions of the constituent parts. Before the blowpipe, sulphurated hydrogen gas is given out; the iron is detected by giving a black colour to the solution of nut galls; the copper, by immersing a plate of iron; and the zinc, by a white efflorescence, which appears when the native salt is exposed to the air.

This substance is a mixed salt, composed of the sulphates of iron, zinc and copper, in variable proportions, so that its appearance and characters must also be variable.

Localities, &c.—Native vitriol is not uncommon in mountains of clay slate which contain metallic ores, and particularly those of copper and iron pyrites, and blende; by the decomposition of which it is formed. It is found in Bohemia, Saxony, and Hungary, as well as in the mines of Britain, where such metallic ores abound.

The native sulphate of iron is common in coal mines which contain iron pyrites, as in many of the coal mines of Britain. This substance is very abundant in the earl of Glasgow's coal mines near Paisley, where the manufacture of copperas, by purifying and crystallizing the native salt, has been long carried on.

Uses.—The mixed substance, native vitriol, can only be employed to any useful purpose, by obtaining the different salts in a separate form. The uses of these salts are well known in various arts, but particularly in dyeing, and some of them in medicine.

2. Species. Native Alum.

Alum, Kirwan ii. 13. *L'Alun Natif*, Brochant, ii. 6. *Alumine Sulfatée alkaline*, Hauy, ii. 387, 388.

Exter. Char.—Native alum is usually found in small capillary crystals, sometimes adhering to other minerals, and very rarely in stalactitical masses. The form of the crystal of alum is the regular octahedron, which is usually obtained artificially. Externally it is dull, or slightly glimmering, but internally shining, with a silky or vitreous lustre; fracture fibrous; very soft; taste astringent.

Salts.

Chem. Char.—Before the blow-pipe melts easily in its water of crystallization, then froths up, and becomes a white spongy mass.

Alum is a triple salt, a sulphate of alumina and potash. It rarely happens that all the three ingredients exist together in nature. The potash is usually added during the preparation of artificial alum.

According to the examination of native alum by Klaproth, from the alum cavern at Cape Miseno near Naples, it appears that from 1000 lbs. of the material furnished by nature, 470 lbs. may be obtained, having the requisite quantity of potash; and by an addition of potash to promote the crystallization, 290 lbs. more may be obtained. *Analyt. Ess.* i. 268. The following is the analysis of the aluminous schistus from Freyenwalde by the same chemist.

Alumina	15.25
Oxide of iron	7.50
Potash	.25
Sulphuric acid and water of crystallization	77.
	100.00*

* *Analyt. Ess.* ii. 78.

Localities, &c.—Native alum is found in those places where the aluminous stones, already described, abound, as in the neighbourhood of volcanoes, and in coal mines. An extensive alum manufactory has been carried on for several years with great skill and success, at Lord Glasgow's coal work near Paisley, mentioned above. The materials are obtained from the rubbish in the old wastes, which consists of the aluminous schistus from the roof and pavement of the coal. These mines also abound with iron pyrites; and from the decomposition of all these substances the native vitriol and native alum are obtained.

Uses.—The uses of alum in various arts are too well known to require any enumeration.

3. Species. Mountain Butter.

La Beurre de Montagne, Broch. ii. 10.

Exter. Char.—Found massive; internal lustre strongly glimmering, waxy; fracture foliated; fragments blunt-edged.

Colour grayish white, sulphur yellow, or yellowish brown; translucent at the edges; feels greasy; taste astringent.

Localities, &c.—This species is found in similar situations with the former. In its native repository it is nearly as soft as butter, and has something of the appearance, from which it has its name. Perhaps it ought to be considered merely as a variety of the former. The same remark may be applied to another variety called *plumose alum*.

4. Species. Capillary Salt. *Sulphate of Magnesia.*

Le Sel Capillaire, Broch. ii. 8. *Haar Salz*, or *Hair Salt*, of the Germans.

Exter. Char.—This salt is always found in fine capillary crystals, so closely united together as to form a compact mass; lustre shining, or weakly shining, silky; fracture fibrous.

Colour

Salts.

Colour white, ſometimes greeniſh, grayiſh, or yellowiſh; tranſlucent, friable; taſte aſtringent.

Conſtituent Parts.—This ſalt was ſuppoſed to be a plumoſe or native alum; but it appears from the analyſis of Klaproth, to be a ſulphate of magneſia, with a ſmall proportion of iron. We have examined a ſimilar capillary ſalt from the coal mines near Paiſley, which alſo appeared to be a ſulphate of magneſia, but with a greater proportion of ſulphate of iron.

Localities, &c.—This native ſalt is found in ſimilar ſituations with the former ſpecies.

5. Species. NATIVE EPSOM SALT, or *Sulphate of Magneſia.*

Le Sel amer Natif, Broch. ii. 11. *Epſom Salt*, Kir. ii. 12.

Exter. Char.—The characters already given of the former ſpecies are equally applicable to this, excepting that it is ſaid to exiſt ſometimes in an earthy form, when it has a dull appearance.

Localities, &c.—Found in a ſtate of efflorеſcence on limeſtone, porphyry, ſandſtones; and it exiſts in ſolution in many mineral waters, as in that of Epſom in England, from which it has its name. This ſalt alſo conſtitutes part of the effloreſcence which is obſerved on walls built with lime.

6. Species. NATIVE GLAUBER SALT, or *Sulphate of Soda.*

Glauber Salt, Kirw. ii. 9. *Le Sel de Glauber Natif*, Broch. ii. 14.

Exter. Char.—This ſalt is ſometimes found maſſive or earthy, rarely ſtalactitical or cryſtallized. The cryſtals are often acicular, or in irregular, ſix-ſided priſms, terminated by a three-ſided pyramid, placed on the lateral edges or ſides. Luſtre ſhining, vitreous; but expoſed to the air becomes dull. Fracture uneven; that of the cryſtals conchoidal. Fragments blunt-edged.

Colour yellowiſh or grayiſh white; opaque or tranſparent; brittle; taſte cooling or bitter.

Localities, &c.—This ſalt is uſually found in the neighbourhood of mineral ſprings which hold common ſalt in ſolution, from the decompoſition of which, and the combination of its baſe with ſulphuric acid, it is obtained. It is not unfrequent on the banks of ſalt lakes, and in a ſtate of effloreſcence on ſandſtone, marl, ſometimes on the ſurface of the ground, and ſometimes on walls built with lime and mortar. It is found in moſt countries in the world.

II. GENUS. NITRATES.

1. Species. NATIVE NITRE, or *Nitrate of Potaſh.*

Nitre. Kirw. ii. 25. *Le Nitre Natif*, Broch. ii. 17. *Potaſſe Nitratée*, Hauy, ii. 346. *Saltpetre.*

Eſſen. Char. Does not deliqueſce, and detonates with a combuſtible body.

Exter. Char.—This ſalt is commonly found ſuperficial, in acicular cryſtals, rarely maſſive, and more rarely cryſtallized in ſix-ſided priſms; luſtre ſhining, vitreous; fracture conchoidal; fragments ſharp-edged.

Colour ſnow white, grayiſh or yellowiſh white; tranſlucent; ſoft; eaſily frangible or friable; taſte ſaline cooling.

Claſſification.

Conſtituent Parts.	Klaproth.
Nitrate of potaſh	42.55
Muriate of potaſh	.20
Sulphate of lime	25.45
Carbonate of lime	30.40
Loſs	1.40
	100.00 †

† *Analyt. Eſſ.* i. 270.

Exter. Char, &c.—Native nitre is found in Italy near Molfetta, in Naples, from which that analyzed by Klaproth was obtained, and which is diſpoſed in ſmall beds, or more rarely in veins, on limeſtone. Native nitre is alſo not uncommon in Hungary, Spain, France, and Peru, in which latter country, and in the Eaſt Indies, where it is very abundant, it is found effloreſcent on the ſurface of the ground at certain ſeaſons of the year.

Uſes.—The uſes of nitre for ſome economical purpoſes, in various arts, in medicine, but particularly in the manufacture of gun-powder, are well known.

III. GENUS. MURIATES.

1. Species. ROCK SALT.

Common Salt, *Sal Gem*, Kirw. ii. 31. *Le Sel de Cuiſine*, Broch. ii. 20. *Soude Muriatée*, Hauy, ii 356.

Eſſen. Char.—Soluble in water, and diviſible into cubes.

This ſpecies is divided into two ſubſpecies; 1. foliated, and 2. fibrous rock ſalt.

Subſpecies 1. FOLIATED ROCK SALT.

Le Sel Gemme Lamelleux, Broch. ii. 21. *Lamellar Sal Gem*, Kirw. ii 32. *Soude Muriatée Amorphe*, Hauy, ii. 359.

Exter. Char.—Uſually found maſſive in conſiderable beds, ſometimes diſſemimated in large maſſes, or kidney-form, ſtalactitical, or cryſtallized in perfect cubes; ſurface of the cryſtals ſmooth; luſtre ſhining, vitreous; fracture foliated; cleavage threefold and rectangular; fragments cubic.

Colour grayiſh, yellowiſh, or reddiſh white, fleſh or browniſh red; tranſparent or tranſlucent; ſoft; ſtreak grayiſh white; taſte ſaline.

Chem. Char.—This ſalt decrepitates violently when thrown on burning coals.

Conſtituent Parts.

	Kirwan.	Bergman.
Soda	35	42
Muriatic acid	40	52
Water	25	6
	100	100

The above are the analyſes of pure ſalt; for as it is found in nature, it contains ſeveral other ingredients.

Localities, &c.—Foliated rock ſalt conſtitutes a peculiar kind of ſtratiform mountain, in which it uſually

Classification. Salts.

ally alternates with beds of clay, which are more or less penetrated with salt. It is also accompanied with gypsum, sandstone, limestone. It is sometimes also found in veins.

Rock salt is found in most countries of the world; the most celebrated mines are those of Wiliczka, which have been wrought for 500 years. There are mines of this mineral in Poland, Silesia, and in Bavaria and Siberia; at Cordova in Spain it constitutes an entire mountain. Rock salt is also found in abundance in Cheshire in England. It is found also in Africa, Asia, as well as in North and South America.

Subspecies 2. Fibrous Rock Salt.

Fibrous Sal Gem, Kirw. ii. 32. *Le Sel Gemme Fibreux*, Broch. ii. 25. *Soude Muriatée Fibreuse*, Hauy, ii. 359.

Exter. Char.—This variety is found massive, in small wedge-shaped veins; lustre glimmering, rarely weakly shining; fracture fibrous, curved parallel or divergent; fragments wedge-shaped, with sharp edges.

Colour grayish white, yellowish or pearl gray, lavender blue, violet blue, or flesh red; varies between translucent and semitransparent. The other characters of fibrous rock salt correspond with those of the preceding subspecies, and it is found in similar situations accompanying it.

2. Species. Sea Salt.

This salt can perhaps scarcely be considered as a separate species. It is found on the shores of the ocean, or of salt lakes during the dry seasons of the year, in consequence of the evaporation and diminution of the water which holds it in solution.

Uses.—The various uses of salt in domestic economy and many of the arts are well known.

Species 3. Native Sal Ammoniac.

Sal Ammoniac, Kirw. ii. 33. *Le Sel Ammoniac Natif*, Broch. ii. 27. *Ammoniaque Muriatée*, Hauy, ii. 380.

Essen. Char.—Entirely volatile by the application of heat.

Exter. Char.—Most commonly found in superficial layers, or efflorescent; sometimes also massive or stalactical, and rarely crystallized. Primitive form of its crystals a regular octahedron; integrant molecule a regular tetrahedron. The crystals are described to be in the form of cubes, six-sided pyramids, and dodecahedral; lustre shining, often only glimmering or dull and vitreous. Fracture even; fragments sharp-edged.

Colour white, grayish, or yellowish; soft, and often friable; taste saline, pungent, and bitter.

Chem. Char.—Very soluble in water, producing a considerable degree of cold; rubbed with lime, gives out a pungent odour of ammonia.

Constituent Parts.	Klaproth.
Muriate of ammonia	77.5
Sulphate of ammonia	2.5
	100.0

Localities, &c.—This salt is a volcanic production, and found deposited in the cavities of lava, as on Vesuvius and Ætna, and in the Lipari islands. It is also met with in Iceland, in Persia, and different places of Asia. The substance analyzed by Klaproth was from Tartary. This salt has also been discovered in the neighbourhood of coal mines in Britain, which have been accidentally on fire. Sal ammoniac from Egypt may be considered rather as an artificial production.

IV. Genus. CARBONATES.

1. Species. Native Soda, or *Carbonate of Soda*.

Natron, Kirw. ii. 6. *L'Alkali Mineral*, Broch, ii. 30. *Soude Carbonatée*, Hauy, ii. 373.

Essen. Char.—Soluble in water, and effervesces with nitric acid.

Exter. Char.—Found in small particles, which are usually in the state of powder; is dull and meagre to the touch.

Colour grayish white, or yellowish gray; taste sharp alkaline.

Chem. Char.—Very fusible before the blow-pipe; the solution renders vegetable blues green.

The following are the constituent parts of Egyptian natron or soda, analysed by Klaproth.

Carbonate of soda	32.6
Sulphate of soda	20.8
Muriate of soda	15.
Water	31.6
	100.0

Localities, &c.—Native soda is found on the surface of the soil, or on the borders of lakes which evaporate during the summer, in Egypt, where it has been long collected, and known under the name of *natron*. In the neighbourhood of Debreczin in Hungary, it is found efflorescent on a heathy soil; in Bohemia, on a decomposed gneiss rock, where it is annually collected in considerable quantity in the spring of the year. Natron is also found near Naples, in Persia, Bengal, and China. It exists also in solution in many mineral waters.

Uses.—This salt is very extensively employed in many arts.

Another variety of native soda has been described. This is in the form of radiated masses, which are composed of acicular crystals. It seems to be a purer carbonate of soda. The following are the constituent parts according to the analysis of Klaproth.

Soda	37.
Carbonic acid	38.
Water	22.5
Sulphate of soda	2.5
	100.0

2. Species. Native Magnesia, or *Carbonate of Magnesia*.

A pretty pure carbonate of magnesia, discovered by Dr Mitchell; and another which contains an admixture of

Salts. Classification.

of silica discovered by Giobert, has been already described under the magnesian genus, species 1. which see.

V. Genus. BORATES.

1. Species. Borax.

Id. Kirw. ii. 37. *Borax Natif*, Broch. ii. 33. *Soude Boratée*, Haüy, ii. 366.

Essen. Char.—Taste sweetish; fusible with considerable intumescence into a vitreous globule.

Exter. Char.—This salt is found massive and disseminated, but most frequently crystallized; the forms are a six-sided prism with the two opposite faces broader; the same prism having its lateral edges truncated, or having its two narrow terminal edges truncated; the crystals are usually imbedded in an earthy mass; surface a little rough, sometimes smooth, and usually covered with a white earthy crust; lustre shining, waxy; fracture foliated.

Colour grayish white, yellowish or greenish; semitransparent, or only translucent; refraction double; soft; brittle; greasy to the feel. Spec. grav. 1.740.

Constituent Parts.—When borax is purified, it is a compound of soda and boracic acid; but in its native state it is always contaminated with earthy matters.

Localities, &c.—Borax is brought from Persia and Thibet. According to some travellers, it is got from the waters of a lake by evaporation in the open air; but according to others it is ready formed on the borders of the lake, where common salt is also collected.

Uses.—Borax is still farther purified after it is brought to Europe, for the purposes of employing it in the arts, particularly as a flux in metallurgical operations.

2. Species. Boracite, or *Borate of Magnesia*.

Boracite, Kirw. i. 172. *Id.* Brochant, i. 589.

Exter. Char.—Always found crystallized: 1. In cubes, having the edges and four of the angles truncated; 2. The cube, having all the edges and angles truncated. When these truncations are increased on the edges, a dodecahedron is nearly formed, or when they increase on the angles, the resulting form is an octahedron. Surface of the crystals smooth, sometimes rough; lustre shining or resplendent; internal lustre shining, resinous; fracture conchoidal; fragments sharp-edged.

Colour ash or yellowish gray, grayish or greenish white; semitransparent or translucent, oftener opaque; semihard; rather easily frangible. Spec. grav. 2.56.

Chem. Char.—Melts before the blow-pipe, froths up, and yields a yellowish enamel, on which small rough points appear, and are thrown off like sparks by continuing the heat.

Constituent Parts.	Westrumb.
Magnesia	13.5
Lime	11.
Silica	2.
Alumina	1.
Oxide of iron	.7
Boracic acid	68.
Loss	3.8
	100.0

Phys. Char.—Boracite has the property of becoming electric by heat, and exhibiting both kinds of electricity by opposite points. These electric poles are the extremities of the axes of the cube, each axis giving out at one extremity positive, and at the other negative electricity.

Localities, &c.—This mineral has been only found at Lunebourg in Lower Saxony, in a mountain composed almost entirely of foliated gypsum, in which the detached crystals are imbedded.

VI. Genus. FLUATES.

1. Species. Cryolite, or *Fluate of Soda and Alumina.*

Id. Brochant, ii. 505. *Alumine Fluatée Alkaline*, Haüy, ii. 398.

Exter. Char.—Found massive; lustre shining, vitreous; fracture foliated; fragments cubical.

Colour grayish white; translucent; immersed in water, transparent; semihard; streak snow-white. Spec. grav. 2.94.

Chem. Char.—Melts in the flame of a candle, and from its easy fusibility it derives its name. It then becomes hard, and is changed into a slag, which is somewhat caustic. Soluble with effervescence in sulphuric acid, and gives out white vapours that corrode glass.

Constituent Parts.

	Klaproth.	Vauquelin.
Soda	36.	32
Alumina	23.5	21
Fluoric acid and water	40.5	47
	100.0	100

Localities, &c.—Cryolite was brought to Copenhagen from Greenland, but nothing is known of its repository (B).

THIRD CLASS. *COMBUSTIBLES.*

I. Genus. SULPHUR.

1. Species. Native Sulphur.

Id. Kirwan, ii. 69. *Le Soufre Natif*, Brochant, ii. 37.

This species is divided into two subspecies; 1. Common; 2. Volcanic native sulphur.

Subspecies

(B) Boracite and cryolite do not certainly possess all the characters that entitle them to a place among the salts; but as magnesia is the predominant base of the one and soda of the other, it was thought better to introduce them here than to multiply divisions.

Classification.

Subſpecies 1. Common Native Sulphur.

Eſſen. Char.—The ſulphurous odour when heated; colour yellow.

Exter. Char.—Sulphur is found maſſive, diſſeminated in ſuperficial layers, or cryſtallized. Primitive form of its cryſtals is an octahedron, whoſe ſides are ſcalene triangles; the integrant molecule is an irregular tetrahedron. The uſual forms of the cryſtals are, 1. That of the primitive form, in which two four-ſided oblique-angled pyramids are joined baſe to baſe, of which the common baſe is a rhomb, whoſe two diagonals are as 5 to 4; 2. The ſame form having its ſummits truncated; 3. The firſt form having its ſummit ſurmounted by an obtuſe four-ſided acumination, ſet on the lateral faces; 4. Or, having the common baſe truncated; or, 5. Having its obtuſe lateral edges truncated; or, 6. Having the obtuſe angles of the common baſe truncated. The cryſtals are of various ſizes, moſt frequently grouped; ſurface ſmooth; luſtre reſplendent; internal luſtre ſhining, or weakly ſhining, between reſinous and adamantine; fracture fine grained, uneven, ſometimes conchoidal or ſplintery; fragments ſharp-edged.

Colour yellow, greeniſh, or grayiſh yellow; tranſlucent or ſemitranſparent; refraction double; ſoft; brittle, and very eaſily frangible; gives out by rubbing a ſulphureous ſmell. Spec. grav. 1.99 to 2.03.

Chem. Char.—Burns with a peculiar blue flame, and gives out a pungent odour, which is well known.

Native ſulphur is not always pure; it is often contaminated with earthy matters.

Phys. Char.—Sulphur becomes electric by friction, and its electricity is negative.

Localities, &c.—Native ſulphur is moſt commonly found in ſtratiform mountains, chiefly in thoſe of gypſum, marl, and compact limeſtone, and there it exiſts in the form of nodules. Found alſo, but rarely, and in ſmall quantity, in the veins of primitive mountains. Sulphur is found in many countries of the world, as in Poland, Hungary, Switzerland, Spain, and Sicily, where the fineſt cryſtals yet known are found.

Subſpecies 2. Native Volcanic Sulphur.

Exter. Char.—Found maſſive, in rounded pieces, ſtalactitical, cellular, or in thin ſublimed layers, ſometimes alſo cryſtallized in confuſed groups; internal luſtre weakly ſhining or ſhining; fracture uneven; fragments blunt-edged.

Colour the ſame as the former, but inclining ſometimes a little towards gray; tranſlucent; in other characters it reſembles the preceding.

Localities, &c.—As its name imports, this variety is found near volcanoes, where it is ſublimed among the lava. The ſulphur of Ætna and Veſuvius chiefly, and alſo that of Iceland, and of ſome of the iſlands in the Weſt Indies, is collected, and forms a very important article in commerce.

Uſes.—Sulphur is one of the moſt valuable ſubſtances in various arts. It is employed in the bleaching of woollen ſtuffs and ſilks; it forms an eſſential ingredient in gunpowder, and it is the baſe of ſulphurous and ſulphuric acid, which are ſo extenſively employed in tanning, hat-making, dyeing, and other arts and manufactures.

Combuſtibles.

II. Bituminous Genus.

1. Species. Petroleum, or *Mineral Oil.*

Le Naphte, and *L'Huile Minerale Commune*, Broch. ii. 59. and 60. *Naphtha* and *Petrole*, Kirwan, ii. 42. and 43. *Bitume Liquide Brune, ou Noiratre*, Haüy, iii. 312.

Exter. Char.—Found fluid and ſomewhat viſcid.

Colour blackiſh or reddiſh brown; almoſt opaque; feels very greaſy; exhales a ſtrong bituminous odour; taſte pungent, acid. Spec. grav. 0.708. to 0.854.

Chem. Char.—Burns eaſily with a denſe ſmoke, and leaves ſome earthy reſidue. When expoſed to the air it becomes thicker and leſs fluid.

Its conſtituent parts are carbone, hydrogen, and a ſmall portion of oxygen.

Localities, &c.—Petroleum is generally found in the vicinity of coal, riſing to the ſurface of the water which flows from coal ſtrata. It is not uncommon in different parts of the world. It is found in Lancaſhire in England, and at St Catharine's well near Libberton, in the vicinity of Edinburgh.

Naphtha, which is conſidered merely as a purer kind of mineral oil, is found in conſiderable abundance in different parts of Perſia, on the ſhores of the Caſpian ſea, in Calabria, Sicily, and America. In 1802, a ſpring of naphtha of a topaz yellow colour, burning eaſily, and leaving little reſidue, with a ſpecific gravity of 0.83, was diſcovered in the ſtate of Parma in Italy, and afforded ſuch a quantity as to be ſufficient to illuminate the ſtreets of Genoa.

Uſes.—Naphtha has been ſometimes employed in the compoſition of varniſh, in that of fire-works, for the purpoſe of heating rooms, when it is mixed with a ſmall quantity of earth; and in Perſia and other countries it is burnt in lamps as a ſubſtitute for oil. Formerly it was employed in medicine as a vermifuge.

2. Species. Mineral Pitch.

This is divided into three ſubſpecies; 1. elaſtic; 2. earthy; and 3. ſlaggy.

Subſpecies 1. Elastic Mineral Pitch.

Mineral Caoutchouc, Kirw. ii. 48. *La Poix Minerale Elaſtique*, Broch. ii. 64. *Bitume Elaſtique*, Haüy, iii. 313.

Exter. Char.—Found in maſſes of different ſizes, diſſeminated, ſometimes ſuperficial, or ſtalactitical; luſtre dull, rarely glimmering; internal luſtre ſhining, reſinous.

Colour browniſh black, hair-brown, often veined yellow; tranſlucent at the edges; ſoft conſiſtence like elaſtic gum, and alſo elaſtic. It gives out the ſmell of leather. Spec. grav. 0.902 to 1.23.

Localities, &c.—This mineral was diſcovered in 1785 in the mine of Odin in Derbyſhire in England, where it is accompanied with galena, calcareous ſpar, heavy ſpar, fluor ſpar, and blende.

This ſubſtance effaces the marks of black lead on paper, like elaſtic gum; but ſtains the paper.

Subſpecies

Combustibles.

Classification.

Subſpecies 2. EARTHY MINERAL PITCH.

Semicompact Mineral Pitch, or *Maltha*, Kirw. ii. 46. *La Poix Minerale Terreuſe*, Broch. ii. 65.

Exter. Char.—Found maſſive; internally dull; fracture earthy, ſometimes uneven; fragments blunt-edged.

Colour blackiſh brown, ſometimes clove brown; ſtreak ſhining, and darker coloured; very ſoft; feels greaſy; ſmell bituminous.

Chem. Char.—Burns with much flame, and ſmoke; exhales a ſtrong odour, and leaves carbonaceous and earthy matter.

Localities, &c.—Found in the principality of Neufchatel in Switzerland.

Subſpecies 3. SLAGGY MINERAL PITCH.

Compact Mineral Pitch, Kirw. ii. 46. *La Poix Minerale Scoriacée*, Broch. ii. 66. *Bitume Solide*, Hauy, iii. 313. *Aſphaltum*, or *Jews Pitch*, of others.

Exter. Char.—Found maſſive and diſſeminated, ſuperficial or ſtalactitical; luſtre reſplendent, reſinous; fracture conchoidal; fragments ſharp-edged.

Colour perfect black, ſometimes browniſh-black; opaque, rarely tranſlucent at the edges; luſtre remains in the ſtreak; ſoft; feels greaſy; by rubbing gives out a bituminous odour. Spec. grav. 1.07 to 1.6.

Localities, &c.—This variety frequently accompanies the preceding. It is found at Morsfeld in the Palatinate, at Neufchatel in Switzerland. It is found floating on the ſurface of the lake Aſphaltum in Judea, from which it derives its name of *Jews pitch*. It is there collected by the inhabitants of the country as an object of commerce, and at the ſame time, it is ſaid to diminiſh the quantity of noxious vapours which it exhales—ſo noxious that birds flying over it drop down dead, whence it has the name of *Dead ſea*. This variety of mineral pitch is found in other places, ſometimes connected with coal and limeſtone ſtrata, and ſometimes with mineral veins. But the iſland of Trinidad furniſhes the greateſt quantity of this ſubſtance. In that iſland there is a pitch lake of about four miles in circumference; but it appears from the information of Mr Spon, in a letter to Mr Tobin of Briſtol, by whom this information was communicated, along with a number of ſpecimens to Mr Hatchett, that the ſubſtance formerly ſuppoſed to be mineral pitch, is nothing more than a porous ſtone impregnated with that ſubſtance; ſo that what was ſuppoſed to be an immenſe lake of mineral pitch or aſphaltum, is only the ſtone of the country impregnated with bitumen. Mr Hatchett thinks this ſtone may be arranged in the argillaceous genus *.

* *Lin. Tranſ.* viii. 251.

3. Species. AMBER.

Id. Kirw. ii. 65. *Le Succin*, Broch. ii. 69. *Id.* Hauy, ii. 327.

This is divided into two ſubſpecies.

Subſpecies 1. WHITE AMBER.

Exter. Char.—Found maſſive, and in rounded pieces; luſtre ſhining or weakly ſhining; fracture conchoidal; fragments ſharp-edged.

Colour yellowiſh white, or ſtraw-yellow; ſlightly tranſlucent; ſoft; eaſily frangible; by friction, or reducing to powder, it gives out an agreeable odour. Spec. grav. 1.07 to 1.08.

Chem. Char.—Burns with a yellow flame, without melting, giving out at the ſame time a peculiar odour; leaves very little reſidue.

Subſpecies 2. YELLOW AMBER.

Exter. Char.—Alſo found in rounded pieces of various ſizes; ſurface rough and uneven; dull, ſometimes glimmering; internal luſtre reſplendent, reſinous; ſometimes tranſparent. In its other external and chemical characters, it reſembles the preceding.

Phyſ. Char.—Amber becomes ſtrongly electric by friction, a property known to the ancients. From the Greek and Latin word *electrum*, the term electricity is derived.

Conſtituent Parts.—Amber is compoſed of a large proportion of oil, and of a peculiar acid, the ſuccinic, which is obtained by diſtillation.

Localities, &c.—Amber is found in the vicinity of bituminous wood, but moſt commonly in the ſand on the ſhores of the ocean, and chiefly on the ſhores of the Baltic. It is found alſo in Sweden, France, Italy, and on the eaſt coaſt of England. Amber frequently contains ſmall parts of vegetables, and entire inſects. Of the origin of this ſubſtance nothing certain is yet known.

Uſes.—The uſes of amber for ornamental purpoſes, are well known. In this country it was formerly in higher eſtimation than at preſent. It ſtill forms an important article of commerce in eaſtern countries.

4. Species. MELLITE, or HONEY STONE.

Id. Hauy, iii. 335. *La Pierre de Miel*, Broch. ii. 73. *Mellilite*, Kirw. ii. 68.

Exter. Char.—Found uſually cryſtallized, in double four-ſided pyramids; the ſurface ſmooth and ſhining; internal luſtre reſplendent, between reſinous and vitreous; fracture conchoidal; fragments rather ſharp-edged.

Colour honey yellow, ſometimes hyacinth red; tranſparent or tranſlucent; refraction double; ſoft; brittle. Spec. grav. 1.58 to 1.66.

Chem. Char.—Becomes white before the blow-pipe, and is reduced to aſhes, without flame.

Conſtituent Parts.	Klaproth.
Alumina,	16
Mellitic acid,	46
Water,	38
	100

Phyſ. Char.—Becomes ſlightly electric by friction.

Localities, &c.—This mineral is hitherto rare. It has been found only in Switzerland, accompanied with mineral pitch, and at Artern in Thuringia, attached to bituminous wood.

5. Species. BROWN COAL.

This is divided into five ſubſpecies; 1. common; 2. bituminous wood; 3. earth coal; 4. alum earth; 5. moor coal.

Classification.

Subspecies 1. COMMON BROWN COAL.

La Houille Brune, Broch. ii. 47.

Exter. Char.—Found massive; lustre shining, resinous; fracture conchoidal; longitudinal fracture slaty; fragments rather sharp edged.

Colour brownish black, or blackish brown; streak shining; soft; not very brittle.

Chem. Char.—Burns with a blue-coloured flame, and gives out an odour like that of bituminous wood.

Constituent Parts. Hatchett *.

	Grains.
Water which soon came over acid, and afterwards turbid by the mixture of bitumen,	60
Thick brown, oily bitumen,	21
Charcoal,	90
Hydrogen, carbonated hydrogen, and carbonic acid gases,	29
	200

* *Phil. Transf.* 1804. p. 399.

The above is the analysis of 200 grains of Bovey coal by distillation.

Localities, &c.—This variety is not uncommon in many places of Germany. It is found also at Bovey near Exeter in England, from which it is called *Bovey coal.*

Subspecies 2. BITUMINOUS WOOD.

Carbonated Wood, Kirw. ii. 60. *Le Bois Bitumineux*, Broch. ii. 44.

Exter. Char.—Has a ligneous form, and even sometimes the appearance of branches and roots of trees; glimmering in the principal fracture, in the cross fracture, conchoidal; fragments splintery, wedge-shaped, or tabular.

Colour commonly light blackish brown, sometimes wood brown; opaque; streak shining; soft, and easily frangible.

Chem. Char.—Burns with a bright flame, and gives out a sweetish, bituminous smell.

Localities, &c.—This variety is found in the same places with the other varieties of coal, and also in places where the more common kinds of coal are rare, or in small quantity, as in the island of Iceland, where it is known by the name of *suturbrand;* and in the island of Skye in Scotland. It is found also in the coal fields round Edinburgh, and also at Bovey near Exeter, and in various places on the continent.

Subspecies 3. EARTHY COAL.

Bois Bitumineux Terreux, Brochant, ii. 45.

Exter. Char.—The consistence of this variety is intermediate between solid and friable; dull, rarely glimmering; fracture earthy.

Colour blackish brown, or liver brown; streak shining; stains; very soft.

Localities, &c.—This is found in Saxony, Bohemia, France, and particularly in the vicinity of Cologne, where it is known by the name of *umber* or *Cologne earth*, which is employed in the fabrication of colours; and from certain varieties which contain pyrites, alum is extracted.

Combustibles.

Subspecies 4. ALUM EARTH.

This has been already described under the name of *aluminous schistus*, in the argillaceous genus.

Subspecies 5. MOOR COAL.

La Houille Limoneuse, Brochant, ii. 48.

Exter. Char.—This variety is found massive, and in extensive beds; internally glimmering; cross fracture even, sometimes flat conchoidal; longitudinal fracture slaty; fragments trapezoidal or rhomboidal.

Colour blackish brown, and brownish black; streak shining; soft, very easily frangible.

Localities, &c.—Moor coal is abundant in Bohemia; it is found also in Transylvania, and chiefly among sandstone, limestone, and trap rocks. It seems to approach nearly to earth coal.

6. Species. BLACK COAL.

This species is divided into six subspecies; pitch, columnar, slaty, cannel, foliated, and coarse coal.

Subspecies 1. PITCH COAL.

La Houille Piciforme, Brochant, ii. 49.

Exter. Char.—Found massive or disseminated; and sometimes parts of vegetables, such as the branches of trees, are observed. Lustre shining, resplendent, resinous; fracture conchoidal; fragments sharp-edged.

Colour perfect black, and the longitudinal fracture sometimes brownish; soft; easily frangible. Specific gravity 1.3.

Localities, &c.—This is one of the most common varieties of coal, and therefore is found in all coal countries.

Uses.—As it is susceptible of a fine polish, it is employed for various ornamental purposes. The substance known by the name of *jet*, belongs to this variety.

Subspecies 2. COLUMNAR COAL.

La Houille Scapiforme, Brochant, ii. 15.

Exter. Char.—Found massive; in its fracture shining, or weakly shining, resinous; fracture more or less perfectly conchoidal; fragments indeterminate.

Colour perfect black, or brownish black. It is composed of distinct concretions, which are columnar, parallel, slightly curved, whose surfaces are smooth and shining; is soft, and easily frangible.

Localities, &c.—This is a very rare variety of coal. It is found in the Meisner, near Almerode, in Hessia, in a basaltic mountain.

Subspecies 3. SLATY COAL.

La Houille Schisteuse, Brochant, ii. 52.

Exter. Char.—Found massive in entire beds; lustre shining, sometimes only weakly shining or glimmering, resinous; principal fracture slaty; cross fracture imperfect conchoidal; fragments in the form of tables; not very sharp-edged.

Colour

Combustibles.

Colour perfect black, often alſo grayiſh, rarely browniſh black; ſtreak ſhining; ſoft, or ſemi-hard; eaſily frangible. Specific gravity 1.25 to 1.37.

Localities, &c.—This is the prevailing coal in Britain, as at Newcaſtle and Whitehaven in England, and in the coal country both in the eaſt and weſt of Scotland.

Subſpecies 4. Cannel Coal.

La Houille de Kilkenny, Brochant, ii. 55. *Id.* Kirwan, ii. 52.

Exter. Char.—Found maſſive; luſtre weakly ſhining, reſinous; fracture commonly conchoidal, ſometimes even and foliated; fragments ſometimes rhomboidal or cubical.

Colour grayiſh black; ſtreak ſhining; ſoft; eaſily frangible. Spec. grav. 1.23 to 1.27.

Localities, &c.—This coal accompanies the former in many places of England and Scotland, as at Whitehaven and Wigan in Lancaſhire in England; in the neighbourhood of Edinburgh; and at Muirkirk, and other places in Ayrſhire in Scotland. The coal at Kilkenny in Ireland belongs alſo to this variety; and from the places where it is found, is called Wigan or Kilkenny coal.

Uſes.—Beſide being employed as fuel with other kinds of coal, this variety, being ſuſceptible of a fine poliſh, is cut and formed into various uſeful and ornamental purpoſes. It is ſaid that the choir of the cathedral church of Litchfield is covered with plates of this coal alternating with black marble.

Subſpecies 5. Foliated Coal.

Le Charbon Lamelleux, Brochant, ii. 54.

Exter. Char.—Found maſſive; principal fracture reſplendent; croſs fracture ſhining; principal fracture more or leſs foliated; croſs fracture ſomewhat uneven; fragments rhomboidal.

Colour perfect black, and on the ſides of the fiſſures ſuperficial colours appear, like the colours of tempered ſteel, or thoſe of the peacock's tail; eaſily frangible.

Localities, &c.—This coal is found at Liege, in Saxony, near Dreſden, and in ſome parts of France.

Subſpecies. 6. Coarse Coal.

La Houille Groſſiere, Brochant, ii. 55.

Exter. Char.—Found maſſive; is weakly ſhining, reſinous; fracture uneven, or more or leſs ſlaty; fragments blunt edged.

Colour grayiſh black, ſometimes browniſh black; ſtreak ſhining; ſoft; eaſily frangible.

Localities, &c.—Accompanies the other kinds of coal, whoſe localities have been already mentioned.

7. Species. Coal Blende.

This is divided into two ſubſpecies, conchoidal and ſlaty.

Subſpecies 1. Conchoidal Coal Blende.

La Houille Eclatante, Brochant, ii. 50. *Glanz-kohle* of the Germans.

Exter. Char.—Found maſſive, rarely diſſeminated; luſtre ſhining or reſplendent, approaching to metallic; fracture perfectly conchoidal; fragments not very ſharp edged.

Claſſification.

Colour iron black, inclining to brown, or exhibiting the ſuperficial colours like tempered ſteel; ſoft; eaſily frangible.

Chem. Char.—Burns without any flame, leaving a white aſh.

Localities, &c.—This variety of coal is very rare. It is found at Newcaſtle, and at Meiſſner in Heſſia, along with the other varieties of coal.

Subſpecies 2. Slaty Coal Blende.

Native Mineral Carbone, Kirw. ii. 49. *La Blende Charbonneuſe*, Brochant, ii. 57. *Anthracite*, Haüy, ii. 307.

Exter. Char.—Found maſſive, and diſſeminated; internal luſtre ſhining, or reſplendent, and between metallic and vitreous; fracture more or leſs perfectly ſlaty; croſs fracture flat conchoidal; fragments ſometimes cubic, and ſometimes in tables.

Colour perfect black, approaching more or leſs to iron black, or grayiſh or bluiſh black; opaque; ſtains, but does not write; ſoft; rather brittle; very eaſily frangible. Spec. grav. 1.3 to 1.8.

Chem. Char.—Reduced to powder, and heated in a crucible, this coal gives neither a ſulphureous nor bituminous ſmell, and neither ſulphur nor bitumen can be obtained from it. After being long expoſed to heat, it conſumes ſlowly without flame, and loſes during the proceſs about two-thirds of its weight. The reſidue is of a blackiſh gray colour, which ſhows that the combuſtion has not been complete.

Conſtituent Parts.

	Panzenberg.	Dolomieu.
Pure carbone	90	72.05
Silica	2	13.19
Alumina	5	3.29
Oxide of iron	3	3.47
Loſs		8.
	100	100.00

Localities, &c.—This variety has been found in a vein at Schemnitz in Hungary, in Pais de Vaud, in a tranſported rock, which ſeems to be intermediate between granite and breccia; at Konigſberg in Norway, where it is accompanied with native ſilver; in Saxony it forms an entire bed in a mountain of clay ſlate; alſo found in the iſland of Arran in Scotland.

III. GRAPHITE Genus.

1. Species. Graphite, or Black Lead.

Plumbago, Kirw. ii. 58. *Le Graphite*, Broch. ii. 76. *Fer Carburé*, Hauy, iv. 98.

This ſpecies is divided into two ſubſpecies, ſcaly and compact.

Subſpecies 1. Scaly Graphite.

Exter. Char.—Found maſſive and diſſeminated; luſtre glimmering or ſhining, metallic; fracture foliated, conchoidal,

Classification.

choidal, fometimes uneven or flaty; fragments blunt-edged, fometimes trapezoidal; commonly appears in diftinct granular concretions, which are fmall or fine grained, with a fplintery afpect.

Colour intermediate between bluifh black and light iron black; fometimes fteel gray, or brownifh black; opaque; ftreak fhining; ftains and writes; foft; eafily frangible; feels greafy.

Subfpecies 2. Compact Graphite.

Chem. Char.—This fubfpecies approaches fo near to the former in its characters, that it feems difficult to diftinguifh it. The following characters and circumftances connected with the natural hiftory of graphite, refer to both. Specific gravity 1.987 to 2.456.

Chem. Char.—When expofed to heat in a furnace, it gives out, during combuftion, a great proportion of carbonic acid, leaving a refiduum of red oxide of iron.

Conftituent Parts.

	Berthollet.	Scheele.	Vauquelin.
Carbone	90.9	90	23 *
Iron	9.1	10	2
Silica	–	–	38
Alumina	–	–	37
	100.0	100	100

* *Jour. des Mines*, N° xii. p. 16.

Of the above analyfis it muft be obferved, that the two firft by Berthollet and Scheele muft have been very pure fpecimens of graphite; and, on the contrary, the fpecimens analyzed by Vauquelin muft have been very impure, containing fo large a proportion of earthy matters, and fo fmall a proportion of the proper ingredients of that mineral.

Localities, &c.—This mineral, which is not very common, is found chiefly in primitive mountains. It is met with in Spain, France, Bavaria, and Hungary. In England at Borrowdale near Kefwick in Cumberland; and at Craigman, near New Cumnock, in Ayrfhire in Scotland, where it is found in detached maffes among rocks nearly fimilar to thofe which accompany coal.

Ufes.—Graphite or black lead is employed for making pencils. The coarfer parts are employed in making crucibles. It is alfo employed for covering caft iron, fuch as grates, to defend them from ruft; and on account of its unctuous property, it is applied to thofe parts of machines which are fubject to friction, for the purpofe of diminifhing it.

2. Species. Mineral Charcoal.

This fubftance, which accompanies the other varieties of coal already defcribed, is of a woody texture, and has therefore a fibrous fracture, with fomewhat of a fhining and filky luftre. It is ufually found in thin layers with the other varieties of coal, and perhaps it might be confidered as coal lefs perfectly formed; but in its characters it agrees fo much with the varieties of coal blende, that it feems quite unneceffary to make it a feparate fpecies.

Metallic Ores.

FOURTH CLASS. *METALLIC ORES.*

I. PLATINA Genus.

Species. Native Platina.

Id. Kirw. ii. 103. *Le Platine Natif*, Broch. ii. 86. *Platine Natif Ferrifere*, Hauy, iii. 368.

Effen. Char.—Of a filver white colour, and infufible.

Exter. Char.—Platina is found in the form of fmall flat or rounded grains; furface fmooth, with fhining metallic luftre; ftreak refplendent.

Colour light fteel gray, or filver white; femi-hard; ductile; flexible in thin plates. Spec. grav. 15.601 to 17.7; but when purified, and hammered, 23, and according to fome, 24.

Chem. Char.—Is almoft infufible without addition, in the focus of a burning glafs, or expofed to the action of oxygen gas. It does not amalgamate with mercury, and is only foluble in nitro-muriatic acid.

Localities, &c.—Platina was firft brought to Europe by Don Ulloa in 1748. The repofitory of this metal is not known, and it has been found only in South America, till lately that it was difcovered in gray filver ore from the mine of Guadalcanal in Spain. In the analyfis of this ore, Vauquelin found the platina to be in the proportion of $\frac{1}{10}$.

Ufes.—Platina is one of the moft valuable mineral fubftances, as, on account of its hardnefs and infufibility, it may be applied to many of the purpofes of gold and iron; and from its properties of being lefs liable to change when expofed to the air, or to the action of other chemical agents, it anfwers thofe purpofes in a fuperior degree.

Platina in its crude ftate is alloyed with other metallic fubftances. It has been long known that it is accompanied with particles of iron, gold, and fome other fubftances. It contains alfo an ore of one of the new metals. This is iridium, which is alloyed with ofmium, another new metal, both which were difcovered by Mr Tennant. This ore is compofed of plates; it is not malleable; its fpecific gravity is 19.5, and it is not acted on by nitro-muriatic acid, which diffolves platina. Rhodium and palladium, two other new metals, are alloyed with platina.

II. GOLD Genus.

Species. Native Gold.

This fpecies is divided into three fubfpecies; 1. golden yellow; 2. brafs yellow; and, 3. grayifh yellow.

Subfpecies 1. Golden-yellow Gold.

L'Or Natif, Jaune d'Or, Broch. ii. 89. *Native Gold*, Kirw. i. 93.

Exter. Char.—Gold is found moft frequently diffeminated, fuperficial, or in grains; reticulated, dendritical, capillary, or cellular, often in fmall plates, more rarely cryftallized. The forms of its cryftals which have been obferved, are fmall perfect cubes, regular octahedrons, dodecahedrons, double eight-fided pyramids, terminated by four-fided fummits, placed on the four

Metallic Ores.

four lateral edges of the pyramids alternately; but the cryſtals are ſmall and ill defined; the ſurface is ſmooth and reſplendent; that of the ſmall plates druſy and ſhining; that of the grains only ſtrongly glimmering; internal luſtre weakly ſhining, metallic; fracture hackly.

This variety preſents the perfect colour of gold. It is ſoft; perfectly ductile, flexible, but not elaſtic; ſtreak reſplendent. Spec. grav. of pure gold 19.25 to 19.64.

Subſpecies 2. Brass-yellow Gold.

L'Or Natif d'un jaune de laiton, Broch. ii. 91.

Exter. Char.—This variety is almoſt always found diſſeminated in ſmall particles, or ſuperficial; ſometimes alſo capillary, in ſmall plates, or cryſtallized in thin ſix-ſided tables.

The colour is that of braſs of various ſhades, according to the proportion of alloy. In other characters it reſembles the former, excepting in the ſpecific gravity, which is inferior, owing to the greater proportion of other metals with which it is alloyed.

Subſpecies 3. Grayish-yellow Gold.

L'Or Natif d'un jaune griſatre, Broch. ii. 92.

Exter. Char.—This variety is alſo found diſſeminated in ſmall flattened grains; ſurface is not very ſmooth; almoſt uneven, and weakly ſhining.

Colour ſteel gray, approaching to that of braſs: ſpec. grav. of this variety is greater than the laſt, but inferior to the firſt. In other external characters they are the ſame.

Chem. Char.—Native gold is only ſoluble in nitro-muriatic acid; platina is alſo ſoluble in the ſame acid, but it is not like gold, precipitated from its ſolution by ſulphate of iron.

Conſtituent Parts.—Native gold is not always found pure. It is frequently alloyed with ſilver or copper, or with both, and ſometimes alſo, it is ſaid, with platina. To theſe alloys the difference of colour, which is the foundation of the diviſion into three varieties, is owing. The firſt variety is the pureſt, containing only a ſmall proportion of ſilver or copper; the ſecond has a greater proportion of theſe metals; and the third, it is ſuppoſed, is alloyed with a ſmall portion of platina.

Uſes.—Gold (on account of its indeſtructible nature, and its remarkable malleability and ductility), is one of the moſt important and valuable of the metals for many purpoſes; but its uſes, whether as money, or articles of luxury, are too well known to require enumeration. As pure gold has no great degree of hardneſs, it is neceſſary to alloy it with a portion of copper. This is not leſs than $\frac{1}{24}$, and never more than $\frac{1}{4}$.

Localities, &c.—Gold is chiefly found in primitive mountains, and there it is uſually in veins, ſometimes diſſeminated in the rock itſelf. The accompanying ſubſtances are quartz, feldſpar, limeſtone, heavy ſpar, pyrites, red ſilver, vitreous ſilver, and galena. Gold is alſo mixed with manganeſe, gray cobalt, nickel, and malachite. Gold has alſo been found, it is ſaid, in foſſil ſubſtances, as in petrified wood, penetrated with ſiliceous earth, a maſs of which was dug out at the depth of 50 fathoms, in an argillaceous breccia, or, as is ſuppoſed by ſome, a porphyry with an argillaceous baſis, in Tranſylvania. This is conſidered as a proof of the more recent formation of gold, as well as the diſcovery of Patrin, who found native gold ſurrounded by muriate of ſilver, in the mine of Zmeof in Siberia. Muriate of ſilver is ſuppoſed to be comparatively a late production.

Claſſification.

But gold is perhaps more common to alluvial ſoil; there it is diſſeminated in grains, along with ſiliceous, argillaceous, and ferruginous ſand, of which certain ſoils are compoſed; and alſo in the ſand of many rivers: and it is obſerved that the gold is moſt abundant when the waters are at the loweſt, and eſpecially ſoon after floods, which ſhews that the gold is carried down along with the earthy matters which are ſwept away by the violence of the current. It has been ſuppoſed too, that the gold found in the bed of rivers, has been detached, by the force of the waters, from the veins and primitive rocks traverſed by theſe currents; and according to this opinion, attempts have been made to trace the ſource of theſe auriferous ſands, in the hope of diſcovering the native repoſitory of this precious metal; but theſe attempts have uſually failed, for it has been found that the gold is peculiar to the alluvial ſoil through which the ſtream is carried, and in which the gold is collected. This point ſeems to be eſtabliſhed by the obſervations of naturaliſts. 1. The ſoil of thoſe plains frequently contains, to a certain depth, and in particular places, particles of gold, which may be ſeparated by waſhing. 2. The bed of the rivers and auriferous ſtreams yields a greater proportion of gold, after the plains which are traverſed by thoſe rivers have been flooded, than in any other circumſtances. 3. It has always been obſerved, that gold is found in the ſand of rivers in a very limited ſpace. By examining the ſand of theſe rivers higher up, and nearer to their ſource, no gold is found; ſo that if this metal were derived from the rocks, which are ſwept by the currents, the quantity would be greateſt neareſt to their ſources; but obſervation has proved the contrary. Thus the river Orco contains no gold, but from Pont to the place where it joins the Po. The Teſin affords no gold till it has traverſed lake Major, where its courſe muſt have been retarded, and where all the heavy particles of matter which it carried along with it from the primitive mountains, muſt have been depoſited. The quantity of the gold collected on the Rhine near Straſburg, is greater, than what is found near Baſle, which is more in the vicinity of the mountains. No gold has been diſcovered in the ſands of the Danube during the firſt part of its courſe. Thoſe ſands become only auriferous below Efferding. The ſame remark may be applied to the Ems. The ſands of the upper part of this river, which traverſes the mountains of Stiria, contain no gold; but from the place where it enters the plain at Steyer, till it joins the Danube, its ſands are auriferous, and ſufficiently rich to be waſhed with advantage.

The moſt of the auriferous ſands in all parts of the world, are of a black or reddiſh colour, and conſequently ferruginous. From this circumſtance, connected with the gold of alluvial land, ſome naturaliſts have inferred, that it is owing to the decompoſition of auriferous pyrites. It was obſerved by Reaumur, that the ſand which accompanies gold in moſt of the rivers, and particularly in the Rhone and the Rhine, is like that of Ceylon

Classification. Ceylon and Expailly, composed of iron and small grain of rubies, corundum, hyacinth. Titanium also has been discovered. It has been observed besides, that the gold of alluvial soil is purer than that which is immediately obtained from rocks, from which it is supposed that it has a different origin. It does not appear to be certainly ascertained, that gold is found in volcanic soil.

Such are the general facts relative to the repositories of gold. We shall now briefly mention the more remarkable places where gold has been found and collected, beginning with those of Europe.

28 Gold mines of Spain. Spain formerly had mines of gold; the richest was in the province of Asturias, where it was dug out from regular veins. These mines, according to ancient historians, where wrought by the Phœnicians, and afterwards by the Romans; but they have been totally abandoned since the discovery of America, and the mineral riches of that country. The rivers of Spain, as well as the Tagus in Portugal, contain auriferous sand.

29 Of France. The only mine of gold which in modern times has been wrought in France, was discovered in 1781, at Gardette, in the valley of Oysans, department of Isere. This was a regular vein of quartz, traversing a mountain of gneiss, and containing auriferous sulphuret of iron, and some fine specimens of native gold; but it was not sufficiently rich to defray the expence of the operations. Many of the rivers of that country contain auriferous sand, as the Rhone, the Rhine, the Garonne, and others of smaller note; and it is said that gold is also found among the black sand, and particles of morassy iron ore, in the neighbourhood of Paris.

30 Of Piedmont. In Piedmont there are some mines of gold. At the foot of Mount Rosa, veins of auriferous sulphuret of iron have been discovered, traversing gneiss; and although these pyrites do not yield more than 10 or 11 grains of gold in the quintal, it has been found worth while to continue the operations. On the south side of the Apennine mountains, there are several auriferous rivers and soils.

Some of the rivers of Switzerland also contain auriferous sands. Such are those of the Reuss and the Aar.

In Germany the only gold mine which is wrought is in Saltsburg, in the chain of mountains which traverses that country from east to west, and which separates it from the Tyrol and Carinthia.

31 Hungary. But Schemnitz and Cremnitz are the most remarkable places in Europe for mines of gold and auriferous sands. The gold of Schemnitz is accompanied by silver, lead, and iron pyrites, and the matrix is quartz. Auriferous sand is found not only in the bed of the river Neva, but this sand is still richer in the plain through which the river flows. According to De Born, this is a ferruginous sand, lying below a bed of chalk.

In Transylvania the celebrated gold mine of Nagyag is remarkable for having the gold combined with native tellurium. There is also another mine at Felsobanya, the ore of which is an auriferous sulphuret of silver, in a vein of a kind of jasper. The rivers of this country also contain gold. The plain on the banks of the river Moros contains an auriferous sand, which is deposited between two beds, neither of which yields a particle of gold. The upper stratum is vegetable soil, and the lower is composed of schistus.

The mines of Hungary are the only gold mines in Europe which are of any importance. Metallic Ores.

In Sweden gold is obtained from the mine of Edelfors in the province of Smoland. This mine yields native gold, and auriferous iron pyrites. The veins are composed of brown quartz, traversing a mountain of schistose hornstone. The gold is sometimes disseminated in the rock itself. 32 Sweden.

In Greece, the island of Thasos in the Archipelago was celebrated in antiquity for its rich mines of gold. The ancients also, it is said, found abundance of gold in Thrace and Macedonia. 33 Greece.

The alluvial soil in several places of the British islands, has also furnished gold. Not many years ago, a considerable quantity of gold was collected in a sandy soil, on the mountains of Wicklow in Ireland. Several masses of native gold, exceeding an ounce in weight, were found in that soil; one weighing 22 ounces was found, which is said to be the largest specimen of native gold found in Europe. 34 Ireland.

It would appear that gold was collected at a very early period, in Scotland, and particularly in the mine field of Leadhills; but the most extensive operations were carried on by Bulmer, an Englishman, in the time of Queen Elizabeth. The trenches, heaps of soil that had been turned up, and other marks of these operations, yet visible between Leadhills and Elvanfoot, still retain the name of *Bulmer's Workings*, and the place where the gold was washed, is still called the *gold scour*. At that time, it is said, an immense quantity of gold was collected. Not many years ago, similar operations were resumed, by the advice of a German; but so far as we understand, the quantity of gold collected was scarcely equal to the expence. The operations during the last attempt were carried on under the superintendance of the late Mr John Taylor, manager of the mines at Wanlockhead; a man of no common sagacity, by which he was enabled to collect many curious facts with regard to the natural history of gold. The gold was found in that country immediately under the vegetable soil; and the method of conducting the operation was, to direct a small stream of water so as to carry this soil along with it, to basons or hollow places, where the water might deposit the matters which had been carried along by its current. The matter deposited was repeatedly washed, till the whole of the earthy substances were carried off. The gold being heaviest, sunk to the bottom, and remained behind. Among other facts which Mr Taylor communicated to us, and which he observed during the progress of these operations he found, that the gold was always most abundant near the top of the lead veins which traverse that country. He was so satisfied of this fact, that he could tell, merely by the quantity of gold increasing, when they approached to a vein; and on the other hand the quantity diminishing as they receded from the vein. This fact shews that there is some connection between metallic veins and the formation or deposition of gold. 35 Scotland.

Gold is still found in the soil of that country; but whether the quantity be less than formerly, or the expence of collecting it, from the difference in the price of labour, greater, the produce is by no means equal to the expences, and therefore searching for gold is now only the employment of the leisure hours of some of the miners.

Metallic Ores.

36 Asia.

The whole extent of the continent of Asia furnishes gold, in greater or smaller quantity. Gold is found in several of the mines of Siberia, and particularly in that of Beresof, which yields auriferous pyrites partially decomposed, and disseminated in a vein of quartz. In the southern parts of Asia, many mines, and particularly the sands of the rivers, contain gold. The Pactolus, a small river of Lydia, was celebrated in antiquity for the quantity of gold which it yielded, and it was supposed to be the source of the riches of Crœsus.

Japan, Formosa, Ceylon, Java, Sumatra, Borneo, the Philippines, and other islands of the Indian Archipelago, are supposed to be rich in gold at this day.

37 Africa.

The greatest quantity of gold which the ancients possessed, beside what was obtained from Spain, was brought from Africa. The gold of Africa, which still forms an important article of commerce, is always in the state of gold dust; a circumstance which shews that it is chiefly extracted from alluvial soil by washing. Little gold is found in the northern parts of Africa; three or four places are remarkable for the quantity of gold which they yield. The first is that part of the country between Darfour and Abyssinia. The gold collected there is brought by the Negroes for sale in quills of the ostrich and of the vulture. It would appear that this country was known to the ancients, who regarded Ethiopia as a country rich in gold; and Herodotus mentions that the king of that country exhibited to the ambassadors of Cambyses, all the prisoners bound with chains of gold.

The second great source of gold dust in Africa is to the south of the great desert Zara, in the western part of that country. The gold is collected in that extensive flat which stretches along the foot of the lofty mountains, among which the rivers Senegal, Gambia, and Niger, have their origin. Gold is found in the sands of all these rivers. Bambouk, which lies to the north-west of these mountains, supplies the greatest part of the gold which is sold on the western coast of Africa; at Morocco, Fez, and Algiers, as well as that which is brought to Cairo and Alexandria in Egypt.

A third region of Africa where gold is abundant, is on the south-east coast, opposite to Madagascar; and it is said that the gold brought from Opbir, in the time of Solomon, was from that part of Africa.

38 America.

America is the richest country of the world, in modern times, in this precious metal. There it is collected in the alluvial soil, and in the beds of rivers, and sometimes, but more rarely, in veins. In Mexico, gold is chiefly found in the numerous silver veins of that country. All the rivers in the province of the Caraccas, about 10° north of the equator, furnish gold. In the Spanish part of America, Chili furnishes gold from the alluvial soil, as well as the province of Choco, where it is more abundant; while that of Peru is obtained from veins of quartz, marked with ferruginous spots.

But the greatest quantity of gold of commerce comes from Brazil, where it is collected in the alluvial soil, and in the sand of rivers, and extracted by washing. Gold is found almost everywhere in that country, at the foot of the immense chain of mountains which is nearly parallel with the coast, and which stretches from the 5° to the 30° of S. Lat.

Classification.

III. Genus. MERCURY.

1. Species. Native Mercury.

Mercury, Kirw. ii. 223. *Mercure Natif*, Broch. ii. 241. *Id.* Hauy, iii. 423.

Essen. Char.—Remains liquid till the temperature be reduced to 40° below 0 Fahrenheit.

Exter. Char.—Native mercury exists disseminated, in globules of different sizes, in small cavities of other ores of mercury; lustre resplendent, metallic.

Colour shining white, or tin white; opaque; perfectly fluid; does not wet the finger; feels very cold. Sp. gr. 13.568 to 13.581.

Chem. Char.—Volatile before the blow-pipe, without diffusing any perceptible odour.

Native mercury is understood to be pure, and having all the properties of that metal; but it is sometimes amalgamated with a little silver, which destroys its fluidity in a slight degree, and renders it somewhat viscous.

Localities, &c.—Native mercury is usually found along with the other ores of that metal, as at Idria, in Friouli, and at Almaden in Spain; but the great proportion of the mercury of commerce is obtained by distillation from native cinnabar. There is also, it is said, a rich mine of native mercury near Guanca Velica in Peru.

Uses.—For many purposes mercury is one of the most important of metallic substances. It is extensively employed in metallurgy, in extracting gold and silver from their ores, by the process to be afterwards described, called *amalgamation*. The uses of mercury in gilding, in silvering the backs of mirrors, and in medicine, are well known.

2. Species. Native Amalgam.

Natural Amalgam, Kirw. ii. 223. *L'Amalgam Natif*, Broch. ii. 99. *Mercure Argental*, Hauy, iii. 432.

Essen. Char.—Communicating to copper a silvery colour by friction.

Exter. Char.—This species is rarely found massive, but usually disseminated, or superficial, sometimes imperfectly crystallized. The form of its crystals is the octahedron, dodecahedron, but it is usually found in thin plates or leaves; lustre resplendent, or shining; fracture conchoidal.

Colour between shining or tin white, and silvery white, according to the predominance of the mercury or silver; soft, and partially fluid; brittle, and easily frangible.

Chem. Char.—Exposed to heat the mercury is driven off, and the silver remains behind.

Constituent Parts.

	Heyer.	Cordier.	Klaproth.
Mercury	75	73	64
Silver	25	27	36
	100	100	100

Localities, &c.—This mineral is rare, and is met with, according to De Born, in the mines of mercury whose whofe veins are croffed by veins of filver ores. It is found chiefly at Rofenau in Hungary, in Moersfeld, and Mofchellandfberg, in the duchy of Deux Ponts, and at Sahlberg in Sweden. It is ufually found in a yellowifh or reddifh ferruginous clay, and accompanied by other ores of mercury.

3. Species. Corneous Ore of Mercury.

Mercury mineralized by the vitriolic and marine acids, Kirw. ii. 229. *La Mine de Mercure cornée*, Broch. ii. 101. *Mercure muriaté*, Hauy, iii. 447.

Effen. Char.—Colour pearl gray, volatilized by the blow-pipe.

Exter. Char.—Rarely found maffive or diffeminated, but ufually in thin crufts, or in fmall globules, compofed of an affemblage of fmall cryftals, which are either perfect cubes, or fix-fided prifms, terminated by a four-fided pyramid; a fix-fided prifm bevelled at the extremity; or an eight-fided prim with four broad and four narrow alternating faces. Cryftals fhining, fometimes refplendent; internal luftre fhining and adamantine; fracture foliated.

Colour fmoke gray, afh gray, or grayifh white; tranflucent; tender, and eafily frangible.

Chem. Char.—Entirely volatilized before the blow-pipe, without leaving any refiduum, and without decompofition.

The conftituent parts are about 70 of mercury, 29 of muriatic acid, and a fmall portion of fulphuric acid.

Localities, &c.—This mineral has only been known about 13 years, and it is hitherto but rare. It was difcovered in the mercury mines of the duchy of Deux Ponts by Woulfe, and has been fince found at Almaden in Spain, and at Horfowitz in Bohemia. The repofitory is in the cavities of a ferruginous clay, which is mixed with malachite and gray copper ore.

4. Species. Liver or Hepatic Ore of Mercury.

Mine de Mercure hepatique, Broch. ii. 104. *Hepatic mercurial ore*, Kirw. ii. 224. *Mercure fulfuré bituminifere*, Hauy, iii. 446.

This is divided into two fubfpecies, 1. compact and 2. flaty.

Subfpecies 1. Compact Liver Ore of Mercury.

Exter. Char.—Found maffive or diffeminated; luftre glimmering, metallic; fracture even, fometimes fine-grained uneven; fragments blunt-edged.

Colour between lead gray, and cochineal red; colour of the ftreak deep cochineal red, and fhining; tender, and eafily frangible. Sp. gr. 7.18 to 7.93.

Subfpecies 2. Slaty Liver Ore of Mercury.

Exter. Char.—Found maffive; luftre fhining and refplendent; in the crofs fracture glimmering; luftre in general metallic, but fometimes vitreous; principal fracture flaty, in curved thick leaves; crofs fracture compact and even; fragments in plates.

Colour of the preceding, but fomewhat darker, and approaching to that of iron; opaque; ftreak fhining; powder between cochineal and fcarlet red; tender, and very eafily frangible.

Localities, &c.—This is the moft common ore of mercury in Idria, where it forms confiderable beds, and yields about 60 per cent. of mercury. It is found alfo, along with other ores of mercury, in Spain and Siberia.

Liver ore of mercury confifts of cinnabar, or the fulphuret of mercury, mixed with a portion of indurated bituminous clay. At Idria it is called *branderz*, or coaly earth, on account of the predominance of the bitumen.

5. Species. Cinnabar.

This fpecies is alfo divided into two fubfpecies, common and fibrous.

Subfpecies 1. Common Cinnabar.

Le Cinnabre Commun, Broch. ii. 107. *Dark Red Cinnabar*, Kirw. ii. 223. *Mercure Sulfuré compacte*, Hauy, iii. 440.

Exter. Char.—Found maffive or diffeminated, or in fuperficial layers, or cellular and kidney-form, and alfo cryftallized. Forms of the cryftals are, a double four-fided pyramid with truncated fummits; a cube having its oppofite diagonal angles truncated; a rhomboidal prifm; a three-fided prifm terminated by a three-fided pyramid, which alfo is truncated. The cryftals which are ufually fmall, are confufedly grouped together; furface of the rhomboidal prifm tranfverfely ftreaked, of the others fmooth; external luftre fhining or refplendent; internal the fame, or only glimmering, vitreous, or adamantine; fracture foliated, uneven, or rarely fplintery; fragments fharp-edged.

Colour cochineal red, carmine red, and in fome varieties lead-gray; opaque, rarely tranflucent at the edges; cryftals tranflucent, or femitranfparent; ftreak fhining, fcarlet red; tender, and eafily frangible. Spec. grav. 6.902 to 7.86.

Chem. Char.—Before the blow-pipe common cinnabar is entirely volatilized with a blue flame, and a fulphureous odour.

Conftituent Parts.	Lampadius.
Mercury	81
Sulphur	15
Iron	4
	100

Localities, &c.—This is the moft common ore of mercury, and may be confidered as the gangue or matrix of the other ores. Found not only in primitive mountains, where it forms beds in clay and chlorite flate, but alfo in ftratiform mountains, and even in alluvial rocks. The mines of Almaden in Spain, of Idria in Friouli, and thofe of the duchy of Deux Ponts, have furnifhed the greateft quantity of common cinnabar. It is alfo found in Bohemia, Saxony, and Hungary, and in fmall quantity in France.

Subfpecies 2. Fibrous Cinnabar.

Le Cinnabre d'un Rouge vif, Brochant, ii. 111. *Bright red Cinnabar*, Kirwan, ii. 229. *Mercure fulfuré fibreux*, Haüy, iii. 440.

Exter. Char.—Found maffive, diffeminated, or fuperficial;

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ficial; lustre glimmering, silky, often also entirely dull; fracture fine grained earthy, or fibrous; fragments blunt-edged.

Colour bright scarlet red, sometimes crimson or aurora red; opaque; streak shining scarlet red; stains; very tender or friable, and very easily frangible.

Localities, &c.—This variety is very rare in a state of purity. According to Haüy, most of the specimens owe their texture to an admixture of radiated sulphuret of iron. It has been found chiefly at Wolfstein in the Palatinate, where it is accompanied by brown iron ore and hematites.

Uses.—Cinnabar is dug out chiefly for the purpose of extracting the metallic mercury. It is employed also as a colouring matter in painting; but the cinnabar used for this purpose is chiefly artificial.

Some other varieties of cinnabar, or sulphuret of mercury, have been noticed by mineralogists, as a native ethiops mineral. This is of a black colour, a loose consistence, and it stains the fingers. It appears to be some bituminous substance penetrated with cinnabar. It is found at Idria.

Alkaline cinnabar of De Born is found at the same place; is of a bright red colour, foliated fracture, with rhomboidal fragments; and supposed to be cinnabar penetrated with an alkaline sulphuret, the odour of which it gives out by friction. Another variety of cinnabar, usually called native vermilion, is in the form of powder. This substance is very rare, but is also sometimes found at Idria.

IV. SILVER GENUS.

1. Species. NATIVE SILVER.

Id. Kirwan, ii. 108. *Id.* Brochant, ii. 114. *Id.* Haüy, iii. 384.

This is divided into two subspecies, common and auriferous.

Subspecies 1. COMMON NATIVE SILVER.

Exter. Char.—Common native silver is usually found disseminated or superficial, under different imitative forms, as dentiform, filiform, capillary, dendritic, reticulated, veined, or in thin plates; and sometimes crystallized, in cubes, octahedrons, rectangular four-sided prisms, double six-sided pyramids with truncated extremities, double three-sided pyramids with truncated angles, and hollow four-sided pyramids. The crystals are small and grouped together in rows, or dendritical, or reticulated; surface smooth; that of the plates drusy, that of dentiform, filiform, and capillary silver; longitudinally streaked; external lustre glimmering or resplendent; internal always glimmering, metallic; fracture hackly; fragments rather sharp-edged.

Colour silvery white, but sometimes on the surface yellowish-brown, or grayish black; opaque; soft; perfectly ductile; flexible, but not elastic; streak shining, metallic. Spec. grav. 10 to 10.47.

Chem. Char.—Native silver is soluble in nitric acid, and may be precipitated by muriatic acid, the muriate of silver being insoluble; or by immersing a plate of copper in the solution of nitrate of silver, the silver is reduced, and appears in the metallic state.

Classification.

Localities, &c.—Native silver is not uncommon in most of the mines which furnish the other ores of that metal. The accompanying substances are usually heavy spar, quartz, calcareous spar, fluor spar, pyrites, blende, cobalt, and galena. Native silver is very abundant in Mexico and Peru, and it is also not uncommon in Siberia, in Germany, France, and was lately discovered in the Herland mine in Cornwall.

Subspecies 2. AURIFEROUS SILVER.

Exter. Char.—This variety is rarely found massive, but is usually disseminated in small particles, or superficial, or reticulated, or in thin plates; lustre shining or resplendent; fracture hackly.

Colour between silver white and brass yellow, sometimes approaching to gold yellow; it is soft, perfectly ductile; flexible without being elastic, and its specific gravity is greater than common native silver in proportion to the quantity of gold with which it is alloyed.

Constituent Parts.—Auriferous silver is a compound of silver alloyed with gold, the latter sometimes in very considerable proportion.

Localities, &c.—This mineral is very rare. It is found at Konigsberg in Norway, disseminated in massive calcareous spar, fluor spar, and rock crystal, accompanied by blende, galena, and pyrites, in a vein which traverses a rock of slaty hornblende. It is also found in Siberia, in granular heavy spar accompanied by vitreous silver ore, vitreous copper ore, and pyrites.

2. Species. ANTIMONIAL SILVER ORE.

Argent Antimonial, Brochant, ii. 119. *Id.* Haüy, iii. 391. *Antimoniated Native Silver*, Kirwan, ii. 110.

Essen. Char.—Colour silvery white; brittle.

Exter. Char.—Found massive or disseminated, kidney-form, or crystallized in four-sided oblique prisms, in six-sided prisms, sometimes with the lateral edges truncated, in six-sided tables, and in cubes, having some of the angles truncated. Surface of the crystals longitudinally streaked; lustre weakly shining, or only glimmering; internal lustre shining or resplendent; fracture foliated.

Colour silvery white, sometimes a superficial colour between yellow, black, and gray, or the colour of tempered steel; streak shining; semihard. Spec. grav. 9.44.

Chem. Char.—Before the blow-pipe it is easily reduced; the antimony is driven off and gives out its peculiar odour, while the pure silver remains behind incrusted with a brown slag, which communicates to borax a green colour.

When antimonial silver is dissolved in nitric acid, a whitish crust, which is the oxide of antimony, soon appears on the surface.

This mineral, as its name imports, is an alloy of silver and antimony, in which sometimes a small portion of iron is observed. The proportions of the two metals seem to be very variable.

Constituent

Classification. Metallic Ores.

Constituent Parts.

	Klaproth.		Vauquelin.
Silver	76	84	78
Antimony	24	16	22
	100	100	100

Localities, &c.—This ore of ſilver is accompanied by calcareous ſpar, heavy ſpar, native ſilver, galena, and quartz, in a vein near the duchy of Furſtenberg in Swabia. It has alſo been found in carbonate of lime and heavy ſpar near Guadalcanal in Spain.

3. Species. Arsenical Silver Ore.

Id. Kirw. ii. 111. *Argent Antimonial Arſenifere, et ferrifere*, Haüy, iii. 398.

Exter. Char.—Found maſſive or diſſeminated, kidney-form or globular, and alſo cryſtallized in perfect ſix-ſided priſms; in ſimilar priſms a little flattened, and having the lateral edges rounded; and in acute ſix-ſided pyramids with truncated ſummits. Luſtre weakly ſhining, ſometimes ſhining; internal luſtre ſhining or reſplendent; fracture foliated; fragments ſharp-edged. Colour tin-white, or lead gray, but expoſed to the air yellowiſh, or ſteel gray; ſtreak ſhining; ſoft; brittle.

Chem. Char.—Before the blow-pipe the arſenic is driven off in fumes, diffuſing the ſmell of garlic; there remains behind an impure globule of ſilver.

Conſtituent Parts.	Klaproth.
Silver	12.75
Arſenic	35.
Iron	44.25
Antimony	4.
Loſs	4.
	100.00

Localities, &c.—This is a rare mineral, which has been found at Andreaſberg in the Hartz, accompanied by native arſenic, red ſilver ore, galena, brown blende, and calcareous ſpar.

4. Species. Corneous Silver Ore.

Id. Kirwan, ii. 113. *La Mine Corné*, Broch. ii. 127. *Argent Muriaté*, Haüy, iii. 418.

Eſſen. Char.—The colour of horn; fuſible like wax.

Exter. Char.—Rarely found maſſive; ſometimes diſſeminated in globular pieces, often in ſuperficial layers, and very often cryſtallized. The forms are, the perfect cube, capillary or needle-formed cryſtals; the cryſtals are always ſmall, and commonly grouped together. Surface ſmooth, ſhining or weakly ſhining; internal luſtre the ſame; reſinous; fracture uneven, or flat conchoidal; fragments blunt-edged.

Colour light pearl gray, violet blue, or lead gray; becomes brown or blackiſh in the air; tranſlucent; ſometimes only at the edges; very ſoft; receives the impreſſion of the nail; ductile, and in thin plates, flexible. Spec. grav. 4.748 to 4.804.

Chem. Char.—Corneous ſilver ore melts very eaſily before the blow-pipe, giving out a diſagreeable ſmell, and the globule of ſilver remains.

Conſtituent Parts.	Klaproth.
Silver	67.75
Muriatic acid	21.
Sulphuric acid	.25
Oxide of iron	6.
Alumina	1.75
Lime	.25
Loſs	3.
	100.00

Localities, &c.—Muriate of ſilver is always found at the upper part of the vein, and it is ſaid that it ſometimes accompanies organized ſubſtances. Leaves of native ſilver have been found attached to petrifactions, at Frankenberg in Heſſia; it is ſuppoſed that this metallic ſilver is the reſult of the decompoſition of the muriate of ſilver. Corneous ſilver ore is almoſt always accompanied by vitreous ſilver, ſooty ſilver, brown iron ore; more rarely by native ſilver, red ſilver, galena, quartz, and heavy ſpar. It is found in Peru and Mexico, in the mines of Freyberg in Saxony, at Allemont in France, and in Siberia.

Another variety of muriate of ſilver has been deſcribed by ſome mineralogiſts under the name of earthy corneous ſilver ore; or, according to the fanciful German name, *butter-milk earth.* This variety has an earthy fracture, owing to a portion of alumina which is combined with it. It is almoſt friable; the luſtre of the ſtreak is reſinous, and it feels ſomewhat greaſy.

Chem. Char.—Before the blow-pipe it is ſlightly agglutinated without melting, and ſmall globules of ſilver exude from the maſs.

Conſtituent Parts.	Klaproth.
Silver	25
Muriatic acid	8
Alumina	67
With a trace of copper	–
	100

This variety is found at Andreaſberg in the Hartz. Another variety has been deſcribed under the name of alkaline ſilver ore, which is nothing more than the muriate of ſilver combined with carbonate of lime.

5. Species. Sooty Silver Ore.

Id. Kirw. ii. 117. *L'Argent Noir*, Broch. ii. 132.

Exter. Char.—Found maſſive or diſſeminated, perforated or corroded; in ſuperficial layers upon other minerals, or in rounded pieces, covered by muriate of ſilver; conſiſtence intermediate between ſolid and friable; dull; fracture fine grained earthy; fragments blunt-edged.

Colour bluiſh black, or blackiſh gray; ſtreak ſhining, metallic; ſtains a little; eaſily frangible.

Chem. Char.—Melts eaſily before the blow-pipe into a ſlaggy maſs, which, by continuing the heat, is partially volatilized, and the globule of ſilver remains.

Its

Metallic Ores.

Its constituent parts are still unknown; as it is usually accompanied by vitreous, corneous, and some other silver ores, it is supposed to be a mixture of those ores in different proportions.

Localities, &c.—Found in Saxony, in France, and in Hungary.

6. Species. Vitreous Silver Ore.

Sulphurated Silver Ore, Kirw. ii. 115. *L'Argent Vitreux*, Brochant, ii. 134. *Argent Sulphuré*, Haüy, iii. 398.

Exter. Char.—Commonly found massive, disseminated, or superficial; sometimes dentiform, filiform, capillary, dendritic, or reticulated, with other forms and impressions. It is also crystallized in cubes, which are either perfect or truncated on the angles or edges; in octahedrons, which are either perfect, or truncated on the angles; in flat, double, three-sided pyramids, the edges of the one corresponding to the faces of the other; in rectangular four-sided prisms, terminated by a four-sided pyramid; in equiangular six-sided prisms, terminated at the two extremities by a three-sided pyramid; corresponding alternately to three of the lateral edges, forming the garnet dodecahedron, of which all the lateral edges are sometimes slightly truncated; in broad and flat six-sided prisms bevelled at the extremity, and having the angles at the acute lateral edges truncated. The crystals are commonly small, and grouped together in rows, or in knots, like the steps of a stair; the cube and the octahedron are the most common, and the cube is sometimes hollow. The surface of the crystal is usually smooth, sometimes rough or drusy; lustre between shining and weakly glimmering; internal lustre shining, metallic; fracture conchoidal, sometimes foliated; fragments blunt-edged.

Colour dark lead-gray, steel gray, or blackish gray, varying by exposure to the air; streak shining; soft; ductile; may be cut with a knife; flexible without being elastic. Spec. grav. 6.909 to 7.215.

Chem. Char.—Before the blow-pipe vitreous silver is reduced to the metallic state, and the sulphur is driven off. By gradually heating it in a furnace, the sulphur may be dissipated without fusion, and the silver is reduced to the metallic state in a dendritical or capillary form, exactly resembling native silver.

Constituent Parts.

	Bergman.	Sage.	Klaproth.
Silver	75	84	85
Sulphur	25	16	15
	100	100	100

Localities, &c.—Vitreous silver is one of the most common silver ores. It is usually accompanied by heavy spar, calcareous spar, and fluor spar; along with the other ores of silver and lead, cobalt and blende. It is found in Bohemia, Saxony, Norway, Siberia, and South America.

7. Species. Brittle Vitreous Silver Ore.

L'Argent Vitreux Aigre, Brochant, ii. 138.

Exter. Char.—Found massive, disseminated, superficial, or crystallized in equiangular six-sided prisms, the terminal faces being sometimes plane, and sometimes convex or concave; the same prism truncated on its terminal edges, or terminated by a six-sided pyramid set on the lateral faces, and having its summit truncated; in equiangular six-sided tables, or in very flat rhomboids. Crystals small, and grouped together; surface smooth, sometimes drusy; prisms longitudinally streaked; lustre shining or resplendent; internal lustre shining, or weakly shining; fracture conchoidal, sometimes uneven; fragments rather sharp-edged.

Classification.

Colour iron-black, or steel or lead gray; soft; brittle. Spec. grav. 7.208.

Chem. Char.—Before the blow-pipe it melts with difficulty; sulphur, antimony, and arsenic, are partially driven off, and there remains a button of metallic silver, which is not very ductile, accompanied by a brown slag.

Constituent Parts.	Klaproth.
Silver,	66.5
Sulphur,	12.
Antimony,	10.
Iron,	5.
Copper and arsenic,	.5
Earthy matters,	1.
Loss,	5.
	100.0

Localities, &c.—This is one of the richest silver ores; and it is usually accompanied by red silver ore, vitreous silver ore, some other metallic ores, and various earthy spars. It is pretty common in Saxony and Hungary, but less abundant than vitreous silver ore. It is also occasionally met with in most other silver mines.

8. Species. Red Silver ore.

Id. Kirw. ii. 122. *Id.* Broch. ii. 143. *Argent Antimonié Sulphuré*, Haüy, iii. 402.

This is divided into two subspecies; dark red, and bright red silver ore.

Subspecies 1. Dark Red Silver Ore.

Exter. Char.—Found massive or disseminated, superficial, dendritical, or crystallized in equiangular six-sided prism, which is either terminated by a three-sided pyramid set on the lateral edges, or has its terminal edges truncated, or is terminated by an obtuse six-sided pyramid set on the lateral faces, and having the summit and lateral edges of the pyramid truncated; sometimes the summit of the pyramid is terminated by a second three-sided pyramid, and sometimes the lateral edges of the prism are bevelled. The crystals are small, and variously grouped together, commonly smooth and resplendent, rarely streaked; internal lustre weakly shining, or only glimmering, adamantine, often semimetallic; fracture usually uneven, sometimes conchoidal; fragments rather blunt-edged.

Colour between cochineal red and lead gray, and sometimes iron black; crystals translucent; in masses opaque; streak but weakly shining, between cochineal red

Claffification.

red and crimfon red ; foft ; brittle, and eafily frangible. Spec. grav. 5.56 to 5.58.

Chem. Char.—Before the blow-pipe it derepitates and flies off before becoming red, and then melts with frothing up ; part is volatilized and fublimes in the form of a yellowifh white powder, and leaves a button of metallic filver.

Its conftituent parts are fuppofed to be nearly the fame as the following.

Localities, &c.—Found in almoft all filver mines, and is ufually accompanied by other filver ores, as well as different metallic ores.

Subfpecies 2. Bright Red Silver Ore.

Exter. Char.—Found maffive, difleminated, or fuperficial, and very often cryftallized. The forms of its cryftals refemble fome of thofe of the former, or are fimple fix-fided pyramids, or acute fix-fided pyramids, having the lateral angles alternately acute and obtufe, with the fummit furmounted by a three-fided pyramid placed on the obtufe edges of the firft ; or furmounted by a fix-fided pyramid fet on the lateral faces. The cryftals are fometimes acicular, and are combined together in a fafcicular or reticulated form. Surface of the cryftals fometimes fmooth, fometimes drufy ; ftreaked longitudinally, but the pyramids are ftreaked tranfverfely or obliquely ; luftre refplendent or fhining ; internal luftre fhining or weakly fhining and adamantine ; fracture conchoidal, or fine grained uneven ; fragments rather blunt-edged.

Colour blood-red, or light cochineal red, fometimes bluifh on the furface ; cryftals femitranfparent ; in maffes tranflucent, often opaque ; ftreak aurora red ; foft, eafily frangible. Spec. grav. 5.44 to 5.59.

Chem. Char.—Melts before the blow-pipe ; blackens, and burns with a bluifh flame, giving out white fumes with the odour of garlic. A button of nearly pure filver remains behind.

Conftituent Parts.

	Klaproth.	Vauquelin.
Silver,	62.	56.67
Antimony,	18.5	16.13
Sulphur,	11.	15.07
Sulphuric acid and water,	8.5	–
Oxygen,	–	12.13
	100.0	100.00

The garlic fmell, which was formerly fuppofed to be owing to arfenic, arifes from the antimony, which is volatilized by the action of the blow-pipe ; although, according to Prouft, there are ores of red filver which contain fometimes arfenic and fometimes antimony feparately, and fometimes the two metals combined. The red colour of this ore is by Thenard afcribed to the antimony in the ftate of purple oxide.

Localities, &c.—Red filver ore is ufually accompanied by native arfenic, other ores of filver, as well as other metallic ores ; and it is found in Bohemia, Saxony, France, Spain, and Hungary.

9. Species. White Silver Ore.

Id. Broch. ii. 150. *Light Gray Silver Ore*, Kirw. ii. 119.

Metallic Ores.

Exter. Char.—Found maffive and difleminated ; luftre ftrongly glimmering ; fracture even ; fragments blunt-edged.

Colour bright lead-gray, or fteel-gray ; foft ; ftreak fhining. Spec. grav. 5.322.

Conftituent Parts.—According to fome, this mineral is compofed of filver, antimony, and fulphur ; but according to others, minerals which have been reckoned white filver ores, contain a very confiderable proportion of lead, and therefore ought to be arranged among the ores of that metal. Such are the following analyfes by Klaproth.

	Light coloured.	Dark coloured.
Silver,	20.40	9.25
Lead,	48.06	41.
Antimony,	7.88	21.5
Iron,	2.25	1.75
Sulphur,	12.25	22.
Alumina,	7.	1.75
Silica,	.25	–
Lofs,	1.91	2.25
	100.00	100.00

Localities, &c.—The real white filver ore has been chiefly found in the mine of Himmelfurft, near Freyberg in Saxony, in a gangue of quartz, and accompanied by galena, red filver, and blende.

10. Species. Black Silver Ore.

Exter. Char.—This ore of filver is of a cellular texture ; the ftreak is fhining and metallic ; it is brittle, and of a black colour ; but it can only be known to be a filver ore by obtaining globules of filver under the blow-pipe. It is ufually accompanied by vitreous red filver ores. It is fuppofed that it is fome of the other fpecies of filver ores that may have undergone fome change from chemical agents. The filver it contains is in very variable proportions.

Localities, &c.—Found in fome of the filver mines at Freyberg in Saxony, and Allemont in France. It is common in Peru and Mexico, and it is called by the Spaniards, *negrillo*.

Befide the filver ores already defcribed, other fpecies have been mentioned by mineralogifts, the exiftence of which has not been diftinctly afcertained ; as the *carbonate* of filver of Widenmann and Kirwan, compofed of 72.5 parts of filver, 12 of carbonic acid, and 15.5 of carbonate of antimony and oxide of copper * ; the reddifh and greenifh black filver ore, alfo defcribed by Kirwan, which is fuppofed to be a mixture of native and fulphurated filver †. Light lamellar filver ore ‡, compofed of alumina, fulphuret of filver, oxide of iron and manganefe.

* II. 112.

† *Ibid.* 125.

‡ *Ibid.* 116.

V. COPPER Genus.

1. Species. Native Copper.

Id. Kirw. ii. 128. *Id.* Broch. ii. 158. *Id.* Hauy, iii. 518.

Effen. Char.—Colour reddifh yellow, and malleable.

Exter. Char.—Native copper is found maffive, diffeminated, fuperficial, or in rounded pieces ; alfo dendritical and capillary, and very often cryftallized in perfect

Metallic Ores.

fect cubes, or with truncated edges or angles; double four-sided pyramids; simple and acute three-sided pyramids. Crystals small, and grouped in a dendritical or botryoidal form; lustre shining or weakly shining; internal lustre glimmering or weakly shining; fracture hackly; fragments blunt-edged.

Colour light copper-red, but exposed to the air, yellowish, blackish, or greenish; streak shining; soft, or semihard; ductile, and flexible, but not elastic. Spec. grav. 7.72 to 8.58.

Chem. Char.—Copper immersed for some time in a solution of ammonia, or volatile alkali, changes it to a beautiful blue colour.

Localities, &c.—Native copper is not a very rare mineral; it is found in many copper mines accompanied by the other ores of copper, as in the copper mines of Siberia, Saxony, Hungary, Sweden, and Cornwall in England.

2. Species. VITREOUS COPPER ORE.

Id. Kirw. ii. 144. *Id.* Broch. ii. 162. *Cuivre Sulfuré*, Haüy, iii. 551.

This is divided into two subspecies; compact and foliated.

Subspecies 1. COMPACT VITREOUS COPPER ORE.

Exter. Char.—Found massive or disseminated, sometimes superficial, and rarely crystallized in perfect cubes with convex faces; in perfect octahedrons, or in six-sided prisms, terminated by a three-sided pyramid, set on three of the lateral edges. Crystals small; surface smooth and shining; internal lustre strongly glimmering or shining; fracture rhomboidal or even, fragments rather sharp-edged.

Colour lead-gray, iron gray, or yellowish, but sometimes the colour of tempered steel when tarnished; streak shining or resplendent; soft, and easily frangible. Spec. grav. 4.81 to 5.338.

Constituent Parts.	Klaproth.
Copper	78.5
Sulphur	18.5
Iron	2.25
Silica	.75
	100.00

Subspecies 2. FOLIATED VITREOUS COPPER ORE.

Exter. Char.—Always found massive or disseminated, rarely superficial; fracture foliated; fragments blunt edged.

Colour similar to the former, approaching a little more to fawn or yellowish brown.

Constituent Parts.	Klaproth.
Copper	50
Sulphur	20
Iron	25
Loss	5
	100

Chem. Char.—Vitreous copper ore is often fusible in the flame of a candle, and it melts easily before the blow-pipe, and yields a button of copper enveloped in a blackish slag; heated with borax, gives it a green colour, and digested in a solution of ammonia, changes it to a fine blue.

Classification.

Localities, &c.—Vitreous copper ore is accompanied by quartz, calcareous spar, heavy spar, and the other ores of copper; and is common in Siberia, Hungary, Norway, Germany, and Cornwall in England.

3. Species. VARIEGATED COPPER ORE.

Purple Copper Ore, Kirwan, ii. 142. *La Mine de Cuivre Panachée*, Brochant, ii. 166. *Cuivre Pyriteux Hepatique*, Hauy, iii. 536.

Exter. Char.—Found massive, disseminated, or superficial, and sometimes, it is said, crystallized in octahedrons; internal lustre shining; fracture conchoidal, or somewhat uneven; fragments rather sharp-edged.

Colour reddish yellow, violet blue, azure blue, and greenish; several colours exist on the same specimen, giving it a variegated appearance, from which it has the name; streak shining; powder reddish; soft, and easily frangible.

Constituent Parts.	Klaproth.	
Copper	63.7	58
Iron	12.7	18
Sulphur	19.	19
Oxygen	4.5	5
Loss	.1	
	100.00	100

Localities, &c.—Variegated copper ore is accompanied by quartz, calcareous spar, bituminous marly schistus, and other copper ores; and is found in Saxony, Hungary, Sweden, Siberia, and England.

4. Species. COPPER PYRITES.

Id. Kirwan, ii. 140. *Id.* Brochant, ii. 169. *Id.* Hauy, iii. 529.

Exter. Char.—Found massive, disseminated, sometimes superficial, more rarely in imitative forms, as dendritical, &c. but often crystallized. Forms are, the tetrahedron, which is either perfect, or with its four angles truncated, giving it the appearance of a six-sided table; the perfect octahedron, the summit terminated by a line; a double crystal formed of two tetrahedrons base to base, the angles of the bases being slightly truncated, produce three re-entering angles, and the lateral faces three salient angles. Crystals are small; surface smooth, shining; internal lustre shining or resplendent; fracture often uneven, sometimes conchoidal, fragments rather sharp edged.

Colour in the fresh fracture, brass yellow, sometimes gold yellow, and steel gray; sometimes with variegated colours; soft or semi-hard; brittle. Spec. grav. 4.08 to 4.3.

Chem. Char.—Before the blow-pipe it decrepitates; gives out a sulphureous odour; fuses into a black globule, and the heat being continued, metallic copper appears. Borax heated with it acquires a green colour.

This

Classification. Metallic Ores.

This ore of copper is composed of sulphur, copper and iron in variable proportions, and sometimes also a small admixture of gold or silver.

Localities, &c.—This is a very common copper ore. It is equally found in primitive and stratiform mountains, either in veins or in beds, and sometimes in great abundance; in Saxony, Hungary, Sweden, France, and England.

5. Species. White Copper Ore.

Id. Kirwan, ii. 152. *Id.* Brochant, ii. 173.

Exter. Char.—Found massive or disseminated; internal lustre weakly shining; fracture fine grained, uneven; fragments rather sharp edged.

Colour between silver white and brass yellow; semi-hard; brittle. Spec. grav. 4.5.

Chem. Char.—Before the blow-pipe it gives out a white fume, with the smell of arsenic, and melts into a grayish black slag.

This ore is said to be composed of copper, iron, arsenic and sulphur.

6. Species. Gray Copper Ore.

Id. Kirwan, ii. 146. *Id.* Brochant, ii. 175. *Id.* Hauy, iii. 537.

Exter. Char.—Found massive or disseminated, superficial, and often crystallized in regular tetrahedrons, which are rare; or having all the edges truncated, or bevelled, sometimes slightly, and sometimes strongly; or having each of its angles surmounted by a three sided pyramid, set on the lateral faces, with some other modifications. Crystals of various sizes; surface smooth, shining; internal lustre between glimmering and resplendent; fracture uneven, or conchoidal; fragments rather sharp edged.

Colour steel gray of various shades, lead gray, and the tarnished colours are often variegated; streak black or brown; semi-hard; brittle. Specific gravity 4.44 to 4.86.

Chem. Char.—Before the blow-pipe it decrepitates, and melts into a brittle metallic globule of a grayish colour, giving out a white fume, and communicating to borax a yellowish red colour.

Constituent Parts. Klaproth.

Copper	16.25	31.36
Sulphur	10.	11.5
Antimony	16.	34.09
Silver	2.25	14.77
Iron	13.75	3.3
Lead	34.5	
Silica	2.5	
Alumina	–	0.3
Loss	4.75	4.68
	100.00	100.00

Localities, &c.—This mineral is most frequently found in veins in primitive mountains, accompanied by other ores of copper, as in Germany, France, Sweden, Siberia, and in England.

7. Species. Black Copper Ore.

Id. Kirwan, ii. 143. *Id.* Brochant, ii. 180.

Exter. Char.—Found in the state of powder, with a dull appearance, and little coherence, sometimes incrusting other ores of copper; usually friable; stains; feels meagre.

Colour brownish black, sometimes deep brown.

Chem. Char.—Gives out before the blow-pipe a sulphureous smell, and melts with borax into a greenish slag.

It is supposed to arise from the decomposition of vitreous copper ore and copper pyrites, and contains sometimes from 40 to 50 per. cent. of copper.

8. Species. Red Copper Ore.

Id. Kirwan, ii. 135. *Id.* Brochant, ii. 181.

This is divided into three subspecies; compact, foliated and capillary.

Subspecies 1. Compact Red Copper Ore.

Exter. Char.—Found massive, disseminated, or superficial; lustre glimmering, semi-metallic; fracture even, or slightly conchoidal; fragments rather sharp edged.

Colour cochineal red, or lead gray; opaque; streak shining, of a brick red colour; semi-hard, and brittle.

Subspecies 2. Foliated Red Copper Ore.

Exter. Char.—Found massive, disseminated, or superficial, often crystallized in octahedrons, which are either truncated on the angles or edges; in perfect cubes, which are sometimes truncated on the angles, and sometimes on the edges. Crystals small, usually aggregated; surface smooth, shining; internally shining, or weakly shining, between metallic and adamantine; fracture imperfectly foliated; fragments rather sharp edged.

Colour similar to the former; opaque, translucent at the edges; crystals semi-transparent.

Subspecies 3. Capillary Red Copper Ore.

Fibrous Red Copper Ore, Kirwan, ii. 137. *Le Cuivre Oxidé Rouge Capillaire*, Brochant, ii. 184.

Exter. Char.—Found in small capillary crystals, which are disseminated in small bundles, or sometimes form a superficial incrustation; lustre shining and adamantine.

Colour carmine red, cochineal or scarlet red; crystals translucent.

Chem. Char.—Red copper ore is easily reduced before the blow-pipe without any odour; entirely soluble in muriatic acid without effervescence, but effervesces in nitric acid; by which means it may be distinguished from cinnabar, which is insoluble, and from red silver ore, which dissolves with effervescence.

The constituent parts of red copper ore are supposed to be copper and oxygen, and not a carbonate of copper, as was formerly conjectured.

Localities, &c.—Red copper ore is found in various places accompanying the other ores of the same metal,

Metallic Ores.

and particularly native copper. The cryſtallized varieties are rare.

9. Species. Brick-red Copper Ore.

Id. Kirwan, ii. 127. *Id.* Brochant, ii. 187.

Of this alſo there are two ſubſpecies, earthy and indurated.

Subſpecies 1. Earthy Brick-red Copper Ore.

Exter. Char.—Found maſſive or diſſeminated, or ſuperficial, in the fiſſures of other copper ores, compoſed of fine earthy particles ſlightly cohering; dull, friable, and ſtaining.

Colour hyacinth red, reddiſh brown, browniſh red, or yellow.

Subſpecies 2. Indurated Brick-red Copper Ore.

Exter. Char.—Found maſſive, diſſeminated, or ſuperficial; luſtre glimmering, or weakly ſhining; fracture imperfectly conchoidal, even or earthy; fragments rather ſharp edged.

Colour deep hyacinth red, browniſh red, or deep brown; ſtreak ſhining; ſoft, or ſemihard; brittle.

Chem. Char.—Before the blow-pipe it is infuſible and blackens.

The conſtituent parts of this ore are ſuppoſed to be a mixture of red copper ore, or oxide of copper, and brown oxide of iron, in variable proportions.

Localities, &c.—This ore is uſually found accompanying red copper ore.

10. Species. Emerald Copper Ore.

Dioptaſe, Hauy, iii. 136. *Id.* Brochant, ii. 511.

Eſſen. Char.—Diviſible into an obtuſe rhomboid, whoſe plane angles are 111° and 69°.

Exter. Char.—Found cryſtallized in ſix-ſided priſms, terminated by a three-ſided ſummit, placed on the three alternate lateral edges; luſtre ſhining, vitreous; fracture foliated; cleavage threefold, parallel to the lateral edges of the ſummit.

Colour emerald green; tranſlucent, or ſemi-tranſparent; ſemi-hard. Spec. grav. 3.3.

Chem. Char.—Infuſible before the blow-pipe, but becomes brown, and tinges the flame of a candle yellowiſh green.

Conſtituent Parts.	Vauquelin.
Oxide of copper	28.57
Silica	28.57
Carbonate of lime	42.85
Loſs	.01
	100.00

Localities, &c.—This mineral is found in Siberia, in a matrix covered with malachite.

11. Species, Azure Copper Ore, or *Carbonate of Copper.*

Blue Calciform Copper Ore, Kirwan, ii. 129. *L'Azur de Cuivre*, Brochant, ii. 190. *Cuivre Carbonaté Bleu.* Hauy, iii. 562.

This ſpecies is divided into two ſubſpecies, earthy and indurated.

Claſſification.

Subſpecies 1. Earthy Azure Copper Ore.

Exter. Char.—Rarely found maſſive, uſually diſſeminated or ſuperficial; compoſed of fine particles which are dull and ſomewhat coherent; fracture earthy.

Colour ſmalt blue, ſometimes ſky blue; opaque; ſtains a little; ſoft or friable.

Subſpecies 2. Indurated or Radiated Azure Copper Ore.

Exter. Char.—Rarely found maſſive, ſometimes diſſeminated, often ſuperficial, or in imitative forms, as ſtalactitical, botryoidal, &c. and alſo cryſtallized in rectangular four-ſided priſms, terminated by four-ſided acute pyramids ſet on the lateral edges; in oblique four-ſided priſms, with two broad and two narrow faces, with a four-ſided pyramid ſet on the lateral faces; ſometimes the lateral edges are truncated, and the termination is by a ſix-ſided pyramid. Cryſtals uſually ſmall, and variouſly aggregated; broad faces of the priſms tranſverſely ſtreaked; narrow faces longitudinally; luſtre ſhining or reſplendent, vitreous; fracture radiated; fragments blunt edged, or wedge ſhaped.

Colour light azure blue, Pruſſian or indigo blue; tranſlucent or ſemi-tranſparent; ſtreak ſky blue; ſoft; brittle. Spec. grav. 3.4 to 3.608.

Chem. Char.—Soluble with effervefcence in nitric acid; nearly infuſible before the blow-pipe, but is eaſily reduced with borax, which aſſumes a fine green colour.

Conſtituent Parts.	Pelletier.
Copper	66
Carbonic acid	18
Oxygen	8
Water	2
Loſs	6
	100

Localities, &c.—This variety of copper ore is not very abundant; but it accompanies the other ores of copper, and other metallic ores, as thoſe of lead, zinc, and iron. It is found in Bohemia, Norway, Siberia, and in the different mines of lead and copper in Britain.

The earthy variety is found in ſuperficial layers on a ſlaty marl in Heſſia, and it is alſo found ſuperficial on ſandſtone in Thuringia. Sometimes the whole of the ſandſtone is impregnated with this earthy carbonate of copper, there called *copper ſand earth*, or *copper ſandſtone.* A ſimilar ſandſtone, at Gourock near Greenock in Scotland, was a few years ago dug out for the purpoſe of extracting copper.

12. Species. Malachite.

Id. Kirwan, ii. 131. *Id.* Brochant, ii. 197.

This ſpecies is divided into two ſubſpecies, fibrous and compact.

Subſpecies

Subſpecies 1. Fibrous Malachite.

Cuivre Carbonaté Vert Soyeux. Hauy, iii. 573.

Exter. Char.—Rarely maſſive, ſometimes diſſeminated, but often ſuperficial, and in the form of ſmall capillary or acicular cryſtals grouped together in different forms; luſtre ſhining, or when maſſive glimmering; internal luſtre weakly ſhining, ſilky; fracture fibrous, ſtraight, or radiated; fragments blunt edged.

Colour, emerald or apple green; opaque; ſtreak of a lighter colour; ſoft; brittle.

Subſpecies 2. Compact Malachite.

Exter. Char.—Sometimes found maſſive, diſſeminated or ſuperficial, but moſt frequently globular, botryoidal, ſtalactitical, &c.; ſurface rough or druſy, ſometimes ſmooth, almoſt always dull, and rarely ſhining; internal luſtre dull or weakly ſhining; fracture conchoidal; fragments rather ſharp edged or wedge ſhaped.

Colour emerald green, apple green, and blackiſh green; opaque; ſoft; brittle. Spec. grav. 3.57 to 3.64.

Chem. Char.—Decrepitates before the blow-pipe, and blackens without fuſion; effervesces with acids; colours borax green, and communicates a blue colour to the ſolution of ammonia.

Conſtituent Parts. Klaproth.

	Compact malachite.
Copper	58.
Carbonic acid	18.
Oxygen	12.5
Water	11.5
	100.0

Localities, &c.—Both the fibrous and compact malachites are uſually found in the ſame repoſitory, and accompanied with other ores of copper. They are found in Germany, but the fineſt ſpecimens are brought from Siberia. Scotland affords fibrous malachite in ſmall quantity, as at Leadhills and in Shetland. Malachite is alſo met with in Cornwall and Derbyſhire in England.

Uſes.—Malachite, when pure, is ſometimes employed as a pigment. The compact variety is ſuſceptible of a fine poliſh; which, with its beautiful and delicate colours, has brought it into much eſtimation for various ornamental purpoſes.

The largeſt and fineſt ſpecimen of compact malachite known, is in the cabinet of Dr Guthrie at Peterſburgh. It is 32 inches long, 17 broad, and two inches thick. It is eſtimated, according to the account of Patrin, who deſcribes it, at 20,000 francs, above 800l. ſterling. If we are rightly informed, this ſplendid maſs of malachite was once offered to ſale in Britain, but, having found no purchaſer, was carried back to Ruſſia.

13. Species. Green Copper Ore.

Mountain Green, Kirw. ii. 134. *Id.* Broch. ii. 203.

Exter. Char.—Found maſſive or diſſeminated, but uſually ſuperficial on other ores; dull; fracture conchoidal or uneven; fragments blunt-edged.

Colour verdigris green, emerald green, ſometimes ſky blue, opaque, or tranſlucent at the edges; ſoft, or friable; brittle.

Chem. Char.—Becomes black before the blow-pipe without fuſion. Colours borax green.

Conſtituent Parts.—Suppoſed to be a mixture of oxide of copper, or according to others, a carbonate, with alumina and lime.

Localities, &c.—It is uſually accompanied by gray copper ore, and ſome other copper ores, particularly with malachite, and ſometimes with iron ochre, alumina, and quartz. Found in Saxony, Hungary, and Siberia.

14. Species. Ferruginous Green Copper Ore.

This is divided into two ſubſpecies; 1. earthy; and, 2. ſlaggy.

Subſpecies 1. Earthy Ferruginous Green Copper Ore.

Iron-ſhot Mountain Green, Kirw. ii. 155. *Id.* Broch. ii. 205.

Exter. Char.—Found maſſive, but moſt frequently diſſeminated; dull, with an earthy fracture; fragments blunt-edged.

Colour light olive green; ſoft, friable; brittle; megre to the feel.

Subſpecies 2. Slaggy Ferruginous Green Copper Ore.

Glaſſy Iron-ſhot Mountain Green, Kirw. ii. 152.

Exter. Char.—Maſſive, or diſſeminated; luſtre ſhining, vitreous; fracture conchoidal; fragments ſharp-edged.

Colour deep olive green, ſometimes black; ſoft; brittle.

Conſtituent Parts.—Seems to be a mixture of oxide of copper with iron ochre, in variable proportions.

Localities, &c.—Found along with other copper ores, and is accompanied by iron ochre, heavy ſpar and quartz. It is a rare mineral. Has been found in Saxony, and it is ſaid in the Hartz.

15. Species. Micaceous Copper Ore, or *Arſeniate of Copper.*

Olive Copper Ore, Kirw. ii. 151. *Le Cuivre Arſenical*, Broch. ii. 208. *Cuivre Arſeniaté*, Hauy, iii. 575. *Arſeniate of Copper*, Bournon, Phil. Tranſ. 1801. p. 193.

This ſpecies is divided into two ſubſpecies, foliated and lenticular.

Subſpecies 1. Foliated Micaceous Copper Ore.

Exter. Char.—Found maſſive, diſſeminated, or cryſtallized in oblique four-ſided priſms, in ſix-ſided priſms, in acute rhomboids, or in very ſmall cubes. Theſe cryſtals are alſo variouſly modified; lateral faces ſtreaked longitudinally; luſtre reſplendent, pearly, or adamantine; fracture foliated, ſometimes conchoidal.

Colour olive green, ſometimes emerald green, or verdigris

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digris green; tranflucent; cryftals femitranfparent; foft. Spec. grav. 2.54.

Subfpecies 2. Lenticular Micaceous Copper Ore.

Exter. Char.—This variety is found cryftallized in octahedrons, compofed of two four-fided pyramids, with ifofceles triangular faces; cryftals fmall; external luftre fhining; fracture foliated.

Colour fky blue, or verdigris green; fcratches calcareous fpar; brittle; eafily frangible. Spec. grav. 2.88.

Chem. Char.—The cryftals of thefe varieties decrepitate before the blow-pipe, and give out the odour of arfenic. They melt into a grayifh globule, which being treated with borax, yields a button of copper.

Conftituent Parts.	Vauquelin.
Oxide of copper	39
Arfenic acid	43
Water	17
Lofs	.1
	100

Localities, &c.—Thefe varieties of copper ores are very rare; and have been hitherto difcovered only in the Carrarach mine, Cornwall, accompanied by brown iron ore and other copper ores.

Other arfeniates of copper have been defcribed by Bournon. In many refpects they refemble the preceding varieties. The fpec. grav. which is 4.28, is confiderably greater, and yet the proportions of the conftituent parts approach very near.

Conftituent Parts. Chenevix.

	Hæmatitiform.	Capillary.	Foliated.
Oxide of copper	50	51	54
Arfenic acid	29	29	30
Water	21	18	16
Lofs	—	2	—
	100	100	100

Count de Bournon has defcribed another, under the name of cupromartial arfeniate, which is alfo cryftallized, has a fpec. grav. 3.3, and the following are its conftituent parts.

	Chenevix.
Oxide of iron	27.5
——— copper	22.5
Arfenic acid	33.5
Silica	3.
Water	12.
Lofs	1.5
	100.0

16. Species. Muriate of Copper, or *Green Sand of Peru.*

Id. Broch. ii. 149. *Id.* Broch. ii. 545.

Exter. Char.—Found maffive, or cryftallized in very fmall fix-fided prifms, bevelled at the extremities, or in fmall oblique four-fided prifms, alfo bevelled at the extremities, but the fides correfponding to the obtufe lateral edges; furface of the cryftals fmooth and refplendent; luftre adamantine; fracture foliated; fragments rather fharp-edged.

Classification.

Colour between emerald and leek green; opaque; cryftals a little tranfparent; foft; ftreak pale apple green. Spec. grav. 3.57 to 4.43.

Chem. Char.—Thrown on burning coals, it communicates a green colour to the flame; foluble in nitric acid without effervefcence.

Conftituent Parts.

	Prouft.		Klaproth.
Oxide of copper	76.6	70.6	73.
Muriatic acid	10.6	11.4	10.1
Water	12.8	18.1	16.9
	100.0	100.0	100.0

Localities, &c.—This mineral has been found in the fand of rivers, accompanied by quartz, fchorl, copper and iron ores, near Remolinos in Chili. It has alfo been found in a fimilar fituation in Peru.

Phosphate of Copper.—This mineral has been found maffive, or cryftallized in oblique fix-fided prifms, with convex faces, lining cavities; luftre refplendent, between vitreous and adamantine; internal luftre filky; fracture fibrous.

Colour grayifh black, but internally emerald green; opaque; ftreak apple green; foft, or femi-hard.

Conftituent Parts.	Klaproth.
Oxide of copper	68.13
Phofphoric acid	30.95
Lofs	.92
	100.00

Localities, &c.—This mineral has been found near Bologne, along with malachite, in a white drufy quartz.

Copper Mines.—In addition to the hiftory of copper ores now given, we fhall juft name fome of the more celebrated copper mines in the world. The copper mines of Spain are fituated on the frontiers of Portugal, and yield from veins of confiderable thicknefs, yellow pyrites. France poffeffes copper mines in the Pyrenees, near Lyons, in Vofges, and in the neighhood of Savoy, in the department of Mont Blanc. There are extenfive copper mines in Piedmont, which have been wrought to a very confiderable depth.

The copper mines of Cornwall in England, which are in primitive rocks, have been long celebrated. The moft abundant ores are copper pyrites, accompanied by native copper, which latter, it is obferved, is moft ufually found near the furface. The fame mines yield all the varieties of arfeniate of copper. The Acton copper mines on the borders of the counties of Derby and Stafford are fituated in limeftone, in very declining or nearly perpendicular beds; but the richeft copper mines in England are thofe of the ifland of Anglefea, where is a mafs of pyritous copper ore of immenfe thicknefs, yielding from 16 to 40 per cent. of copper. Native copper is alfo found near the furface, and immediately under the turf.

This

Classification.

The mines of Cronebane, in the county of Wicklow in Ireland, are very confiderable. They are fituated in a primitive mountain, compofed of flinty flate and argillaceous fchiftus, which alternate with beds of fteatites.

In Germany, Hungary, Sweden, Norway, and Siberia, there are many extenfive and valuable copper mines. In the eaftern parts of the Afiatic continent, in the ifland of Japan, in China, and in fome of the iflands of the Indian ocean, rich copper ores are abundant.

Africa, in various places of that extenfive region, abounds with ores of copper, as in the mountains to the north of the Cape of Good Hope. On the weftern coaft of Africa, the natives dig out copper ore, and are acquainted with the mode of extracting it.

In North America maffes of native copper have been found, near Hudfon's Bay; but the richeft copper mines in the world are thofe of South America, and particularly in Chili, from which maffes of native copper of immenfe magnitude have been obtained. The copper mines of Peru and Mexico are alfo wrought to great advantage.

VI. IRON GENUS.

1. Species. NATIVE IRON.

Id. Kirw. ii. 156. *Id.* Brochant, ii. 215. *Id.* Haüy, iv. 1.

Exter. Char.—Found maffive or branched; furface fmooth, fhining; internal luftre fhining, metallic; fracture hackly; fragments rather fharp-edged.

Colour light fteel gray, or filvery white; femihard; ftreak fhining; perfectly ductile; flexible; but not elaftic.

Localities, &c.—The exiftence of native iron as a terreftrial production ftill remains doubtful. It is faid that it has been found along with other ores of iron, in Saxony and in France. The only inftances fully eftablifhed of the difcovery of native iron, are thofe of the immenfe mafs found by Pallas in Siberia, which amounted to no lefs than 1680lb. or 15 cwt. and another of 3 cwt. which was difcovered by Rubin de Celis in South America; but thefe maffes correfpond fo nearly with the fubftances which are certainly known to have fallen from the atmofphere, in their conftituent parts, that it feems extremely probable they have had a fimilar origin. But for a full account of this curious fubject, fee METEOROLITE.

2. Species. IRON PYRITES.

Martial Pyrites, Kirwan. ii. 76. *Id.* Brochant, ii. 221. *Fer fulfuré*, Haüy, iv. 65.

Subfpecies 1. COMMON IRON PYRITES.

Exter. Char.—Found maffive or diffeminated, fuperficial, or in imitative forms, and frequently cryftallized. The forms are, a perfect cube with plane or convex faces; or with truncated angles, or edges; or having a three-fided pyramid on each angle; the perfect octahedron, or truncated on all its angles; the dodecahedron with pentagonal faces, or with fix oppofite and parallel edges truncated, or truncated on eight of its angles; or the perfect icofahedron, which is rare.

Metallic Ores.

Cryftals fmall, excepting the cube, and grouped together; furface fmooth or ftreaked; luftre fhining, refplendent; internal luftre fhining, metallic; fracture uneven; fometimes conchoidal; fragments rather fharp-edged.

Colour bronze yellow, golden yellow, fometimes fteel gray; opaque; hard; brittle; rather eafily frangible. Spec. grav. 4.6 to 4.83.

Chem. Char.—Before the blow-pipe it gives out a ftrong fulphureous fmell, and burns with a bluifh flame; a brownifh globule is then obtained, which is attracted by the magnet.

Conftituent Parts. Hatchett.

Sulphur	52.15	52.5
Iron	47.85	47.5
	100.00	100.0

Some varieties of common iron pyrites contain a mixture of gold, which is fuppofed to be accidental, as the external characters are not affected by it, and it is only recognifed by chemical analyfis. Thefe varieties are called auriferous pyrites.

Subfpecies 2. RADIATED IRON PYRITES.

Exter. Char.—Found maffive, or in different imitative forms, and alfo cryftallized in fmall cubes or octahedrons; furface fmooth or drufy; luftre fhining or refplendent; fracture radiated; fragments wedge-fhaped.

Colour bronze yellow, lighter than the former; fometimes fteel gray, and fometimes tarnifhed; hard; brittle, and eafily frangible.

Subfpecies 3. CAPILLARY IRON PYRITES.

Exter. Char.—Found in fmall, capillary, or acicular cryftals, having the appearance of flocks of wool; fometimes the cryftals are acicular or in a ftellated form; luftre fhining or weakly fhining, metallic.

Colour bronze yellow, approaching to fteel gray.

Subfpecies 4. HEPATIC IRON PYRITES.

Exter. Char.—Maffive or diffeminated, or in different imitative forms, as ftalactitical, cellular, &c.; fometimes cryftallized in perfect fix-fided prifms, or in fix-fided tables, which are either perfect or bevelled on the terminal faces. Cryftals fmall; fometimes fmooth; fometimes drufy; internal luftre glimmering, or weakly fhining; fracture even, or imperfectly conchoidal; fragments fharp-edged.

Colour bronze yellow, fteel-gray, fometimes brownifh or tarnifhed; ftreak fhining; hard; brittle.

Phyfical Char.—By rubbing gives out a fulphureous odour, and, according to fome, the fmell of arfenic.

Conftituent Parts.—According to fome mineralogifts, this variety is compofed of fulphur and iron, with a portion of arfenic.

Localities, &c.—The firft variety is univerfally diffufed; it is found in every kind of rock, and often in great abundance.

The fecond is rarer; but is not uncommon in veins of lead and filver, and fometimes in nefts in indurated marl. It is found in Saxony and Bohemia, in Derbyfhire

Metallic Ores.

ſhire in England, and at Leadhills and the iſland of Iſlay in Scotland.

This variety is more ſubject than the firſt to decompoſition.

Capillary pyrites is only found in ſmall quantity, as in Saxony, and Andreaſberg in the Hartz.

Hepatic pyrites is only found in veins, particularly thoſe of ſilver and lead, accompanied with quartz, calcareous ſpar, and heavy ſpar, as in Germany and Siberia, and at Wanlockhead in Scotland.

Expoſed to the air, this variety is extremely liable to decompoſition.

3. Species. Magnetic Pyrites.

Id. Kirwan. ii. 79. *Id.* Brochant, ii. 232.

Exter. Char.—Maſſive or diſſeminated; internal luſtre ſhining or weakly ſhining; fracture uneven, rarely conchoidal; fragments rather ſharp-edged.

Colour between copper red and bronze yellow; when expoſed to the air it becomes browniſh or tarniſhed; hard, or ſemihard; brittle. Spec. grav. 4.51.

Phyſ. Char.—This variety of pyrites acts on them agnetic needle, but not very powerfully.

Chem. Char.—Before the blow-pipe it gives out a ſlight odour of ſulphur, and melts eaſily into a grayiſh black globule, which is attracted by the magnet.

Conſtituent Parts.	Hatchett.
Iron	63.5
Sulphur	36.5
	100.0

Localities, &c.—Magnetic pyrites has been only found in primitive rocks, as in micaceous ſchiſtus; and is uſually diſpoſed in beds, along with other ores of iron, and accompanied by quartz, hornblende, and garnets. It is found in Saxony, Bavaria, Bohemia, and in Caernarvonſhire in Wales.

Uſes.—This, as well as the former ſpecies, is employed for the purpoſe of extracting ſulphur, or of manufacturing copperas, or ſulphate of iron.

4. Species. Magnetic Iron Ore.

Magnetic Ironſtone, Kirwan, ii. 158. *Id.* Brochant, ii. 235. *Fer Oxidulé*, Haüy, iv. 10.

This is divided into two ſubſpecies, common and arenaceous.

Subſpecies 1. Common Magnetic Iron Ore.

Exter. Char.—Maſſive or diſſeminated, and often alſo cryſtallized in ſix-ſided priſms, having a three-ſided pyramid at each extremity, ſet on three alternate lateral edges; an oblique four-ſided priſm; a double four-ſided pyramid, or perfect octahedron, which is ſometimes truncated on all its edges. Cryſtals of various ſizes; faces ſometimes ſmooth; thoſe of the four-ſided priſm ſtreaked tranſverſely; luſtre ſhining; internal luſtre reſplendent, or weakly glimmering; fracture uneven, ſometimes conchoidal or foliated; fragments rather blunt-edged.

Classification.

Colour iron-black, perfect black, or ſteel-gray; ſtreak browniſh black; ſemihard, or hard; brittle; more or leſs eaſily frangible. Spec. grav. 4.2 to 4.93.

Subſpecies 2. Arenaceous Magnetic Iron Ore.

Exter. Char.—Found in rounded grains, from the ſize of millet to that of a nut, and ſometimes in ſmall octahedral cryſtals; external ſurface rough or weakly glimmering; internal ſhining or reſplendent; fracture conchoidal; fragments ſharp-edged.

Colour deep iron-black, ſometimes aſh gray.

Phyſ. Char.—Magnetic iron ore, as the name imports, ſtrongly attracts the magnetic needle, and iron filings; to the compact varieties of this ore, in which this property was firſt diſcovered, the name of natural magnet is given.

Chem. Char.—Magnetic iron ore becomes brown before the blow-pipe, and colours borax dark green.

Conſtituent Parts.—This is ſuppoſed to be an oxide of iron in conſiderable purity, as it yields from 80 to 90 per. cent of metallic iron.

Localities, &c.—Common magnetic iron ore is very common in primitive mountains, particularly in thoſe of gneiſs and micaceous ſchiſtus, where it forms very powerful beds, and even entire mountains. It is diſſeminated in cryſtals in chlorite ſchiſtus, as in Corſica, and in baſalt and greenſtone, at Taberg in Sweden. Found in Saxony, Bohemia, and Italy, and particularly in the iſland of Elba in the Mediterranean; and indeed is very univerſally diſtributed over every part of the globe.

The ſecond variety, or magnetic ſand, is found in the beds of rivers, in a looſe ſtate, and ſometimes imbedded in baſalt and wacken. It is found in thoſe countries where the other ores of iron abound; and alſo in the ſand of many of the rivers within the torrid zone, as in Jamaica, St Domingo, &c.

Uſes.—Magnetic iron is wrought for the purpoſe of obtaining metallic iron. Moſt of the Swediſh iron ores belong to this variety, and furniſh the iron which is ſo celebrated on account of its ſuperior qualities, throughout Europe.

Magnetic ſand, where it is abundant, is alſo ſmelted as an iron ore.

5. Species. Specular Iron Ore.

Id. Broch. ii. 242. *Id.* Kirw. ii. 162. *Micaceous Iron Ore*, ibid. 284. *Fer Oligiſte*, Haüy, iv. 38.

This ſpecies is divided into two ſubſpecies, common and micaceous.

Subſpecies 1. Common Specular Iron Ore.

Exter. Char.—Maſſive or diſſeminated, but moſt frequently cryſtallized in doubled three-ſided pyramids, flattened, and the lateral faces of the one ſet on the lateral edges of the other; the ſame pyramid with the angles at the common baſe truncated; in perfect cubes, having the angles truncated; or the cube conſidered as a double three-ſided pyramid; or as a rhomboid, in which the ſummits are ſurmounted by an obtuſe three-ſided pyramid, ſet on the lateral faces; the ſame cube bevelled at each of the angles of the common baſe; in ſix-ſided tables variouſly modified, or in perfect lenſes.

Surface

4

Classification.

Surface of the cryſtals ſmooth, reſplendent; internal luſtre weakly ſhining or reſplendent; fracture uneven, ſometimes conchoidal or foliated; fragments ſharp-edged.

Colour ſteel gray, bluiſh, or reddiſh; ſometimes with tarniſhed colours, which are iridelcent; ſtreak dark cherry-red; hard; opaque; brittle. Spec. grav. 4.79 to 5.21.

Chem. Char.—Before the blow-pipe it is infuſible; but heated on charcoal becomes white, and melts with borax into a dirty yellow ſlag.

Phyſ. Char.—Affects the magnetic needle, but does not attract iron filings.

Conſtituent Parts.—This variety is ſuppoſed to be a pretty pure oxide of iron, yielding from 60 to 80 per cent. of iron.

Of this ſubſpecies two varieties have been formed, compact and foliated, depending probably on the appearance of the fracture.

Subſpecies 2. MICACEOUS IRON ORE.

Exter. Char.—Maſſive, or diſſeminated, or in thin ſix-ſided tables, ſo grouped together as to appear cellular; ſurface ſmooth, reſplendent; internal luſtre reſplendent; fracture foliated; fragments in tables.

Colour iron-black, ſteel-gray, or dark red; in thin plates ſlightly tranſlucent; ſtreak dark cherry-red; ſemihard; brittle. Spec. grav. 4.5 to 5.

Localities, &c.—Theſe varieties are found in primitive mountains, in beds or veins, accompanied by other ores of iron, and in ſuch quantity in many places as to be dug out for the purpoſe of manufacture, as in Germany, France, Ruſſia, Sweden, Siberia, and particularly in the iſlands of Corſica and Elba, which furniſh the fineſt ſpecimens of ſpecular iron ore for the cabinet.

The latter variety is found in England, and ſome parts of Scotland.

6. Species. RED IRON ORE.

This is divided into four ſubſpecies; 1. red iron froth; 2. compact; 3. red hæmatites; and, 4. red ochre.

Subſpecies 1. RED IRON FROTH.

Id. Broch. ii. 249. *Red Scaly Iron Ore*, Kirw. ii. 172.

Exter. Char.—Sometimes maſſive, and frequently ſuperficial; luſtre glimmering or ſhining, uſually compoſed of ſcaly friable particles which ſtain ſtrongly; feels greaſy.

Colour dark cherry-red, blood-red, browniſh-red, or ſteel-gray.

Chem. Char.—Blackens before the blow-pipe.

Conſtituent Parts.	Henry.
Iron,	66.
Oxygen,	28.5
Silica,	4.25
Alumina,	1.25
	100.00 *

* Nich. Jour. 4to, iii. 456.

Localities, &c.—A rare mineral, uſually incruſting other ores of iron. Found in Germany, and in Cornwall and at Ulverſtone in Lancaſhire in England.

Metallic Ores.

Subſpecies 2. COMPACT RED IRON ORE.

Id. Broch. ii. 251. *Id.* Kirw. ii. 170.

Exter. Char.—Maſſive or diſſeminated, in imitative forms, as cellular, &c. or cryſtallized in perfect cubes, or four-ſided pyramids with truncated ſummits. Surfaces of the cube ſmooth; that of the pyramids rough and dull; internal luſtre glimmering; fracture even, ſometimes uneven or conchoidal; fragments rather blunt-edged.

Colour browniſh-red, dark ſteel-gray, ſometimes blood-red; ſemihard; brittle; ſtreak blood-red; ſtains. Spec. grav. 3.4 to 3.8.

Chem. Char.—Infuſible before the blow-pipe.

Conſtituent Parts.	Lampadius.
Oxide of iron,	65.4
Silica,	20.7
Alumina,	9.3
Oxide of manganeſe,	2.7
Loſs,	1.9
	100.0

Localities, &c.—Found along with other iron ores, abundant in Cumberland and Lancaſhire, and various places of the world.

Subſpecies 3. RED HÆMATITES.

Id. Kirw. ii. 168. *Id.* Broch. ii. 254.

Exter. Char.—Maſſive, and in various imitative forms; ſurface ſmooth or druſy; internal luſtre ſhining, or only glimmering; fracture fibrous; fragments wedge-ſhaped.

Colour browniſh-red, ſteel-gray, or blood-red; ſtreak light blood-red; hard or ſemihard; brittle; ſtains. Spec. grav. 4.7 to 5.

Conſtituent Parts.—It yields from 60 to 70 per cent. of iron, and contains, it is ſuppoſed, a portion of alumina, ſilica, and manganeſe.

Localities, &c.—This ore of iron is not very common, although in ſome places it is very abundant, as in the weſt of England. It is diſpoſed in veins and beds, accompanied by the former variety.

Subſpecies 4. RED OCHRE.

Id. Kirw. ii. 171. *Id.* Broch. ii. 256.

Exter. Char.—Found maſſive, diſſeminated, or ſuperficial; dull; fracture earthy.

Colour between blood-red and browniſh-red; ſtains much; ſoft; often friable.

Localities, &c.—This variety uſually accompanies the former, and is a very fuſible iron ore.

7. Species. BROWN IRON ORE.

This is divided into four ſubſpecies; 1. brown iron froth; 2. compact; 3. brown hæmatites; and, 4. brown ochre.

Subſpecies 1. BROWN IRON FROTH.

Brown Scaly Iron Ore, Kirw. ii. 166. *Le Eiſenrahm brun*, Broch. ii. 258.

Metallic Ores.

Exter. Char.—Maſſive or diſſeminated, often ſuperficial, or ſpumiform; ſtrongly glimmering or ſhining; fracture foliated or compact.

Colour between brown and dull gray; very ſoft; almoſt friable; ſtains; feels greaſy; nearly ſwims on water.

Chem. Char.—Blackens before the blow-pipe without fuſion.

Localities, &c.—Accompanies other iron ores, as in Saxony, but is rare.

Subſpecies 2. Compact Brown Iron Ore.

Exter. Char.—Maſſive or diſſeminated, ſometimes in different imitative forms; dull, or rarely glimmering; fracture ſmooth, earthy, or conchoidal.

Colour clove brown, or browniſh yellow; ſtreak yellowiſh brown; ſemihard; brittle. Spec. grav. 3.07 to 3.75.

Localities, &c.—In veins or beds, accompanied by other iron ores, in various parts of the world.

Subſpecies 3. Brown Hæmatites.

Id. Kirw. ii. 163. *Id.* Broch. ii. 261.

Exter. Char.—Maſſive, but moſt frequently in different imitative forms; ſurface ſmooth, granulated, rough or druſy; luſtre ſhining; internal luſtre glimmering or weakly ſhining; fracture fibrous; fragments ſplintery, or wedge-ſhaped.

Colour clove brown, blackiſh brown, ſometimes yellow, and ſometimes with tarniſhed colours; opaque; ſtreak yellowiſh brown; ſemihard; brittle. Spec. grav. 3.78 to 4.02.

Localities, &c.—Always accompanies the preceding variety, but in ſmaller quantity.

Subſpecies 4. Brown Ochre.

Id. Kirw. ii. 167. *Id.* Broch. ii. 263.

Exter. Char.—Maſſive or diſſeminated; dull; fracture earthy; fragments blunt-edged.

Colour yellowiſh brown, or ochre yellow; ſoft; ſometimes friable; ſtains more or leſs.

Localities, &c.—Always accompanies compact brown iron ore, and is therefore found in ſimilar places.

8. Species. Sparry Iron Ore.

Id. Brochant, ii. 264. *Id.* Kirw. ii. 190.

Exter. Char.—Maſſive, diſſeminated, ſometimes with impreſſions, and often cryſtallized. Its forms are, the rhomboid with plane or convex faces, or having two oppoſite angles ſtrongly truncated; and the lens, the equiangular ſix-ſided priſm, or the ſimple or double four-ſided pyramid. Cryſtals ſmall; ſurface ſmooth, ſometimes druſy, ſometimes a little rough; luſtre ſhining and ſomewhat metallic; internal luſtre ſhining, rarely reſplendent, between pearly and vitreous; fracture foliated; fragments rhomboidal.

Colour yellowiſh gray, grayiſh white, and expoſed to the air, blackiſh brown, or with tarniſhed colours; ſometimes tranſlucent at the edges; thoſe of a dark colour, opaque; ſemihard, or ſoft; brittle. Spec. grav. 3.6 to 4.

Claſſification.

Chem. Char.—Before the blow-pipe it blackens without fuſion.

Conſtituent Parts.—According to Bergman, this mineral contains equal parts of carbonate of lime and of iron, with about one-fourth of manganeſe.

Localities, &c.—Found equally in primitive and ſtratiform rocks, and always accompanied by calcareous ſpar, and other ores of iron, as in Saxony, France, Britain, and Ireland.

9. Species. Black Iron Ore.

Id. Kirw. ii. 167. *Id.* Broch. ii. 268.

This ſpecies is divided into two ſubſpecies: 1. compact; and, 2. black hæmatites.

Subſpecies 1. Compact Black Iron Ore.

Exter. Char.—Maſſive, or in various imitative forms; ſurface rough or dull; internal luſtre glimmering; fracture flat conchoidal; fragments ſharp-edged.

Colour between ſteel gray and bluiſh-black; ſemihard; brittle.

Subſpecies 2. Black Hæmatites.

Exter. Char.—Maſſive or kidney-form; internal luſtre glimmering and ſhining; fracture fibrous, ſometimes even; fragments wedge-ſhaped.

Colour ſteel gray.

Conſtituent Parts.—This ore is ſuppoſed to contain a larger proportion of manganeſe, with alumina and lime, than other ores of iron.

Localities, &c.—Found in veins in primitive mountains, and ſometimes alſo in ſtratiform mountains, accompanied by brown and ſparry iron ore.

10. Species. Argillaceous Iron Stone.

This is divided into ſix ſubſpecies: 1. red chalk; 2. columnar argillaceous iron ſtone; 3. granular; 4. common; 5. reniform; and, 6. piſiform.

Subſpecies 1. Red Chalk.

Id. Broch. ii. 271.

Exter. Char.—Maſſive; fracture ſlaty; luſtre glimmering; croſs fracture earthy, dull; fragments in plates, or ſplintery.

Colour browniſh red, black or blood red; ſtreak blood red; writes and ſtains; ſoft; adheres to the tongue; feels meagre. Spec. grav. 3.13 to 3.93.

Chem. Char.—Decrepitates, and becomes black when expoſed to a red heat.

Localities, &c.—Uſually accompanies clay ſlate, either in thin beds, or in maſſes, as at Thalitter in Heſſia, where it is dug out in conſiderable quantity. It is alſo found in Bohemia and Saxony.

Uſes.—Employed as crayons in drawing, and for this purpoſe it is dug out, rather than as an ore of iron.

Red chalk, on account of the quantity of alumina and other earths which it contains, was formerly arranged in the argillaceous genus.

Subſpecies

Classification. Metallic Ores.

Subſpecies 2. Columnar Iron Stone.

Id. Kirw. ii. 176. *Id.* Broch. ii. 273.

Exter. Char.—Found in angular or rounded pieces; ſurface rough and dull; fracture dull and earthy; compoſed of columnar diſtinct concretions, which are often a little curved, ſometimes ſtraight and articulated, and very eaſily ſeparated; ſurface of the concretions rough and dull.

Colour cherry red, blood or browniſh red; ſtreak blood red, ſometimes yellowiſh brown; ſoft; adheres to the tongue; feels meagre, and is a little rough.

Localities, &c.—Uſually met with in beds of clay, in ſtratiform mountains, and particularly in the neighbourhood of ſubterranean fires, by the effects of which, as it is ſuppoſed, it may have been produced. It is found in Bohemia and ſome other places, where it is wrought as an ore of iron.

Subſpecies 3. Granular Iron Stone.

Id. Broch. ii. 274. *Acinoſe Iron Ore*, Kirw. ii. 177.

Exter. Char.—Maſſive, or conſtituting the baſe of petrifactions; ſtrongly glimmering, or weakly ſhining; fracture uneven, ſometimes ſlaty; fragments blunt-edged.

Colour reddiſh and yellowiſh brown, or grayiſh black; ſtreak blood red, or varying according to the colour of the ore, uſually ſoft, or ſemihard. Specific gravity 2.673.

Conſtituent Parts.	Lampadius.
Oxide of iron	64.
Alumina	23.
Silica	7.5
Water	5.
Loſs	.5
	100.0

Localities, &c.—Is found only in ſtratiform mountains, as in Bohemia, Bavaria, and Switzerland.

Subſpecies 4. Common Iron Stone.

Id. Kirw. ii. 173. *Id.* Broch. ii. 276.

Exter. Char.—Maſſive or diſſeminated, ſometimes cellular or botryoidal; dull; fracture earthy; fragments rather ſharp-edged.

Colour yellowiſh or bluiſh gray; yellowiſh brown, or browniſh red; ſtreak varies with the colour; ſoft; brittle; adheres to the tongue; feels meagre.

Localities, &c.—A common ore of iron in many places of Saxony and Bohemia, in Norway, and in England. It is connected with ſtratiform mountains, alternating with beds of clay ſlate.

Subſpecies 5. Reniform Iron Stone.

Id. Broch. ii. 278. *Nodular Iron Ore*, Kirw. ii. 178.

Exter. Char.—Found in rounded or tuberculated pieces, of a kidney-form figure; ſurface rough, covered with earthy particles; internal luſtre glimmering; fracture ſmooth, or earthy; fragments rather ſharp-edged; compoſed of lamellar and concentric diſtinct concretions, including a nodule which is uſually moveable.

Colour yellowiſh brown; ſtreak the ſame; ſoft; brittle; adheres to the tongue; feels meagre. Specific gravity 2.57.

Localities, &c.—Found in Bohemia, Saxony, Sileſia, and Poland, and in the coal countries of England and Scotland, and almoſt always in clay beds, ſometimes accompanied with bituminous wood, in ſtratiform mountains.

This variety was formerly called *ætites* or *eagle-ſtone*, as it was ſuppoſed that the eagle carried it to its neſt.

Subſpecies 6. Pisiform Iron Stone.

Id. Kirw. ii. 178. *Id.* Broch. ii. 280.

Exter. Char.—In ſpherical or flattened particles, which are generally ſmall; ſurface rough, dull; internal luſtre glimmering or weakly ſhining; fracture ſmooth.

Colour between brown and red; ſtreak yellowiſh-brown; ſemihard; brittle. Spec. grav. 5.2.

Conſtituent Parts.	Vauquelin.
Iron,	30
Oxygen,	18
Alumina,	31
Silica,	15
Water,	6
	100

Localities, &c.—This variety is found in conſiderable beds in ſtratiform mountains. It is abundant in France, Switzerland, and ſome parts of Germany.

11. Species. Bog Iron Ore.

This is divided into three ſubſpecies: 1. moraſſy; 2. ſwampy; and 3. meadow.

Subſpecies 1. Morassy Bog Iron Ore.

Id. Kirw. ii. 183. *Id.* Broch. ii. 283.

Exter. Char.—Sometimes earthy, ſometimes in amorphous, tuberculated, or corroded maſſes; fracture earthy.

Colour yellowiſh-brown; ſtains; ſoft; friable; feels meagre.

Subſpecies 2. Swampy Iron Ore.

Id. Kirw. ii. 183.

Exter. Char.—In amorphous maſſes, which are tuberoſe or corroded; dull or ſlightly glimmering; fracture earthy; fragments blunt-edged.

Colour dark yellowiſh-brown, blackiſh-brown, or ſteel-gray; ſtreak light yellowiſh-brown; very ſoft; brittle; heavier than the former.

Subſpecies 3. Meadow Iron Ore.

Id. Kirw. ii. 182. *Id.* Broch. ii. 284.

Exter. Char.—In kidney-form, tuberoſe, often corroded maſſes; externally dull or rough; internal luſtre ſhining, reſinous; fracture conchoidal, or earthy when it is dull; fragments rather blunt-edged.

Colour dark blackiſh-brown, or yellowiſh-brown; ſtreak yellowiſh-brown; ſoft and brittle.

Conſtituent Parts.—Bog iron ore is an oxide of iron, combined with the phoſphate of iron, with ſome earthy matters, as alumina and ſilica.

 Localities,

Metallic Ores.

Localities, &c.—Bog iron ore is more abundant in the northern than in the southern parts of Europe. It is not uncommon in Poland, Prussia, Sweden, and in the Western islands of Scotland, as Jura and Islay. It is sometimes found in extensive beds, alternating with sandstone and clay.

12. Species. BLUE EARTHY ORE.

Id. Broch. ii. 288. *Blue Martial Earth*, Kirw. ii. 185. *Native Prussiate of Iron*, of others.

Exter. Char.—Usually found slightly cohering, or loose, or friable; particles dull; stains, and feels meagre.

Colour grayish-white, indigo blue, rarely smalt-blue.

Chem. Char.—Becomes reddish-brown before the blow-pipe; melts into a black globule; easily soluble in acids.

Constituent Parts.—It was suspected by Bergman, that this was a native Prussian blue; but according to Klaproth, it is composed of iron and phosphoric acid, with a mixture of alumina.

Localities, &c.—Found in small nests in beds of clay, or bog iron ore, as in Saxony, Russia, and Siberia.

13. Species. GREEN EARTHY IRON ORE.

Green Martial Earth, Kirw. ii. 188.

Exter. Char.—Found friable and superficial, rarely massive; internally dull; fracture earthy.

Colour yellowish or olive-green, stains; soft; feels meagre.

Chem. Char.—Becomes red before the blow-pipe, and then dark-brown, but without fusion.

Constituent Parts.—It is conjectured to be a compound similar to the former, but in different proportions.

Localities, &c.—Found in Saxony, in veins, and accompanied with quartz and pyrites.

14. Species. PHOSPHATE OF IRON.

Id. Jour. de Physique, lviii. 259. Ann. de Chim. l. 200.

Exter. Char.—Found in rounded pieces, composed of capillary crystals, which seem to be four-sided prisms; fracture radiated and divergent.

Colour blue, from a blue powder coating the crystals, which are otherwise colourless; semitransparent. Spec. grav. 2.5 to 2.6.

Constituent Parts.

	Cadet.	Laugier.
Oxide of iron.	42.1	41 25
Phosphoric acid,	26.9	19.25
Silica,	3.	1.25
Alumina,	5.8	5.
Lime,	9.1	–
Water,	13.1	31.25
Loss,	–	2.
	100.0	100.00

Localities, &c.—This mineral is found imbedded in clay in the isle of France, and in Brazil.

15. Species. PITCHY IRON ORE, or *Phosphate of Iron and Manganese.*

Id. Broch. ii. 533. Jour. de Mines, N° 64. p. 295.

Classification.

Exter. Char.—Massive; surface earthy and dull; internal lustre weakly shining, resinous; fracture compact or foliated.

Colour dark reddish-brown, or black; opaque; semihard; brittle; streak dark red. Spec. grav. 3.956.

Chem. Char.—Melts before the blow-pipe into a black enamel.

Constituent Parts. Vauquelin.

Oxide of iron,	31
Oxide of manganese,	42
Phosphoric acid,	27
	100

Localities, &c.—Found near Limoges.

16. Species. CUBE ORE, or *Arseniate of Iron.*

Id. Phil. Transf. 1801. p. 190.

Exter. Char.—Found crystallized in small cubes, grouped together in a drusy form; crystals sometimes truncated on their angles; surface smooth; shining; lustre between resinous and adamantine; fracture conchoidal.

Colour olive-green, yellow, or brown; translucent; semihard; powder yellow. Spec. grav. 3.

Chem. Char.—Before the blow-pipe froths up with the smell of arsenic, and melts into a yellowish-gray metallic globule.

Constituent Parts.

	Vauquelin.	Chenevix.
Oxide of iron,	48	45.5
Oxide of copper,	–	9.
Arsenic acid,	18	31.
Silica,	–	4.
Lime,	2	–
Water,	32	10.5
	100	100.0

Localities, &c.—Found in the copper mines in Cornwall.

17. Species. ARSENIATE OF IRON AND COPPER.

Id. Phil. Transf. 1801. p. 219.

Exter. Char.—Crystallized in four-sided rhomboidal prisms, with two edges very obtuse, and two very acute, terminated by an acute four-sided pyramid; edges of the prism are sometimes truncated.

Colour bluish-white; crystals semitransparent; semihard. Spec. grav. 3.4.

Constituent Parts.

Oxide of iron,	27.5
Oxide of copper,	22.5
Arsenic acid,	33.5
Silica,	3.
Water,	12.
Loss,	1.5
	100.0

Localities,

Localities, &c.—Found in Cornwall, in Siberia, and Spain.

13. Species. Chromate of Iron.

Id. Broch. ii. 534. *Id.* Hauy, iv. 129.

Exter. Char.—Maffive; glimmering or weakly fhining; fracture compact and uneven, or imperfectly foliated.

Colour grayifh or blackifh brown; opaque; ftreak afh-gray; fmell earthy when breathed on; hard. Spec. grav. 4.032.

Chem. Char.—Infufible before the blow-pipe; melts with borax, and colours it of a beautiful green.

Conftituent Parts.

Oxide of iron,	35
Chromic acid,	43
Alumina,	20
Silica,	2
	100

Localities, &c.—Difcovered by Pontier in France, in the department of Var, and found in confiderable abundance in veins and nodules, in beds of ferpentine; found alfo in Siberia.

VII. LEAD Genus.

1. Species. Galena.

This is divided into two fubfpecies; common and compact galena.

Subfpecies 1. Common Galena.

Id. Kirw. ii. 216. *Id.* Broch. ii. 294. *Plomb Sulfuré*, Hauy, iii. 456.

Exter. Char.—Maffive, diffeminated, fuperficial, in imitative forms, or cryftallized in cubes, octahedrons, fix-fided prifms, and fix-fided tables; all which are varioufly modified by truncations and bevelments on the edges and angles. Cryftals grouped or imbedded; furface fmooth, or drufy; luftre from glimmering to refplendent; internal the fame; fracture foliated; fragments cubic, excepting the fine-grained galena.

Colour lead-gray, fometimes tarnifhed, or iridefcent; foft; eafily frangible; ftains a little. Spec. grav. 7.22 to 7.58.

Chem. Char.—Decrepitates before the blow-pipe, and fufes, giving out a fulphureous odour.

Conftituent Parts.—Compofed of fulphur and lead in variable proportions, and generally a little filver, fometimes antimony. The proportion of lead is from 50 to 80 per cent.

Localities, &c.—This is the moft common ore of lead, and exifts in all kinds of rocks, either in beds or veins. In many countries this lead ore is dug out to a great extent, as in Germany, France, and Britain.

Subfpecies 2. Compact Galena.

Id. Kirw. ii. 218. *Id.* Broch. ii. 301.

Exter. Char.—Maffive, diffeminated, kidney-form, or fpecular; luftre of the fpecular variety refplendent; the others only glimmering; internal luftre glimmering; fracture even or conchoidal; fragments rather fharp-edged.

Colour lead or fteel-gray; ftreak fhining; ftains; foft. Spec. grav. 7.44.

Localities, &c.—This is a rare mineral. It is found along with common galena, in Saxony, and other parts of Germany; in Derbyfhire, where it is known by the name of *flickenfide*, and in the county of Durham, where it is known by the name of *looking-glafs ore.*

2. Species. Blue Lead Ore.

Id. Kirw. ii. 220. *Id.* Broch. ii. 203.

Exter. Char.—Rarely maffive, moft commonly cryftallized in regular fix-fided prifms, which are often a little curved, and fometimes fafcicularly grouped; furface rough; longitudinally ftreaked; luftre glimmering; fracture even.

Colour between lead-gray and indigo blue; opaque; ftreak fhining; foft; eafily frangible. Specific gravity 5.46.

Chem. Char.—Melts eafily before the blow-pipe; burns with a bluifh flame, and a fulphureous odour, leaving a globule of lead.

Its conftituent parts have not been exactly afcertained. Suppofed to be a green lead ore, which has undergone fome change, but retaining its original form.

Localities, &c.—This ore has only been found in Saxony, and alfo, it is faid, in France and Hungary.

3. Species. Brown Lead Ore.

Id. Kirw. ii. 222. *Id.* Broch. ii. 305.

Exter. Char.—Rarely maffive, commonly cryftallized in equal fix-fided prifms, or the cryftals are acicular or capillary; luftre glimmering; internal fhining; fracture uneven.

Colour reddifh or clove-brown; tranflucent at the edges; ftreak white; foft; brittle. Spec. grav. 6.6 to 6.97.

Chem. Char.—No effervefcence with acids; fufes readily before the blow-pipe, but is not reduced; cryftallizes in fmall needles on cooling.

Conftituent Parts.	Klaproth.
Oxide of lead,	78.58
Phofphoric acid,	19.73
Muriatic acid,	1.65
Lofs,	.04
	100.00

Localities, &c.—Found along with white lead ore, quartz, and heavy fpar, in France and Germany.

4. Species. Black Lead Ore.

Id. Kirw. ii. 221. *Id.* Broch. ii. 307.

Exter. Char.—Maffive, diffeminated, cellular, but moft frequently cryftallized in fix-fided prifms, with equal or unequal fides, or bevelled at the extremity. Cryftals fmall, irregularly grouped; fmooth, and fometimes longitudinally ftreaked; luftre fhining; fracture uneven.

Colour

Metallic Ores.

Colour grayish black; opaque; streak grayish black; soft; brittle. Spec. grav. 5.7.

Chem. Char.—Decrepitates before the blow-pipe; and is then reduced to the metallic state.

Constituent Parts.	Lampadius.
Oxide of lead,	78.5
Carbonic acid,	18.
Carbone,	1.5
Water,	2.
	100.0

Localities, &c.—Found in Saxony, England, and Scotland, frequently accompanying white lead ore.

5. Species. WHITE LEAD ORE, or *Carbonate of Lead.*

Id. Kirw. ii. 203. *Id.* Broch. ii. 309. *Plomb Carbonaté*, Haüy, iii. 475.

Exter. Char.—Rarely massive, commonly disseminated, superficial, or crystallized in six-sided prisms; in four-sided prisms; in double crystals, composed of two four-sided prisms; in oblique four-sided prisms, and in double six-sided pyramids. These are variously modified by truncations and acuminations on the edges and angles. They are also of various sizes, and variously grouped together: surface usually smooth, resplendent, sometimes rough or streaked; lustre shining, adamantine; fragments conchoidal, splintery, or fibrous.

Colour white, yellowish, or grayish white; transparent or translucent; refraction double. Specific gravity 6.48 to 7.23.

Chem. Char.—Decrepitates before the blow-pipe, becomes yellowish or reddish, and melts into a metallic globule; effervesces strongly with acids.

Constituent Parts.

	Klaproth.	Macquart.
Oxide of lead	82	73
Carbonic acid	16	24
Water	2	3
	100	100

Some carbonates of lead are also combined with a small portion of iron and earthy matters.

Localities, &c.—Found in veins, accompanied by galena and other lead ores, in Germany, France, and Britain.

6. Species. GREEN LEAD ORE, or *Phosphate of Lead.*

Plomb Phosphaté, Hauy, iii. 490. *Id.* Broch. ii. 314. *Phosphorated Lead Ore*, Kirw. ii. 207.

Exter. Char.—Massive or disseminated, botryoidal or reniform, and often crystallized in six-sided prisms, truncated on all the edges, or on the terminal edges, or terminated by a six-sided pyramid; in six-sided prisms with the lateral faces converging towards one of the extremities; and in six-sided pyramids; but this last is rare. Surface smooth, shining; internal lustre weakly shining and resinous; fracture uneven.

Colour olive green, emerald green, yellow or brown; grayish, greenish, or yellowish white; translucent, or only at the edges; streak greenish white; brittle. Spec. grav. 6.909 to 6.941.

Chem. Char.—Melts easily before the blow-pipe, into a grayish polyhedral globule, but without being reduced; soluble in acids, without effervescence, but sometimes with difficulty.

Constituent Parts.		Klaproth.
Oxide of lead	77.10	80.
Phosphoric acid	19.	18.
Muriatic acid	1.54	1.62
Oxide of iron	.10	-
Loss	2.26	.38
	100.00	100.00

Localities, &c.—Found in veins along with other lead ores, and generally near the top of the vein, in Germany, France, and Leadhills in Scotland.

7. Species. RED LEAD ORE, or *Chromate of Lead.*

Id. Broch. ii. 318. *Red Lead Spar*, Kirw. ii. 214.

Exter. Char.—Rarely massive, sometimes disseminated or superficial, but most frequently crystallized in oblique four-sided prisms with the extremity bevelled, or the lateral edges truncated; and in six-sided prisms, with two broad and two narrow faces; lateral faces longitudinally streaked; external surface smooth, shining; fracture even.

Colour aurora red, or hyacinth red; translucent or semitransparent; streak orange yellow; soft; brittle. Spec. grav. 5.75 to 6.02.

Chem. Char.—No effervescence with acids; decrepitates a little before the blow-pipe, and melts into a black slag.

Constituent Parts.	Vauquelin.
Oxide of lead	64
Chromic acid	36
	100

Localities, &c.—Found in veins at Beresof in Siberia, accompanied by other ores of lead, some ores of iron, and native gold.

A similar ore of lead, but of a brown colour, was brought from Mexico by Humboldt.

8. Species. YELLOW LEAD ORE, or *Molybdate of Lead.*

Id. Broch. ii. 322. *Yellow Lead Spar*, Kirw. ii. 212. Haüy, iii. 498.

Exter. Char.—Rarely massive, usually crystallized in rectangular four-sided tables; in perfect cubes, with plane or convex faces, or truncated on the terminal edges; in four-sided tables bevelled on the terminal faces; in obtuse octahedrons, truncated on the summit, the lateral angles, or lateral edges. Crystals small; surface smooth and shining; internally shining; lustre waxy; fracture conchoidal.

Colour wax yellow, or honey yellow; translucent, or only at the edges; soft; brittle. Spec. grav. 5.48 to 5.7.

Classification.

Chem.

Classification. Metallic Ores.

Chem. Char.—Before the blow-pipe it decrepitates ſtrongly, and then melts into a blackiſh-gray globule, in which are ſeen particles of lead. Soluble in nitric acid, and in fixed alkalies.

Conſtituent Parts.

	Macquart.	Hatchett.
Oxide of lead	63.5	58.4
Molybdic acid	28.	38.
Oxide of iron	—	2.1
Silica	4.	.28
Carbonate of lime	4.5	—
Loſs	—	1.22
	100.0	100.00

Localities, &c.—This ore of lead was firſt diſcovered at Bleyberg in Carinthia; it has been ſince found in Saxony and France.

9. Species. Native Sulphate of Lead.

Id. Kirw. ii. 211. Broch. ii. 325. Hauy, iii. 503.

Exter. Char.—Cryſtallized in irregular octahedrons, which are variouſly truncated and bevelled. Cryſtals ſmooth and ſhining; luſtre ſhining and vitreous; fracture compact.

Colour ſnow white, grayiſh or yellowiſh white; tranſlucent; ſemihard. Spec. grav. 6.3.

Chem. Char.—Reduced even in the flame of a candle; inſoluble in nitric acid.

Conſtituent Parts.	Klaproth.
Oxide of lead	70.5
Sulphuric acid	25.75
Water	2.25
Loſs	1.5
	100.00

Localities, &c.—Found on brown iron ore in the iſland of Angleſea, and on galena in the veins at Leadhills and Wanlockhead in Scotland.

10. Species. Earthy Lead Ore.

Id. Broch. ii. 327. *Id.* Kirwan, ii. 105.

This is divided into two ſubſpecies: 1. friable; and, 2. indurated.

Subſpecies 1. Friable Lead Ore.

Exter. Char.—This is compoſed of fine earthy particles, which are dull, and have little coherence.

Colour ſulphur or ochre yellow, yellowiſh or ſmoke gray; ſtains; feels meagre.

Subſpecies 2. Indurated Lead Ore.

Exter. Char.—Maſſive or diſſeminated; dull; fracture uneven or earthy.

Colour of the former; opaque; ſtreak lighter colour; very ſoft and friable.

Chem. Char.—Eaſily reduced before the blow-pipe, into a black ſlag; effervefces a little with acids.

Conſtituent Parts.—Earthy lead ore is ſuppoſed to be a mixture of oxide of lead, with a little oxide of iron, and ſome earthy matters.

Localities, &c.—Found on the ſurface, or in the cavities of other lead ores, in Saxony, France, Siberia, and at Leadhills and Wanlockhead in Scotland.

11. Species. Muriate of Lead.

Exter. Char.—Maſſive, or cryſtallized in cubes, or flat ſix-ſided priſms; external ſurface ſhining; internal luſtre reſplendent, adamantine; fracture foliated.

Colour between aſparagus green and wine yellow; ſemitranſparent; ſoft; not brittle; ſtreak dull, white.

Conſtituent Parts.	Klaproth.
Oxide of lead	55
Muriatic acid	45
	100

Localities, &c.—Found in Derbyſhire, and alſo, it is ſaid, in the mountains of Bavaria, but not cryſtallized.

12. Species. Murio-Carbonate of Lead.

Id. Bournon and Chenevix, Nich. Jour. 4to. p. 219.

Exter. Char.—Cryſtallized in cubes, which are variouſly modified; luſtre ſhining, adamantine; fracture foliated; croſs fracture conchoidal.

Colour ſtraw yellow, or clear white; ſemitranſparent; ſtreak dull, ſnow white; eaſily ſcratched by carbonate of lead. Spec. grav. 6.065.

Conſtituent Parts. Chenevix.			
Oxide of lead	51	Muriate of lead	59
Muriatic acid	8		
Oxide of lead	34	Carbonate of lead	40
Carbonic acid	6		
Loſs	1		1
	100		100

Localities, &c.—Found in Derbyſhire.

13. Species. Arseniate of Lead.

Id. Broch. ii. 546.

Exter. Char.—Diſſeminated, ſometimes in an earthy ſtate, ſometimes in ſilky filaments, and cryſtallized in ſmall, double, ſix-ſided pyramids. Dull, or weakly glimmering; luſtre ſilky.

Colour citron or greeniſh yellow; very ſoft; friable.

Chem. Char.—Before the blow-pipe it melts eaſily into a globule of lead, and gives out the ſmell of garlic.

Conſt. Parts.—Compoſed of oxide of lead and of arſenic, with ſome oxide of iron and earthy matters.

VIII. TIN Genus.

1. Species. Tin Pyrites.

Id. Kirw. ii. 200. *Id.* Broch. ii. 332.

Exter. Char.—Found maſſive or diſſeminated; luſtre ſhining

Metallic Ores.

shining or weakly shining; fracture uneven; fragments rather blunt-edged.

Colour steel gray, sometimes brass or bronze yellow; semihard; brittle. Spec. grav. 4.3 to 4.7.

Chem. Char.—Before the blow-pipe it melts easily into a black slag, but without being reduced, and gives out a sulphureous smell.

Constituent Parts.	Klaproth.
Tin	34
Copper	36
Iron	3
Sulphur	25
Earthy substances	2
	100

Localities, &c.—This is a rare mineral, found only in Cornwall, in a vein along with copper pyrites.

2. Species. Common Tinstone, or *Oxide of Tin.*

Id. Kirw. ii. 197. *Id.* Broch. ii. 334. Haüy, iv. 137.

Exter. Char.—Massive, disseminated, in rounded pieces or grains, and often crystallized in rectangular four-sided prisms, which are variously modified by truncations and bevelments; in octahedrons, which are rare; in eight-sided prisms, or in double octahedrons, which are so united by one of their summits as to form a re-entering angle. Crystals of various sizes, always grouped together; surface smooth; lustre shining or resplendent; internal lustre shining, between vitreous and resinous; fracture uneven.

Colour brownish black, blackish brown, yellowish gray, or grayish white; opaque, or semitransparent; streak light gray; hard; brittle. Specific gravity 6.3 to 6.9.

Chem. Char.—Before the blow-pipe it decrepitates, loses its colour, and is partially reduced to the metallic state.

Constituent Parts.	Klaproth.
Tin	77.5
Iron	.25
Oxygen	21.5
Silica	.75
	100.00

Localities, &c.—Found in Germany, in the East Indies, and particularly in Cornwall in England. It is not very universally distributed; but where it exists, it is deposited in granite, gneiss, micaceous schistus, and porphyry; and either in masses, veins, or disseminated in the rocks.

3. Species. Grained Tin Ore, or *Wood Tin.*

Id. Broch. ii. 340. *Id.* Kirw. ii. 298.

Exter. Char.—Found only in small pieces, rounded or angular; surface rough; weakly shining; internal lustre glimmering; a little silky; fracture fibrous; fragments wedge-shaped.

Colour hair brown of various shades; streak yellowish gray; hard and brittle. Spec. grav. 5.8 to 6.4.

Classification.

Chem. Char.—Becomes brownish red before the blow-pipe, then decrepitates strongly, but is infusible.

Const. Parts.—According to Klaproth, it is composed of 63 of tin in the 100, with a little iron and arsenic.

Localities, &c.—Found in Cornwall, in alluvial land, where it seems to have been deposited in a stalactitical form, accompanied by common tin.

IX. BISMUTH Genus.

1. Species. Native Bismuth.

Id. Kirw. ii. 264. *Id.* Broch. ii. 343. *Id.* Hauy, iv. 184.

Exter. Char.—Rarely massive, but usually disseminated in a plumose or reticulated form, and rarely crystallized, in small four-sided tables or cubes; lustre shining or resplendent; fracture foliated.

Colour silvery white, inclining to red; colours commonly tarnished; soft; almost ductile. Specific gravity 9.02 to 9.82.

Chem. Char.—Fusible almost in the flame of a candle; by increasing the heat it is volatilized; soluble with effervescence in nitric acid, and precipitated by water in the form of a white powder.

Localities, &c.—Bismuth is a rare metal, found in veins in primitive mountains, accompanied by calcareous spar, heavy spar, and quartz, and commonly with gray cobalt, sometimes also with black blende and native silver. Found in Saxony, Bohemia, France, and Sweden.

2. Species. Vitreous Bismuth Ore.

Sulphurated Bismuth, Kirwan, ii. 266. *Id.* Brochant, ii. 346.

Exter. Char.—Massive or disseminated, rarely crystallized in small imbedded capillary prisms; lustre shining or resplendent; fracture radiated or foliated.

Colour between lead gray and tin white; stains a little; soft; easily frangible. Specific gravity 6.13 to 6.46.

Chem. Char.—Easily fusible before the blow-pipe, with a sulphureous odour.

Const. Parts.—Composed of bismuth about 60 per cent. and sulphur with a little iron.

Localities, &c.—Found in Bohemia, Saxony and Sweden, and is usually accompanied by native bismuth.

3. Species. Ochre of Bismuth.

Id. Kirwan, ii. 265. *Id.* Brochant, ii. 348.

Exter. Char.—Rarely massive, commonly disseminated on the surface of other minerals; internally glimmering; fracture uneven or earthy.

Colour yellowish gray, ash gray, or straw yellow, opaque; soft; sometimes even friable. Spec. grav. 4.37.

Chem. Char.—Very easily reduced before the blow-pipe to the metallic state; effervesces with acids.

Constituent

Classification.

Constituent Parts. Lampadius.

Oxide of bismuth	86.3
——— iron	5.2
Carbonic acid	4.1
Water	3.4
Loss	1.
	100.0

Localities, &c.—This mineral is very rare, and chiefly found near Schneeberg in Saxony, along with native bismuth; and also in Bohemia and Suabia.

X. ZINC Genus.

1. Species. Blende.

Id. Brochant, ii. 350. *Id.* Kirwan, ii. 237. *Zinc Sulfuré*, Hauy, iv. 167.

This species is divided into three subspecies; yellow, brown, and black.

Subspecies 1. Yellow Blende.

Exter. Char.—Massive or disseminated, or sometimes crystallized in cubes or octahedrons, but they are so confused as to prevent the form being easily discovered. Surface smooth, resplendent; internal lustre resplendent, between adamantine and vitreous; fracture foliated; cleavage six-fold; fragments rather sharp-edged, or assume sometimes a dodecahedral form, which is the result of the complete cleavage.

Colour dark sulphur yellow, olive green, or brownish red; translucent, sometimes semitransparent; streak yellowish gray; semi-hard; brittle. Spec. grav. 4.04 to 4.16.

Chem. Char.—Decrepitates before the blow-pipe, and becomes gray, but is infusible.

Constituent Parts. Bergman.

Zinc	64
Sulphur	20
Iron	5
Fluoric acid	4
Water	6
Silica	1
	100

Physical Char.—Most of the varieties of yellow blende become phosphorescent by friction in the dark.

Localities, &c.—Found in Saxony, Bohemia, Hungary and Norway; accompanied by lead, copper, and iron ores. It is rather a rare mineral.

Subspecies 2. Brown Blende.

Exter. Char.—Massive, disseminated, and sometimes crystallized in simple three-sided pyramids, octahedrons, and four-sided prisms, which are variously modified. External lustre shining or resplendent; surface sometimes drusy; internal lustre shining, between vitreous and resinous; fracture foliated; cleavage six-fold.

Colour reddish, or yellowish brown; colour sometimes tarnished; translucent, or opaque; crystals transparent; streak yellowish gray; semi-hard; brittle. Spec. grav. 4.

Metallic Ores.

Constituent Parts. Bergman.

Zinc	44
Sulphur	17
Iron	5
Silica	24
Alumina	5
Water	5
	100

Localities, &c.—Very common in veins of lead ore, in most parts of the world.

Subspecies 3. Black Blende.

Exter. Char.—Massive, or disseminated, or crystallized like the former, which it resembles in most of its characters.

Colour perfect black, brownish black, or blood red; often iridescent.

Constituent Parts. Bergman.

Zinc	45
Sulphur	29
Iron	9
Lead	6
Silica	4
Water	6
Arsenic	1
	100

Localities, &c.—Found in the same places with the former.

2. Species. Calamine.

This is divided into two subspecies, compact and foliated.

Subspecies 1. Compact Calamine.

Id. Kirwan, ii. 234. *Id.* Brochant, ii. 361.

Exter. Char.—Massive or disseminated, cellular, or stalactitical; dull; fracture compact or earthy.

Colour grayish white, yellowish, or reddish, or milk white; opaque; semi-hard or friable; brittle; stains sometimes. Spec. grav. 3.52, to 4.1.

Chem. Char.—Decrepitates before the blow-pipe when suddenly heated; is infusible. Forms a jelly with acids, and sometimes effervesces.

Constituent Parts.

	Bergman.	Tennant.
Oxide of zinc	84	68.3
Silica	12	25.
Iron	3	–
Alumina	1	–
Water	–	4.4
Loss	–	2.3
	100	100.0

Oxide

Metallic Ores.

	Tennant.	
Oxide of zinc	64.8	65.2
Carbonic acid	35.2	34.8
	100.0	100.0

Another variety examined by the ſame chemiſt contained,

Oxide of zinc	71.4
Carbonic acid	13.5
Water	15.1
	100.0

From theſe analyſes it appears, that calamines are very different in their compoſition, conſiſting ſometimes of oxide of zinc, ſilica, and water, and this variety forms a jelly with acids; others are compoſed of carbonic acid and oxide of zinc, which effervelce in ſulphuric acid, but do not form a jelly; a third variety is compoſed of oxide of zinc, carbonic acid, and water, conſtituting a hydro-carbonate of zinc, which is ſoluble with effervefcence in ſulphuric acid.

Localities, &c.—Uſually accompanied with iron ochre, and very often with galena, white lead, and other metallic ores. Found in Bohemia, Bavaria, France, and Britain, in ſome places in conſiderable abundance.

Subſpecies 2. Foliated Calamine.

Id. Brochant, ii. 364. Kirwan, ii. 236. Hauy, iv. 161.

Exter. Char.—Found maſſive or diſſeminated, ſtalactitical, incruſted, or cryſtallized, in ſmall four-ſided tables, or in very ſmall cubes with plane or convex faces, ſhining, or glimmering; luſtre between pearly and vitreous; fracture radiated.

Colour yellowiſh, or ſmoke gray; grayiſh, or yellowiſh white; tranſlucent or ſemitranſparent; ſemihard; brittle. Specific gravity 3.52.

Chem. Char.—Becomes white before the blow-pipe, but is infuſible, and does not effervefce with acids.

Phyſ. Char.—Becomes electric by heat.

Localities, &c.—This variety accompanies the former, lining its cavities, but is leſs common. It is found in the ſame places.

XI. ANTIMONY Genus.

1. Species. Native Antimony.

Id. Brochant, ii. 369. *Id.* Kirwan, ii. 245. *Id.* Hauy, iv. 252.

Exter. Char.—Found maſſive, diſſeminated, or reniform; reſplendent; fracture foliated.

Colour tin white; but expoſed to the air, grayiſh or yellowiſh; ſoft; eaſily frangible. Spec. grav. 6.7.

Chem. Char.—Before the blow-pipe it is very eaſily fuſible into a metallic globule, which gives out fumes with the odour of garlic.

Conſt. Parts.—Native antimony ſometimes contains a ſmall proportion of arſenic.

Localities, &c.—Has only been found in two places: at Sahlberg in Sweden, where it was diſcovered in 1748, in limeſtone; and at Allemont in France, where it is accompanied by other ores of antimony and cobalt.

Claſſification.

2. Species. Gray Ore of Antimony.

Id. Brochant, ii. 371. Kirwan, ii. 246. Hauy, iv. 64.

This is divided into four ſubſpecies; compact, foliated, radiated, and plumoſe.

Subſpecies 1. Compact Gray Ore of Antimony.

Exter. Char.—Maſſive or diſſeminated; ſhining; fracture uneven.

Colour lead gray, or ſteel gray; ſoft; not very brittle; ſtains a little; ſtreak ſhining. Spec. grav. 4.36.

Localities, &c.—This variety is rarer than the others, but is met with in Saxony, Hungary, and France.

Subſpecies 2. Foliated Ore of Antimony.

Exter. Char.—Maſſive or diſſeminated; fracture foliated. In other characters it reſembles the other varieties, and is uſually accompanied by the following.

Subſpecies 3. Radiated Ore of Antimony.

Exter. Char.—Maſſive, diſſeminated, and very often cryſtallized in acicular, often in capillary cryſtals, and in ſix and four-ſided priſms variouſly modified; ſurface ſtreaked longitudinally; internal luſtre reſplendent; fracture radiated, ſtraight, parallel, or divergent.

Colour ſimilar to the preceding; ſoft; not very brittle. Spec. grav. 4.1 to 4.5.

Conſtituent Parts.	Bergman.
Antimony	74
Sulphur	26
	100

Localities, &c.—This is the moſt common ore of antimony, and is found in Germany, France, and Sweden. There is only one mine of antimony in Britain, which is in the ſouth of Scotland, near Weſterhall, in the neighbourhood of Langholm.

Subſpecies 4. Plumose Ore of Antimony.

Exter. Char.—Uſually found in capillary cryſtals, ſo interwoven, that they form a ſuperficial covering to other minerals: theſe groups are externally weakly ſhining; internal luſtre glimmering; fracture fibrous.

Colour ſimilar to the former, and ſometimes tarniſhed brown or like tempered ſteel; opaque; ſoft; ſometimes almoſt friable; brittle.

Conſt. Parts.—Plumoſe antimony is compoſed of ſulphuret of antimony combined with arſenic, iron, and accidentally a little ſilver.

Chem. Char.—Before the blow-pipe this and the other varieties of gray antimony give out white fumes, with a ſulphureous ſmell, and are almoſt entirely volatilized, or changed into a black ſlag.

Localities, &c.—Plumoſe antimony is found at Freyberg in Saxony, in the Hartz, and in Hungary.

3. Species.

Classification.

3. Species. Black Ore of Antimony.

Exter. Char.—Found cryſtallized in rectangular four-ſided tables, truncated on the edges or angles; cryſtals ſmooth; luſtre ſhining; fracture conchoidal.

Colour iron black; ſoft.

Localities, &c.—This ſpecies, which is alſo a ſulphuret of antimony, combined probably with ſome other ingredients, is found in Cornwall.

4. Species. Red Ore of Antimony.

Id. Kirwan, ii. 250. *Id.* Brochant, ii. 379. *Antimoine Hydroſulfuré*, iv. 276.

Exter. Char.—Maſſive or diſſeminated, but moſt commonly in capillary cryſtals; luſtre weakly ſhining, vitreous; fracture fibrous.

Colour cherry red, brown, reddiſh, or bluiſh; ſoft, almoſt friable; brittle. Specific gravity 3.7 to 4.

Chem. Char.—Before the blow-pipe it melts eaſily, and in nitric acid a white powder is depoſited.

Conſtituent Parts.	Klaproth.
Oxide of antimony	78.3
Sulphur	19.7
Loſs	2.
	100.0

Localities, &c.—Found in Saxony and France, uſually accompanying gray or native antimony.

5. Species. White Ore of Antimony.

Muriated Antimony, Kirwan, ii. 151. *Antimoine Oxidé*, Hauy, iv. 273.

Exter. Char.—Rarely maſſive, uſually ſuperficial, in divergent fibres, or cryſtallized in rectangular four-ſided tables, cubes, or four-ſided priſms. Cryſtals aggregated; ſmooth; ſtreaked longitudinally; reſplendent; internal luſtre ſhining, between adamantine and pearly; fracture foliated.

Colour ſnow white, yellowiſh white, or grayiſh; tranſlucent; ſoft; brittle.

Chem. Char.—Cryſtals decrepitate before the blow-pipe, but in powder is eaſily fuſible.

Conſt. Parts.—Was formerly ſuppoſed to be a muriate of antimony, but according to Klaproth, it is a pure oxide. The white ore of France, according to Vauquelin, contains,

Oxide of antimony	86
——— lead	3
Silica	8
Loſs	3
	100

6. Species. Ochre of Antimony.

Id. Brochant, ii. 383. *Id.* Kirwan, ii. 252.

Exter. Char.—Maſſive, diſſeminated, or in ſuperficial cruſts, on gray antimony; dull; fracture earthy.

Colour ſtraw yellow, or yellowiſh gray; ſoft; friable.

Chem. Char.—Infuſible before the blow-pipe; becomes white, and emits white fumes. Its conſtituents are unknown.

Localities, &c.—In Saxony and Hungary, accompanying gray and red antimony, and in the antimony mine near Weſterhall, in the ſouth of Scotland.

Metallic Ores.

XII. Cobalt Genus.

1. Species. White Cobalt Ore.

Id. Kirw. ii. 382. *Id.* Broch. ii. 386.

Exter. Char.—Maſſive, diſſeminated, reniform, and rarely cryſtallized in ſmall four-ſided tables, or in ſmall cubes or octahedrons. Luſtre weakly ſhining, or ſhining; fracture uneven.

Colour tin white, but on the ſurface variable, and tarniſhed; ſtreak ſhining; hard; brittle.

Chem. Char.—Eaſily fuſible before the blow-pipe, emitting a denſe vapour, with a ſmell of arſenic, and leaves a white metallic globule; colours borax blue.

Localities, &c.—Found in Norway, Sweden, and Saxony, in beds of micaceous ſchiſtus, along with red cobalt ore, quartz, and hornblende. Its compoſition is not known, but ſuppoſed to be alloyed with ſome other metals.

2. Species. Gray Cobalt Ore.

Id. Kirw. ii. 271. *Id.* Broch. ii. 388.

Exter. Char.—Maſſive, diſſeminated, reniform, and and botryoidal; luſtre ſhining; fracture even.

Colour light ſteel gray, or tin white; ſurface ſteel tarniſhed; ſtreak ſhining; ſemi-hard; brittle.

Chem. Char.—Infuſible before the blow-pipe; emitting fumes and the ſmell of arſenic.

Conſtituent Parts.	Klaproth.
Cobalt	20
Arſenic	33
Iron	24
Loſs	23
	100

It contains alſo ſometimes nickel and ſilver.

Localities, &c.—Found in Saxony, France, Norway, and Cornwall in England, with other ores of cobalt.

3. Species. Shining Cobalt Ore.

Id. Broch. ii. 390. Kirw. ii. 273.

Exter. Char.—Maſſive, diſſeminated, ſuperficial, in various imitative forms, and cryſtallized in cubes and octahedrons, which are variouſly modified; cryſtals ſmall, ſmooth, and reſplendent, rarely druſy; luſtre ſhining; fracture uneven, radiated, or fibrous.

Colour tin white, commonly grayiſh, or yellowiſh tarniſhed; hard; brittle. Spec. grav. 6.3 to 6.4

Chem. Char.—Before the blow-pipe it burns with a ſmall white flame, and a white vapour, ſmelling ſtrongly of garlic; then blackens, and is almoſt infuſible; ſoluble in nitric acid.

Conſtituent Parts of cryſtallized ſhining cobalt from Tunaberg in Sweden.

	Klaproth.	Taſſaert.
Cobalt	44.	36.66
Arſenic	55.5	49.
Sulphur	5	6.5
Iron		5.66
Loſs		2.18
	100.0	100.00

Localities,

Metallic Ores.

Localities, &c.—This is the moſt common ore of cobalt; and it is uſually accompanied by the other ores, and ſometimes alſo by vitreous, red, and native ſilver. It is found in Bohemia, Saxony, Sweden, and Cornwall in England, and uſually in beds in primitive mountains.

Uſes.—This ore of cobalt is commonly wrought for the purpoſe of employing it in the preparation of the fine blue colour known by the name of *ſmalt*, which is uſed in the manufacture of porcelain, glaſs, and as a pigment.

4. Species. Black Cobalt Ochre.

Id. Broch. ii. 396. Kirw. ii. 275. Hauy, iv. 214.

This is divided into two ſubſpecies, friable and indurated.

Subſpecies 1. Friable Cobalt Ochre.

Exter. Char.—Compoſed of particles which are more or leſs cohering; ſtains a little.

Colour browniſh, bluiſh, or grayiſh black; ſtreak ſhining; feels meagre. In other characters it agrees with the following.

Subſpecies 2. Indurated Cobalt Ochre.

Exter. Char.—Maſſive, diſſeminated, in imitative forms, or marked with impreſſions; dull, or weakly glimmering; fracture earthy.

Colour bluiſh black; ſtreak ſhining, reſinous; ſoft; ſemi-hard; rather brittle. Spec. grav. 2.01 to 2.42.

Chem. Char.—Before the blow-pipe it gives out an arſenical odour, but is infuſible.

Its conſtituent parts are ſuppoſed to be oxide of cobalt, with ſome iron and arſenic.

Localities, &c.—Both varieties are found together, and accompanied by ores of ſilver, copper, iron, in Saxony, Suabia, and the Tyrol, as well as in France and Spain.

5. Species. Brown Cobalt Ochre.

Id. Broch. ii. 400.

Exter. Char.—Maſſive, or diſſeminated; always dull; fracture earthy; ſtreak ſhining, reſinous.

Colour light or dark liver brown; ſoft, almoſt friable; very eaſily frangible.

Conſtituent Parts.—Suppoſed be compoſed of oxide of cobalt and iron.

Localities, &c.—Found at Saalfeld in Thuringia, in ſtratiform mountains, and in Wirtemberg, in primitive mountains, accompanied by other varieties of cobalt ochre.

6. Species. Yellow Cobalt Ochre.

Id. Kirw. ii. 277. Broch. ii. 401.

Exter. Char.—Maſſive, or diſſeminated, or adhering to the ſurfaces of other minerals; dull; fracture earthy; ſtreak ſhining, reſinous.

Colour dirty ſtraw yellow, or yellowiſh gray; very ſoft or friable.

Chem. Char.—Before the blow-pipe it gives out an odour of arſenic, and is infuſible.

Claſſification.

Its conſtituents are ſuppoſed to be oxide of cobalt, and a little arſenic.

Localities, &c.—Found in the ſame places with the former, but is rare.

7. Species. Red Cobalt Ochre, or *Arſeniate of Cobalt.*

Id. Kirw. ii. 278. Broch. ii. *Cobalt Arſeniaté*, Haüy, iv. 216.

This is divided into two ſubſpecies; earthy and radiated.

Subſpecies 1. Earthy Red Cobalt Ochre.

Exter. Char.—In thin ſuperficial layers, or cruſts; dull, or weakly glimmering; fracture earthy.

Colour peach-bloſſom red, roſe red, or reddiſh white; ſtreak a little ſhining; very ſoft, friable.

Localities, &c.—Found in Bohemia, Saxony, France, and Norway.

Subſpecies 2. Radiated Red Cobalt Ochre, or *Cobalt Bloom*, or *Flowers of Cobalt.*

Exter. Char.—Maſſive, or diſſeminated, rarely botryoidal or reniform; often ſuperficial, and in ſmall druſy cryſtals, whoſe forms are rectangular four-ſided tables, four-ſided priſms, double ſix-ſided pyramids, with different modifications. Cryſtals ſmall and variouſly aggregated; ſmooth and ſhining, ſometimes reſplendent; fracture radiated; fragments wedge-ſhaped, or ſplintery.

Colour peach bloſſom red, crimſon red, or, expoſed to the air, browniſh, grayiſh, or whitiſh; tranſlucent; cryſtals ſemitranſparent; ſoft; brittle.

Chem. Char.—Before the blow-pipe becomes blackiſh gray, giving out a feeble odour of arſenic, without any fumes, but is infuſible. Colours borax a fine blue.

This ſpecies has not been particularly analyzed, but is conſidered as a compound of cobalt and arſenic acid.

Localities, &c.—The ſame as the former, and alſo in Cornwall in England, and along with copper ores at Alva in Scotland.

8. Species. Sulphate of Cobalt.

A ſaline ſubſtance in a ſtalactitical form, of a pale roſe red colour and tranſlucent, is found at Herrengrund near Newſohl in Hungary, which was at firſt ſuppoſed to be a ſulphate of manganeſe, and afterwards a ſulphate of cobalt.

This ſubſtance has been examined by Klaproth, who diſſolved it in water, added an alkali, and obtained a bluiſh precipitate, which coloured borax of a beautiful ſapphire blue; and with muriatic acid he obtained from it a ſympathetic ink.

XIII. NICKEL Genus.

1. Species. Copper-coloured Nickel.

Id. Brochant, ii. 408. *Sulphurated Nickel*, Kirw. ii. 286. *Nickel Arſenical*, Haüy, iii. 518. *Kupfernickel* of the Germans.

Exter. Char.—Maſſive or diſſeminated, rarely reticulated;

Classification.

lated; ſhining, or weakly ſhining; fracture uneven, ſometimes conchoidal; fragments rather ſharp-edged.

Colour pale copper red, whitiſh, or grayiſh; ſemi-hard; brittle. Spec. grav. 6.64 to 7.56.

Chem. Char.—Before the blow-pipe it gives out the fumes and odour of arſenic; melts with difficulty into a ſlag, mixed with metallic particles. Solution in acids, green.

Conſtituent Parts.	Sage.
Nickel	75
Arſenic	22
Sulphur	2
Loſs	1
	100

Localities, &c.—Found in veins, in primitive and ſtratiform mountains, almoſt always accompanied with ores of cobalt, and often with rich ſilver ores. It is found in Bohemia, Saxony, France, Spain, and Cornwall in England.

2. Species. NICKEL OCHRE, or *Oxide of Nickel.*

Id. Kirw. ii. 283. Broch. ii. 411. Haüy, iii. 516.

Exter. Char.—Uſually diſſeminated and effloreſcent on other minerals; compoſed of friable, looſe, and ſlightly agglutinated particles.

Colour apple-green of different ſhades; ſtains; feels meagre.

Chem. Char.—Remains unchanged before the blow-pipe; colours borax yellowiſh red, and is inſoluble in nitric acid.

Conſtituent Parts.	Lampadius.
Oxide of nickel	67.
——— iron	23.2
Water	1.5
Loſs	8.3
	100.0

Localities, &c.—Found in ſimilar ſituations with the preceding ſpecies.

XIV. MANGANESE GENUS.

1. Species. GRAY ORE OF MANGANESE, or *Oxide of Manganeſe.*

Id. Brochant, ii. 414. *Id.* Kirwan, ii. 291. *Id.* Hauy, iv. 243.

This ſpecies is divided into four ſubſpecies: 1. radiated; 2. foliated; 3. compact; and, 4. earthy.

Subſpecies 1. RADIATED GRAY ORE OF MANGANESE.

Eſſen. Char.—Colours borax violet.

Exter. Char.—Maſſive or diſſeminated, or cryſtallized in oblique four-ſided priſms, or in acicular priſms faſcicularly grouped together; the cryſtals are variouſly modified. Faces ſtreaked longitudinally; ſhining or reſplendent; fracture radiated; fragments wedge-ſhaped.

Metallic Ores.

Colour ſteel gray, or iron black; ſtreak black, without luſtre; ſtains; ſoft; brittle. Specific gravity 3.7 to 4.7.

Conſtituent Parts. Cordier and Beaunier *.

	From France,	Germany,	Piedmont.
Oxide of manganeſe,	83.5	82.	86.
Brown oxide of iron	2.	–	3.
Carbone	–	–	1.5
Carbonate of lime	–	7.5	–
Barytes	1.5	3.	–
Silica	7.5	7.	5.
Loſs	5.5	.5	4.5
	100.0	100.0	100.0

* *Jour. des Mines*, No. lviii. p. 778.

Of purer ſpecimens by Klaproth.

Oxide of manganeſe	99.25	92.75
Water	.25	7.
Loſs	.5	.25
	100.00	100.00

Subſpecies 2. FOLIATED GRAY ORE OF MANGANESE.

Exter. Char.—Found maſſive, diſſeminated, or cryſtallized in ſmall, rectangular, four-ſided tables, faſcicularly grouped; luſtre ſhining; fracture foliated.

Colour ſimilar to the former; ſtreak black and dull; ſtains; ſoft, and brittle. Spec. grav. 3.74.

Subſpecies 3. COMPACT GRAY ORE OF MANGANESE.

Exter. Char.—Maſſive or diſſeminated, in angular, or botryoidal, or dendritical forms; luſtre glimmering; fracture uneven, ſometimes even or conchoidal.

Colour ſteel gray, or bluiſh black; ſtains; ſemihard, or ſoft; brittle.

Conſt. Parts—approach pretty nearly to thoſe of the radiated variety.

Subſpecies 4. EARTHY GRAY ORE OF MANGANESE.

Exter. Char.—Found maſſive, diſſeminated, ſometimes ſuperficial and dendritical; dull; ſometimes a little glimmering; fracture earthy.

Colour between ſteel gray and bluiſh black; ſtains very much; very ſoft, often even friable; feels meagre.

Conſtituent Parts—ſuppoſed to be the ſame as the former, but with a larger proportion of oxide of iron.

Chem. Char.—Gray ore of manganeſe is infuſible before the blow-pipe, but becomes of a blackiſh brown colour; gives a blue colour to borax.

Localities, &c.—All the varieties of this ſpecies are uſually found together, and chiefly in primitive mountains. The earthy ore of manganeſe almoſt always accompanies ſparry iron ore, and other ores of iron. Manganeſe is found in conſiderable abundance in Saxony, Bohemia, France, near Exeter in England, and in Aberdeenſhire in Scotland.

2. Species. BLACK ORE OF MANGANESE.

Exter. Char.—Found maſſive, diſſeminated, or cryſtallized in ſmall four-ſided double pyramids, arranged in

Metallic Ores.

in rows; furface fhining; internal luftre weakly glimmering; fracture imperfectly foliated.

Colour grayifh black, and brownifh black; ftreak dull, brownifh red; foft; brittle.

Localities, &c.—This fpecies is of rare occurrence. It has been found in Thuringia, forming a cruft on gray ore of manganefe, and alfo, it is faid, in Piedmont.

3. Species. Red Ore of Manganese, or *Carbonate of Manganefe*.

Exter. Char.—Maffive, diffeminated, botryoidal, &c. or cryftallized in flat rhomboids, or in very fmall pyramids or lenfes. Surface of the cryftals fmooth; dull, or weakly glimmering; fracture uneven or fplintery.

Colour rofe red, or brownifh white; tranflucent at the edges; femihard; brittle. Spec. grav. 3.23.

Chem. Char.—Infufible before the blow-pipe; becomes grayifh black, and colours borax violet blue, or crimfon red.

Conftituent Parts.	Lampadius.
Oxide of manganefe	48.
——— iron	2.1
Carbonic acid	49.
Silica	.9
	100.0

Localities, &c.—This fpecies of manganefe, which is rare, is found in Tranfylvania at Offenbanya, and particularly at Nagyag, where it conftitutes part of the maffes of an auriferous vein, from which the gold ore of Nagyag is obtained.

XV. MOLYBDENA Genus.

1. Species. Sulphuret of Molybdena.

Id. Brochant, ii. 432. *Id.* Kirwan, ii. 322. *Id.* Hauy, iv. 289.

Exter. Char.—Maffive or diffeminated, fometimes in plates, and rarely cryftallized in equal fix-fided tables; cryftals fmall, imbedded, the lateral faces fhining; internal luftre fhining; fracture foliated; fragments rather blunt-edged, fometimes in plates.

Colour lead gray; opaque; ftains, and writes; very foft, and eafily frangible; flexible in thin plates, but not elaftic; feels greafy. Spec. grav. 4.56 to 4.73.

Chem. Char.—Infufible before the blow-pipe; gives out a fulphureous fmell; nitric acid converts it to a white oxide, which is the molybdic acid.

Conftituent Parts.

	Pelletier.	Klaproth.
Molybdic acid	45	60
Sulphur	55	40
	100	100

Localities, &c.—Always found in primitive mountains, in nefts or nodules, and very commonly in the neighbourhood of tin ores. It is alfo accompanied by wolfram, quartz, native arfenic, and fluor fpar. It is found in Bohemia, Saxony, Sweden, France, and England.

Claffification.

XVI. ARSENIC Genus.

1. Species. Native Arsenic.

Id. Broch. ii. 435. *Id.* Kirw. ii. 255. *Id.* Haüy, iv. 220.

Exter. Char.—Maffive, diffeminated, in imitative forms, or with impreffions; furface rough or granulated; dull, or weakly glimmering; internal luftre weakly fhining; fracture uneven, fometimes imperfectly foliated; fragments rather blunt-edged in plates.

Colour light lead-gray, tin-white or grayifh black when tarnifhed; ftreak fhining; femihard; very eafily frangible. Spec. grav. 5.72 to 5.76.

Chem. Char.—Melts readily before the blow-pipe, giving out white vapour, with the fmell of garlic; then burns with a bluifh flame, and is diffipated, leaving only a whitifh powder, which is the oxide of arfenic.

Conftituent Parts.—Native arfenic is ufually alloyed with a fmall portion of iron, and fometimes alfo with a little gold or filver.

Localities, &c.—Found in veins in primitive mountains, accompanied by ores of filver, lead, copper, quartz, and earthy fpars, in Bohemia, Saxony, and France.

2. Species. Arsenical Pyrites.

Id. Broch. ii. 438. *Id.* Kirw. ii. 256. *Fer Arfenical*, Hauy, iv. 56.

This is divided into two fubfpecies, common and argentiferous.

Subfpecies 1. Common Arsenical Pyrites.

Exter. Char.—Maffive, diffeminated, often cryftallized in oblique four-fided prifms, acute octahedrons, and lenfes; the prifms being varioufly modified on their angles, faces, and extremities. Cryftals fmall; lateral faces fmooth, fhining; bevelled faces ftreaked tranfverfely; luftre fhining; fracture uneven.

Colour filvery white, but ufually tarnifhed yellow, or bluifh, and iridefcent; hard; brittle. Specific gravity 5.75 to 6.52.

Phyf. Char.—By friction gives out the odour of garlic.

Chem. Char.—Before the blow-pipe gives out a white vapour with the odour of arfenic, the fumes depofiting a white powder on cold bodies; a reddifh brown matter, which is infufible, remains.

Conftituent Parts.—Compofed of arfenic, iron, and fulphur.

Subfpecies 2. Argentiferous Arsenical Pyrites.

Exter. Char.—Rarely maffive, often diffeminated, and cryftallized in fmall, acicular, four-fided prifms; luftre fhining, or weakly fhining; fracture uneven.

Colour tin-white, or filvery-white, ufually tarnifhed.

Localities, &c.—Arfenical pyrites is found in Bohemia, Saxony, and Silefia, in veins of primitive mountains, or diffeminated in the rocks.

The fecond variety is found in fimilar places, and differs only from the firft, in being combined with a fmall quantity of filver, which varies from 1 to 10 per cent.

3   3. Species.

3. Species. Orpiment.

Id. Kirw. ii. 260. *Id.* Broch. ii. 444. Hauy, iv. 234.

This ſpecies is divided into two ſubſpecies, yellow and red.

Subſpecies 1. Yellow Orpiment.

Exter. Char.—Maſſive, diſſeminated, ſuperficial, and cryſtallized in oblique four-ſided priſms, bevelled at the extremity, or terminated by a four-ſided pyramid, or in acute octahedrons. Cryſtals ſmall, and confuſedly aggregated; ſurface ſmooth; that of the bevelment and pyramids finely ſtreaked; internal luſtre reſplendent, between reſinous and adamantine; fracture foliated; fragments in plates.

Colour citron-yellow, golden-yellow, or aurora-red; tranſlucent; in thin plates, ſemitranſparent; ſoft; flexible in thin plates. Spec. grav. 3.31 to 3.45.

Chem. Char.—Gives out a blue flame before the blow-pipe, with white vapour, and the ſmell of arſenic and ſulphur.

Conſtituent Parts.

	Kirwan.	Weſtrumb.
Arſenic,	84	80
Sulphur,	16	20
	100	100

Localities, &c.—Uſually found in ſtratiform mountains, accompanied by clay, quartz, and ſometimes by red orpiment, in Tranſylvania, Hungary, and other places.

Subſpecies 2. Red Orpiment.

Exter. Char.—Rarely maſſive, uſually diſſeminated, or ſuperficial, and often cryſtallized in oblique four-ſided priſms, with obtuſe lateral edges, truncated, or bevelled: cryſtals ſmall, ſtreaked longitudinally; ſhining or reſplendent; internal luſtre ſhining between vitreous and reſinous; fracture uneven, or conchoidal.

Colour light aurora-red, ſcarlet-red, orange yellow; tranſlucent, or ſemitranſparent, often opaque; ſtreak orange, or citron-yellow; very ſoft: ſomewhat brittle. Spec. grav. 3.2.

Chem. Char.—Similar to the former.

Conſtituent Parts—according to ſome, the ſame as the preceding, but with the addition of iron and ſilica, with a ſmaller proportion of ſulphur.

Localities, &c.—Chiefly found in primitive mountains, as in Saxony, Hungary, France, and in the neighbourhood of Ætna and Veſuvius.

4. Species. Native Oxide of Arsenic.

Id. Kirw. ii. 258. *Id.* Broch. ii. 450. *Id.* Hauy, iv. 225.

Exter. Char.—Found ſuperficial, in an earthy form, and friable, on other minerals; rarely indurated, ſometimes botryoidal, or cryſtallized in capillary cryſtals, very ſmall octahedrons, or four-ſided tables; luſtre glimmering or dull; fracture earthy or fibrous.

Colour ſnow-white, yellowiſh white, reddiſh or greeniſh-white; opaque; cryſtals tranſlucent; ſoft, or friable. Spec. grav. 3.706.

Chem. Char.—Before the blow-pipe it gives out a white fume, and a garlic odour; burns with a bluiſh flame, and is entirely diſſipated; ſoluble in water and acids.

Conſtituent Parts.—This is a pure oxide of arſenic, with an accidental mixture of earth.

Localities, &c.—A rare mineral, but is found in ſmall quantity, along with native arſenic, and ores of cobalt, in Bohemia and Hungary.

5. Species. Pharmacolite, or *Arſeniate of Lime.*

Id. Broch. ii. 523. *Chaux Arſeniaté*, Hauy, ii. 293.

Exter. Char.—Found in ſmall capillary cryſtals; luſtre glimmering, ſilky; fracture fibrous or radiated.

Colour ſnow-white; tranſlucent; very ſoft. Specific gravity 2.53 to 2.64.

Chem. Char.—Soluble in nitric acid with efferveſcence, and gives out the odour of arſenic before the blow-pipe.

Conſtituent Parts.	Klaproth.
Arſenic acid,	50.54
Lime,	25.
Water,	24.46
	100.00 *

* *Analyt. Eſſ.* ii. 23.

Localities, &c.—Found in a vein in primitive rocks, accompanied by heavy ſpar and gypſum, near Wittichen in Suabia. It has alſo been found in France.

XVII. TUNGSTEN Genus.

1. Species. Wolfram.

Id. Kirw. ii. 316. *Id.* Broch. ii. 456. *Scheelin Ferruginé*, Haüy, iv. 314.

Exter. Char.—Found maſſive, diſſeminated, or cryſtallized in ſix-ſided priſms, and in rectangular four-ſided tables, which are variouſly modified. Cryſtals not very ſmall, uſually grouped; internal luſtre ſhining or reſplendent; longitudinal fracture foliated; croſs fracture uneven.

Colour browniſh black, or perfect black, ſometimes tarniſhed; opaque; ſtreak dark reddiſh-brown; ſoft; brittle. Spec. grav. 7.11 to 7.33.

Chem. Char.—Before the blow-pipe it decrepitates, but is infuſible.

Conſtituent Parts.

	Delhuyart.	Wiegleb.	Klaproth.	Vauquelin.
Tungſtic acid,	65	35.75	46.9	67.
Oxide of mangane∫e,	22	32.	–	6.25
Oxide of iron,	13	11.	31.2	18.
Silica,	–	–	–	1.5
Loſs,	–	21.25	21.9	7.25
	100	100.00	100.0	100.00

Localities, &c.—Wolfram, which is a rare mineral, is found in primitive mountains, accompanied by quartz, and

Metallic Ores.

and tin ores, in Bohemia, France, and Cornwall in England.

2. Species. Tungstate of Lime.

Tungsten, Kirw. ii. 314. *Id.* Broch. ii. 453. *Scheelin Calcaire*, Hauy, iv. 320.

Exter. Char.—Maſſive, diſſeminated, ſometimes cryſtallized in regular octahedrons, which are ſometimes ſlightly bevelled on the edges of the common baſe. Cryſtals uſually ſmall; ſurface ſmooth, reſplendent; bevelled ſurface ſtreaked tranſverſely; internal luſtre ſhining or reſplendent, reſinous or adamantine; fracture foliated.

Colour grayiſh or yellowiſh white; tranſlucent; ſemi-hard; brittle. Spec. grav. 6.06.

Chem. Char.—Before the blow-pipe decrepitates, and loſes its tranſparency, but is infuſible. Reduced to powder, and digeſted with nitric or muriatic acid, it leaves a citron yellow reſiduum, which is tungſtic acid.

Conſtituent Parts. Klaproth.		
Oxide of tungſten	77.75	75.25
—— iron	–	1.25
—— mangaueſe	–	.75
Lime	17.6	18.7
Silica	3.	1.5
Loſs	1.65	2.55
	100.00	100.00

Localities, &c.—This is a rare mineral, uſually found in primitive mountains, accompanied by ores of tin, ſome iron ores, quartz, fluor ſpar, &c. in Sweden, Saxony, and Cornwall in England.

XVIII. TITANIUM Genus.

1. Species. Menachanite.

Id. Brochant, ii. 468. *Id.* Kirwan, ii. 326. Hauy, iv. 305.

Exter. Char.—Found in ſmall, detached, rounded grains; ſurface rough, or weakly glimmering; luſtre ſhining, ſemi-metallic; fracture imperfectly foliated.

Colour grayiſh or iron black; ſoft or ſemi-hard; brittle. Spec. grav. 4.4.

Chem. Char.—Infuſible before the blow-pipe; colours borax greeniſh brown.

Conſtituent Parts.

	Klaproth.	Chenevix.
Oxide of titanium	45.25	40
—— iron	51.	49
Silica	3.5	11
Oxide of manganeſe	2.5	–
	100.00	100

Localities, &c.—This mineral was firſt diſcovered by Mr Gregor, among ſand, in the bed of a rivulet, in the valley of Menachan in Cornwall; hence its name. It has ſince been found in the iſland of Providence, one of the Bahamas, and at Botany Bay in New Holland.

Claſſification.

2. Species. Octahedrite.

Anataſe, Haüy, iii. 129. *Id.* Brochant, ii. 548. *Octahedrite*, Sauſſure, Voyages, §. 1901.

Exter. Char.—Found only cryſtallized, in elongated octahedrons with ſquare baſes, and truncated, or acuminated; cryſtals ſmall and imbedded; lateral faces ſtreaked tranſverſely; luſtre reſplendent, vitreous; fracture foliated.

Colour ſteel gray, ſometimes light indigo blue; tranſlucent, ſemi-hard; brittle. Spec. grav. 3.85.

Chem. Char.—Infuſible before the blow-pipe, but melts with borax, which it colours green, and in cooling, cryſtallizes in needles.

Conſt. Parts.—It is chiefly compoſed of oxide of titanium.

Localities, &c.—Has been found lining the cavities of a vein, accompanied by quartz and feldſpar, in a primitive rock, in Dauphiné in France.

3. Species. Titanite.

Id. Kirwan, ii. 329. *Le Ruthile*, Brochant, ii. 470. *Titane Oxidé*, Hauy, iv. 296. *Red Schorl* of many.

Exter. Char.—Found cryſtallized in oblique four-ſided priſms, the lateral edges truncated; ſometimes theſe cryſtals are double, being united obliquely; alſo in acicular and capillary cryſtals, imbedded and grouped together; ſurface longitudinally ſtreaked, ſhining; internal luſtre ſhining, adamantine; fracture foliated.

Colour blood-red or reddiſh brown; opaque, or tranſlucent; hard; brittle. Spec. grav. 4.1 to 4.24.

Chem. Char.—Infuſible before the blow-pipe, but loſes its tranſparency, and becomes gray.

Conſt. Parts.—Compoſed chiefly of oxide of titanium.

Localities, &c.—Found in Hungary, in gneiſs, and imbedded in quartz. It has been found alſo in Switzerland, Spain, and France.

4. Species. Nigrine.

Kirwan, ii. 331. Brochant, ii. 474. Hauy, iv. 307.

Exter. Char.—Diſſeminated, ſometimes amorphous, often cryſtallized in oblique four-ſided priſms, variouſly modified by truncations and bevelments. Surface ſmooth; luſtre ſhining, or reſplendent, between reſinous and vitreous; fracture foliated.

Colour dark browniſh black, yellowiſh white, or violet brown; opaque, or tranſlucent; ſemi-hard. Spec. grav. 3.51 to 4.6.

Chem. Char.—Infuſible before the blow-pipe.

Conſtituent Parts.

	Klaproth.	Abilgaard.	
Oxide of titanium	33	58	74
Silica	35	22	8
Lime	32	20	18
	100	100	100

Localities, &c.—Found in Bavaria, and at Arendal in Norway.

5. Species.

Classification. Metallic Ores.

5. Species. BROWN ORE OF TITANIUM.

This ſpecies in its characters ſo nearly reſembles the preceding, that it may be conſidered merely as a variety, as has been done by Brochant and Hauy.

6. Species. ISERINE.

Id. Brochant, ii. 478.

Exter. Char.—Found in rounded or angular grains, having a rough and glimmering ſurface; internally ſhining; fracture conchoidal.

Colour iron black, or browniſh; hard; brittle. Spec. grav. 4 5.

Chem. Char.—Melts before the blow-pipe into a dark brown ſlag.

Conſtituent Parts. Klaproth.

Oxide of titanium	59.1
——— iron	30.1
——— uranium	10.2
Loſs	.6
	100.0

Localities, &c.—Found in the ſand of a river in Bohemia, called *Iſer*, whence the name is derived.

XIX. URANIUM GENUS.

1. Species. PITCHY ORE OF URANIUM.

Id. Brochant, ii. 460. Kirwan, ii. 305. Hauy, iv. 280.

Exter. Char.—Maſſive, diſſeminated, ſometimes cellular; ſhining or glimmering; fracture imperfectly conchoidal; fragments rather ſharp-edged.

Colour velvet black, iron black, or bluiſh, ſometimes ſteel-tarniſhed; ſtreak black; opaque; ſemi-hard; brittle. Spec. grav. 6.5 to 7.5.

Chem Char.—Infuſible before the blow-pipe; ſoluble in nitric acid.

Conſtituent Parts. Klaproth.

Uranium a little oxidated	86.5
Sulphuret of lead	6.
Oxide of iron	2.5
Silica	5.
	100.0

Localities, &c.—Found in Bohemia and Saxony, accompanying galena, copper pyrites, iron ochre, and ſome ores of ſilver and cobalt.

2. Species. MICACEOUS URANITE.

Id. Brochant, ii. 463. Kirwan, ii. 304.

Exter. Char.—Sometimes in thin layers, but often cryſtallized in rectangular four-ſided tables; in cubes, and ſix-ſided priſms variouſly modified. Cryſtals ſmall, and grouped together; luſtre ſhining, pearly; fracture foliated.

Colour emerald or graſs green of various ſhades, rarely wax yellow; tranſlucent; ſtreak greeniſh white; ſoft; not very brittle. Spec. grav. 3.12.

Chem. Char.—Soluble, without effervеſcence, in nitric acid, which it colours citron yellow.

Conſt. Parts.—This ſpecies is an oxide of uranium, with a ſmall portion of copper.

Localities, &c.—Found in Saxony, France, and Cornwall in England, accompanied by ſome ores of iron, ſometimes by cobalt.

3. Species. URANITE OCHRE.

Id. Broch. ii. 466. *Id.* Kirw. ii. 303.

Exter. Char.—Found maſſive, but uſually diſſeminated, or ſuperficial; is dull, or rarely ſhining; fracture earthy, or foliated; fragments blunt-edged.

Colour citron yellow, aurora red, or ſulphur yellow; opaque; ſoft and friable; brittle; ſtains a little; feels meagre. Spec. grav. 3.15 to 3.24.

Conſtituent Parts.—Compoſed of oxide of uranium, with a portion of iron.

Localities, &c.—Found in ſimilar places with the former.

XX. TELLURIUM GENUS.

1. Species. NATIVE TELLURIUM.

Id. Broch. ii. 480. *Sylvanite*, Kirw. ii. 324. Hauy, iv. 325.

Exter. Char.—Maſſive or diſſeminated; ſhining; fracture foliated.

Colour between tin and ſilvery white; ſoft; not very brittle. Spec. grav. 5.7 to 6.1.

Chem. Char.—Melts eaſily before the blow-pipe.

Conſtituent Parts. Klaproth.

Tellurium	92.6
Iron	7.2
Gold	.2
	100.0

Localities, &c.—Has been only found at Fatzebay in Tranſylvania, where it exiſts in veins, in mountains of gray wacken and tranſition limeſtone. The ore is dug out for the purpoſe of extracting the gold.

It was called *aurum paradoxum*, and *aurum problematicum*, becauſe its external appearance did not indicate that it contained gold.

2. Species. GRAPHIC ORE OF TELLURIUM.

Id. Broch. ii. 482. Hauy, iv. 327.

Exter. Char.—Maſſive, and cryſtallized in flat four or ſix-ſided priſms, which are arranged in rows, exhibiting ſomething of the appearance of written characters, and hence the name graphic ore. Surface ſmooth, ſhining; longitudinal fracture foliated and reſplendent; croſs fracture uneven.

Colour tin white, yellowiſh, or lead gray; ſoft and brittle. Spec. grav. 5.72.

Chem. Char.—Burns with a greeniſh flame before the blow-pipe.

Metallic Ores.

Constituent Parts.	Klaproth.
Tellurium	60
Gold	30
Silver	10
	100

Localities, &c.—Has only been found at Offenbanya in Transylvania, in veins traversing porphyry and granular limestone accompanied by iron pyrites and copper ore. It is wrought for the sake of the gold.

3. Species. Yellow Ore of Tellurium.

Id. Broch. ii. 484. Hauy, iv. 327.

Exter. Char.—Disseminated, and crystallized in small four-sided prisms; shining, or weakly shining; fracture foliated; cross fracture uneven.

Colour silvery white, brass yellow, or gray.

Chem. Char.—Soluble in nitric acid.

Constituent Parts.	Klaproth.
Tellurium	44.75
Gold	26.75
Lead	19.5
Silver	8.5
Sulphur	.5
	100.00

Localities, &c.—Found only at Nagyag in Transylvania.

4. Species. Black or Foliated Ore of Tellurium.

Id. Broch. ii. 486. Hauy, iv. 327.

Exter. Char.—Found in plates, which are united into masses, or disseminated, rarely crystallized in six-sided tables; surface smooth, shining; external lustre resplendent; fracture foliated.

Colour between lead gray and iron black; stains; soft; flexible in thin plates. Spec. grav. 8.91.

Chem. Char.—Before the blow-pipe the sulphur and tellurium are dissipated in white fumes, and a metallic globule remains, surrounded by a black slag.

Constituent Parts.	Klaproth.
Tellurium	33.
Lead	50.
Gold	8.5
Silver and copper	1.
Sulphur	7.5
	100.0

Localities, &c.—Found only in the same place with the preceding.

XXI. CHROMIUM Genus.

1. Species. Needle Ore of Chromium.

Exter. Char.—Found in small crystals, which are imbedded; lustre shining; fracture uneven or conchoidal.

Classification.

Colour steel grey, and usually covered with a greenish efflorescence; soft, or semihard; not very brittle.

Constituent Parts.—This is supposed to be an alloy of chromium.

Exter. Char. &c.—Found in the gold mine of Rudnick near Schlangenberg in Suabia, in a matrix of white quartz, containing gold and galena.

2. Species. Ochre of Chromium.

Exter. Char.—Massive, disseminated, and in thin plates; dull; fracture uneven or earthy.

Colour verdigris green, or yellowish; soft.

Localities, &c.—Found only in the same place, accompanying the former.

The chromates of lead and iron have been already described among the ores of those metals.

XXII. COLUMBIUM Genus.

Exter. Char.—Massive; fracture uneven, or foliated; lustre shining.

Colour dark gray; opaque; not very hard; brittle. Spec. grav. 5.918.

Constituent Parts.	
Oxide of columbium	78
——— iron	21
Loss	1
	100

Localities, &c.—This mineral, of which the only specimen known is in the British Museum, was brought from Massachussets in America; it was analyzed by Mr Hatchett, and found to contain a new metal, which he denominated *columbium*.

XXIII. TANTALIUM Genus.

Two species of this mineral have been discovered; tantalite, and yttrio-tantalite.

1. Species. Tantalite.

Exter. Char. Crystallized in octahedrons; surface smooth; fracture compact.

Colour bluish gray, or black. Spec. grav. 7.95.

Constituent Parts.—Composed of tantalium, iron, and manganese.

Localities. &c.—Found in Finland, in globular pieces, in a vein of red feldspar, traversing a gneiss rock.

2. Species. Yttrio-Tantalite.

Exter. Char.—Disseminated, in pieces of the size of a nut; fracture even; lustre metallic.

Colour dark gray; may be scratched with a knife; powder gray. Spec. grav. 5.13.

Constituent Parts.—Composed of iron, manganese, tantalium, and the new earth yttria.

Localities, &c.—Found at Ytterby in Sweden, in the same place with gadolinite.

These minerals were analyzed by Eckeberg, who discovered in them the new metal tantalium.

XXIV.

XXIV. CERIUM Genus.

1. Species. Cerite.

Exter. Char.—Found maffive or differminated; luftre weakly glimmering; fracture fine grained, even.

Colour pale rofe red; opaque; powder grayifh; fcratches glafs. Spec. grav. 4.5 to 4.9.

Chem. Char.—Infufible before the blow-pipe, and does not colour borax.

Conftituent Parts.

	Vauquelin.	Klaproth.
Oxide of cerium	67.	54.5
——— iron	.02	4.
Silica	17.	34.
Lime	.02	
Water and carbonic acid	.12	5.
Lofs	15.84	2.5
	100 00	100.0

Localities, &c.—This mineral has been found in the copper mine of Baftnaes, at Riddarhytta, in Sweden, accompanied by copper, molybdena, bifmuth, mica, and hornblende.

The new metal contained in this mineral was difcovered by Hinger and Berzelius, chemifts at Stockholm.

APPENDIX.

IX. YTTRIAN Genus.

To follow Strontian genus, p. 209.

Species. Gadolinite.

Id. Brochant, ii. 512. *Id.* Haüy, iii. 141.

Exter. Char.—Found maffive; fhining, vitreous; fracture conchoidal.

Colour velvet black, or brownifh black; opaque; hard; fcratches quartz; brittle. Spec. grav. 4.04.

Chem. Char.—Reduced to powder, and heated in diluted nitric acid, it is converted into a thick yellowifh gray jelly. Before the blow-pipe it decrepitates and becomes whitifh red, but remains infufible.

Conftituent Parts.

	Eckeberg.	Vauquelin.	Klaproth.
Yttria	47.5	35.	59.75
Silica	25.	25.5	21.25
Lime		2.	
Alumina	4.5		.5
Oxide of iron	18.	25.	17.5
———manganefe		2.	
Water and carbonic acid		10.5	.5
Lofs	5.		.5
	100.0	100.0	100.00

Localities, &c.—This mineral was examined by profeffor Gadolin of Sweden, whofe name it bears, and found to contain a peculiar earth. It was found near Ytterby in Sweden, and hence the new earth was call- *Yttria*.

The unavoidable length to which the firft part of this treatife has extended, and fome other circumftances, render it neceffary for us to introduce in a different part of the work, what we propofed to lay before our readers in the fecond part relative to the analyfis of ftones and metallurgical operations. See Ores, *Reduction of*, and Stones, *Analyfis of*.

EXPLANATION of the PLATES.

Plate CCCLI.

Fig. 1. Reprefents the goniometer or graphometer, an inftrument invented by Carangeau for meafuring the angles of cryftals. MTN is a graduated femicircle of brafs or filver, furnifhed with two arms or rulers AB, FG, one of which, FG, has a flit from *a* to R, excepting the crofs bar at K, which ftrengthens the inftrument. This arm is fixed to a brafs ruler at R and *c* placed behind, and which makes part of the femicircle. The arm FG is connected with the ruler behind by nails which enter the flit and are furnifhed with nuts. The other arm has alfo a flit or opening from *x* to *c*, where it is fixed to the firft by the fcrew nail which paffes through both. By flackening the fcrews, the two parts *c* G and *c* B may be fhortened at pleafure. The arm AB being only fixed at *c*, which is the centre of the circle, moves round this centre, while the arm GF remains conftantly fixed in the direction of the diameter which paffes through the points 0 and 180°. The upper part of the arm AB fhould be brought to a thin edge from *z* to *s*, and the line of this edge fhould pafs through the centre *c*; becaufe it is by this edge that the meafure of the angle on the graduated circumference is indicated.

To difcover the meafure of any angle of a cryftal, the two arms *c* B, *c* G are brought into contact with the fides containing the angle, and the degree indicated by the line *z s* on the circumference denotes the meafure of that angle. The inftrument is fo contrived that the arms may be fhortened for the convenience of applying it in different cafes. But it might happen that it could not be applied in cafes where the cryftals are aggregated or attached to the matrix. This difficulty is obviated by another contrivance. The femicircle is furnifhed with a hinge at 90°, by which means it may be diminifhed at pleafure to a quadrant, by folding back one half. There is a fmall bar of fteel, one end of which is fixed behind the immoveable arm FG, and the other is attached by a notch and fcrew nail at O. When this nail is unfcrewed, the bar *c* O falls behind the ruler which fupports FG, and thus one half of the femicircle folds back, and any angle not exceeding 90° may be meafured; but when the angle is greater, it muft be replaced.

Fig. 2. is an apparatus by which fmall degrees of electricity

Explanation of the Plates.

electricity may be obſerved in minerals. A is a ſmall braſs needle with knobs $a\ b$, and moveable on the pivot at the middle. The mineral whoſe electricity is to be tried, is rubbed on ſilk or woollen, and then preſented to one of the knobs; and by the diſtance at which the knob begins to be attracted, the ſtrength of the electricity may be, in ſome degree, eſtimated. In the ſame way ſubſtances which become electric by heat, ſuch as the tourmaline, are to be tried; the ſame apparatus may be employed. To aſcertain in what part of the mineral the different electricities exiſt, take a ſtick of ſealing wax, at the extremity of which a ſilk thread has been attached, and having rubbed the wax, bring alternately the oppoſite extremities of the ſubſtance, for example, each of the ſummits of a tourmaline, within a ſmall diſtance of the ſilk thread. If the extremity which is brought near the thread poſſeſs negative electricity, the thread will be repelled; on the contrary, it will be attracted. Or the experiment may be made in another way, particularly when the electrical body is ſmall, or its electricity feeble. At B, fig. 2. the tourmaline $t\ t'$ is held by a pair of pincers in ſuch a way that the pole t is at a ſmall diſtance from the knob a of the needle. C c is the ſtick of wax, one of whoſe extremities is placed on a tube of glaſs U u, and which acts by its extremity C, on the knob a, to excite in it poſitive electricity. In this caſe the wax, after the extremity which has been rubbed is placed in the poſition deſcribed, communicates to the knob of the needle to which it is preſented, an electricity contrary to its own; ſo that the extremity of the tourmaline acted on by poſitive electricity, repels the needle to which it is preſented, and the other extremity, poſſeſſing negative electricity, attracts the needle.

Fig. 3. is a ſpirit of wine blow-pipe, nearly on the plan of that invented by Mr Paul. It is made of braſs, and conſiſts of the following parts.

a Is a hollow oval frame about five inches in its longeſt dimenſion, which ſupports the pillar d and the two lamps $b\ c$, which may burn either oil or alcohol, but the latter is the beſt. The rim $e\ e$ ſlips upon the pillar d as low as the ſhoulder of the latter will permit, but the rim may be raiſed at pleaſure and kept faſt by the ſcrew-peg f. The rim ſupports the boiler g which is a ſingle hollow piece of thick braſs containing about an ounce of alcohol, and has four openings, viz. three at top h, i, k, and one at bottom to receive the tube o. This latter is long enough to reach the level of the outſide of the top of the boiler, and conſequently the alcohol within the boiler cannot readily boil over into the tube, and the opening k which correſponds with it, is cloſely ſhut by a ſcrew ſtopper, hollowed out a little beneath, to allow the free paſſage of the vapour down the tube. Here the vaporized alcohol is prevented from condenſing at the point o by the contiguity of the flame of the lamp b, and as it paſſes on through the hollow $p\ q$ into the jet tube r, it is immediately kindled by the flame of the lamp c, and the united flames are compelled ſideways with ſuch violence as to form a long pencil of blue flame, attended with a conſiderable roaring noiſe. This continues as long as any alcohol is left in the boiler, which allows ample time for moſt blowpipe operations. The boiler is filled at the opening h. The centre hole i is nicely fitted with a ſmall braſs plug kept down by a thin ſlip of iron l, the other end of which ſlips over the top of the upright pillar d, and is confined between two flat ſcrew-plates $m\ n$. The uſe of this is as a ſafety valve to take away all danger of the boiler burſting by the confined vapour not being able to eſcape faſt enough through the jet-pipe r, for when the internal preſſure is great, the elaſticity of the iron ſpring l allows the valve i to riſe ſufficiently to let out part of the encloſed vapour. The ſcrew ſtoppers h and k are made ſtill tighter by collars of leather, as is the part where the tube o joins the boiler. The jet-pipe r has a complete rotatory motion, ſo that the flame may be impelled in any direction. This is effected by turning in the form of a ball that part of the pipe which is incloſed in the hollow $p\ q$.

But this blow-pipe, although an elegant philoſophical apparatus, will not be found to anſwer where a great degree of heat is required to be kept up for a conſiderable time. Other contrivances, therefore, of a ſimpler nature, have been propoſed; and perhaps the beſt of theſe is the blow-pipe which is uſed by the mouth. The following is a deſcription of a blow-pipe of this kind.

Fig. 4. repreſents this blow-pipe. a is a braſs tube, having a circular enlargement c, for the purpoſe of condenſing the moiſture which is blown from the lungs; the ſmaller end d is moveable round the centre c, ſo that any degree of obliquity may be given to the flame. Fig. 5. is a ſeparate jet-pipe with a ſmall opening, which is ſcrewed on the blow-pipe at d; and it may be convenient to have two or three jet-pipes of different ſizes, according as a larger and more moderate, or a ſmaller and more intenſe flame is wanted. b is a piece of ivory which ſlips on the larger end, for the purpoſe of being applied to the mouth, as being more agreeable.

The beſt kind of flame for blowing through with the common blow-pipe is a wax or tallow candle with a very large wick, which ſhould be kept ſnuffed moderately low, and the wick turned a little aſide from the pipe. A ſpirit lamp is ſometimes uſed, which makes a perfectly clear flame without ſmoke, but weak when uſed in this way. There is a kind of knack in blowing with the mouth, which is not eaſily deſcribed, and requires a little practice to be performed with eaſe. As the flame muſt often be kept for ſeveral minutes, the act of reſpiration muſt be carried on through the noſtrils without interruption, and the ſtreſs of blowing muſt be performed merely by compreſſion of the cheeks upon the air in the mouth.

The ſubſtance to be heated is placed either on a piece of charcoal or a metallic ſupport. When the former is uſed, a large cloſe well-burnt piece of charcoal muſt be choſen, a ſmall ſhallow hole ſcooped out with a knife, and the ſubſtance laid upon it. The charcoal itſelf kindles all round the hole, and the hole is thus gradually enlarged; and the heat too is kept up round the ſubſtance much more uniformly than when a metal ſupport is uſed. At the ſame time however the chemical effect produced by heated charcoal ſhould not be forgotten, particularly the reduction of metallic oxides, and the deoxygenation of the fixed acids; ſo that, for example, a ſmall heap of minium or litharge heated red-hot on

charcoal

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charcoal by the blow-pipe, is ſpeedily reduced to a globule of metallic lead; the phoſphates are partially reduced to phoſphurets, &c.

For a metallic ſupport, platina is in general by far the beſt material. A ſmall ſpoon of this metal, the ſhank of which may be ſtuck in a cork when held, and a ſmall ſilver cup, the ſhank of which is fixed into a wooden handle, may be uſed in fuſions with borax or alkaline fluxes. A ſmall forceps lately brought into uſe, and made entirely of two thin pieces of platina joined by rivets, and bent, will be uſeful in holding any ſmall hard ſubſtance in the blow-pipe flame for any length of time, without danger of the points of the forceps melting; and it is alſo found that this metal is ſo much worſe a conductor of heat than any other, that the forceps never gets too hot for the naked fingers to touch at the bend *.

Fig. 6. repreſents a portable pocket blow-pipe, invented by Dr Wollaſton, and of its actual ſize. The interior tube is longer than the exterior, that it may be readily withdrawn; and the upper edge of the large end is turned outward, to diminiſh the effort of the lips requiſite for retaining it in the mouth.

Fig. 7. repreſents the whole apparatus, one half of its real dimenſions, and connected for uſe. The ſmall extremity *a* is placed obliquely at an angle of about 120°, that the flame impelled by it may be carried to a more convenient diſtance from the eye, and thus anſwering the purpoſe of a longer blow-pipe. This oblique piece *a* is compoſed of three parts, the largeſt of which is made ſtronger, that it may not be injured by uſe. One end is cloſed, and into the other is inſerted a ſmall peg of wood, perforated ſo as to receive the tip which is intended to be occaſionally ſeparated, for the purpoſe of paſſing a fine needle into it, to remove obſtructions †.

* *Aikin's Dict. of Chemiſtry*, &c. *Appendix.*

† *Nich. Jour.* xv. 284.

Plates CCCLII. and CCCLIII.

Fig. 1. *Diamond*,—ſpheroidal, with 48 convex faces.

Fig. 2. *Zircon*,—the primitive form an octahedron with iſoſceles triangles.

Fig. 3. *Zircon*,—rectangular four-ſided priſm terminated by a four-ſided pyramid ſet on the lateral faces.

Fig. 4. *Hyacinth*,—a dodecahedron formed from a rectangular four-ſided priſm terminated by a four-ſided pyramid ſet on the lateral edges.

Fig. 5. *Chryſoberyl*,—double ſix-ſided pyramid flattened, having the ſummits truncated.

Fig. 6. *Chryſolite*,—a compreſſed eight-ſided priſm, terminated by an eight-ſided pyramid, whoſe ſides correſpond to thoſe of the priſm, and whoſe ſummit is truncated by a convex ſurface.

Fig. 7. *Augite*,—the primitive form, an oblique four-ſided priſm with rhomboidal baſes.

Fig. 8. *Common form of augite*,—a ſhort, eight-ſided, compreſſed priſm, terminated by two oblique faces.

Fig. 9. *Piſtazite*,—a ſix-ſided priſm with two broad and four narrow faces, and bevelled at the extremities.

Fig. 10. and 11. other forms in which the priſms are terminated by ſeveral oblique faces with a truncated ſummit.

Fig. 12. *Veſuvian*,—a four-ſided priſm with the edges truncated, and terminated by four oblique and one horizontal face.

Fig. 13. *Garnet*,—primitive form, a rhomboidal dodecahedron.

Fig. 14. *Trapezoidal garnet*,—compoſed of 24 faces, which are equal and ſimilar trapezoids.

Fig. 15. *Grenatite*,—a ſix-ſided priſm with the greater angles at each baſe truncated.

Fig. 16. Two cryſtals of the ſame croſſing each other obliquely. *Staurotide, obliqueangle*, of Haüy.

Fig. 17. *Corundum*,—two ſix-ſided pyramids united by the baſes, with the ſummits and angles truncated.

Fig. 18. A ſix-ſided priſm, having the alternate angles at each baſe truncated.

Fig. 19. *Topaz*,—an eight-ſided priſm terminated by an obtuſe four-ſided pyramid at one extremity, and by a different one at the other.

Fig. 20. A ſimilar priſm with ſix of the terminal edges truncated.

Fig. 22. *Tourmaline*,—primitive form, which is an obtuſe rhomboid.

Fig. 23. A nine-ſided priſm, terminated at one extremity by a ſix-ſided ſummit, and by a three-ſided ſummit at the other.

Fig. 24. Same priſm with a three and a ſeven-ſided ſummit at the extremities.

Fig. 25. *Axinite* or *Thumerſtone*,—primitive form, which is a rectangular four-ſided priſm, whoſe baſes are oblique-angled parallelograms.

Fig. 26. A ſecondary form, ſame priſm, having the alternate lateral and terminal edges truncated.

Fig. 27. *Rock-cryſtal*.—A double ſix-ſided pyramid.

Fig. 28. A ſix-ſided priſm terminated at each extremity by a ſix-ſided pyramid, having the alternate angles at the oppoſite baſes ſlightly truncated.

Fig. 29. *Feldſpar*,—the primitive form, which is an oblique-angled parallelopiped.

Fig. 30. An oblique four-ſided priſm.

Fig. 31. A ſix-ſided priſm with four of the angles truncated, and the two extremities bevelled.

Fig. 32. The ſame priſm, with four of the terminal edges truncated.

Fig. 33. An oblique four-ſided priſm, bevelled and truncated at the extremities.

Fig. 34. *Chiaſtolite*,—the outer rhomboid marked with black lines parallel to the ſides of the black internal rhomboid.

Fig. 35. *Foliated Zeolite*, or *Stilbite*,—compreſſed four-ſided priſm, terminated by a four-ſided ſummit ſet on the lateral edges.

Fig. 36. A ſix-ſided priſm with two ſolid angles at each extremity, truncated.

Fig. 37. *Cubic Zeolite* or *Analcime*,—the cube with all the ſolid angles truncated.

Fig. 38. *Cubic Zeolite* or *Chabaſie*,—compoſed of three rhomboids.

Fig. 39. *Croſs-ſtone*,—a double cryſtal compoſed of two dodecahedrons croſſing each other at right angles.

Fig. 40. *Hornblende*,—primitive form, an oblique four-ſided priſm, whoſe baſe is a rhomboid.

Fig. 41. *Baſaltic Hornblende*,—a ſix-ſided priſm terminated at one extremity by four trapezoidal planes; and at the other by a bevelment, the planes of which are pentagons.

Fig. 42. *Tremolite*,—an oblique four-ſided priſm, having the acute angles truncated and terminated by a dihedral ſummit.

Fig.

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Fig. 43. *Calcareous Spar*, or *Carbonate of Lime*,—primitive form a rhomboid.

Fig. 44. A very obtuſe rhomboid.

Fig. 45. An acute rhomboid.

Fig. 46. Approaching to the cube.

Fig. 47. Double ſix-ſided priſm, known by the name of *dog-tooth ſpar*.

Fig. 48. A ſix-ſided priſm, terminated at each extremity by a trihedral ſummit whoſe faces are pentagons.

Fig. 49. Alſo a ſix-ſided priſm with trihedral ſummits; but the baſes of the terminal pentagons are enlarged in conſequence of the inclination of the lateral faces.

Figs. 50, 51, 52. Other forms of calcareous ſpar.

Fig. 53. *Sulphate of lime*,—primitive form.

Figs. 54. 55. Common forms.

Fig. 56. *Sulphate of Barytes*,—primitive form.

Figs. 57, 58, 59. Common forms of ſulphate of barytes.

Fig. 60. *Sulphate of Strontites*,—primitive form.

Fig. 61. Common form.

Fig. 62. *Borate of Soda*,—primitive form.

Fig. 63. One of the common forms.

Fig. 64. *Carbonate of Soda*,—primitive form, an acute octahedron.

Fig. 65. One of the common forms, having two angles at the baſe truncated.

Fig. 66. *Nitrate of Potaſh*,—primitive form, a rectangular octahedron.

Fig. 67, 68. Common forms.

Fig. 69. *Sulphate of Magneſia*,—the common form.

Fig. 70. *Borate of Magneſia.*

Fig. 71. *Sulphur*,—primitive form.

Fig. 72. Common form.

Fig. 73. *Mercury, Native Amalgam.*

Fig. 74. *Cinnabar.*

Figs. 75, 76, 77. *Red Silver Ore.*

Figs. 78, 79, 80, 81, 82. *Cryſtals of Copper Ore.*

Figs. 83, 84, 85, 86, 87, 88, 90, 91, 92, 93. *Cryſtals of the Ores of Iron.*

Fig. 94. *Carbonate of Lead.*

Fig. 95. *Sulphate of Lead.*

Figs. 96, 97. *Molybdate of Lead.*

Figs. 98, 99, 100. *Crystals of Tin.*

Fig. 101. *Oxide of Zinc.*

Fig. 102. *Sulphuret of Zinc.*

Fig. 103. *Sulphuret of Antimony*

Figs. 104, 105. *Crystals of Cobalt.*

Fig. 106. *Manganeſe.*

Fig. 107. *Sulphuret of Arſenic.*

Fig. 108. *Tellurium*,—primitive form.

Fig. 109. Common form.

Figs. 110, 111, 112, 113. *Crystals of Titanium.*

INDEX.

Tremolite,

Minerva || Mingrelia.

MINERVA, or Pallas, in Pagan worſhip, the goddeſs of ſciences and of wiſdom, ſprung completely armed from Jupiter's brain; and on the day of her nativity it rained gold at Rhodes. She diſputed with Neptune the honour of giving a name to the city of Athens; when they agreed that whoſoever of them ſhould produce what was moſt uſeful to mankind, ſhould have that advantage. Neptune, with a ſtroke of his trident, formed a horſe; and Minerva cauſed an olive to ſpring from the ground, which was judged to be moſt uſeful, from its being the ſymbol of peace. Minerva changed Arachne into a ſpider, for pretending to excel her in making tapeſtry. She fought the giants; favoured Cadmus, Ulyſſes, and other heroes; and refuſed to marry Vulcan, chooſing rather to live in a ſtate of celibacy. She alſo deprived Tireſias of ſight, turned Meduſa's locks into ſnakes, and performed ſeveral other exploits.

Minerva is uſually repreſented by the poets, painters, and ſculptors, completely armed, with a compoſed but agreeable countenance, bearing a golden breaſtplate, a ſpear in her right hand, and her ægis or ſhield in the left, on which is repreſented Meduſa's head encircled with ſnakes, and her helmet was uſually entwined with olives.

Minerva had ſeveral temples both in Greece and Italy. The uſual victim offered her was a white heifer, never yoked. The animals ſacred to her were the cock, the owl, and the baſiliſk.

Minervæ Caſtrum, *Arx Minervæ*, *Minervium*, or *Templum Minervæ*, in *Ancient Geography*, a citadel, temple, and town on the Ionian ſea, beyond Hydrus; ſeen a great way out at ſea. Now *Caſtro*, a town of Otranto in Naples. E. Long. 19. 25. N. Lat. 46. 8.

Minervæ Promontorium, in *Ancient Geography*, the ſeat of the Sirens, a promontory in the Sinus Paeſtanus, the ſouth boundary of Campania on the Tuſcan coaſt; ſo called from a temple of Minerva on it; ſituated to the ſouth of Surrentum, and therefore called *Surrentium*. Now *Capo della Minerva*, on the weſt coaſt of Naples, over againſt the iſland Capri.

MINERVALIA, in Roman antiquity, feſtivals celebrated in honour of Minerva, in the month of March; at which time the ſcholars had a vacation, and uſually made a preſent to their maſters, called from this feſtival *Minerval*.

MINGRELIA, anciently Colchis, a part of Weſtern Georgia, in Aſia; bounded on the eaſt by Iberia, or *Georgia* properly ſo called; on the weſt, by the Euxine ſea; on the ſouth, by Armenia, and part of Pontus; and on the north, by Mount Caucaſus.

Mingrelia.

Colchis, or Mingrelia, is watered by a great many rivers; as the Corax, the Hippus, the Cyaneus, the Chariſtus, the Phaſis, where the Argonauts landed, the Abſarus, the Ciſſa, and the Ophis, all emptying themſelves into the Euxine ſea. The Phaſis does not ſpring from the mountains in Armenia, near the ſources of the Euphrates, the Araxes, and the Tigris, as Strabo, Pliny, Ptolemy, Dionyſius, and after them Arrian, Reland, Calmet, and Sanſon, have falſely aſſerted; but riſes in Mount Caucaſus; and flows not from ſouth to north, but from north to ſouth, as appears from the map of Colchis or Mingrelia in Thevenot's collection, and the account which Sir John Chardin gives of that country. This river forms in its courſe a ſmall iſland called alſo *Phaſis*: whence the pheaſants, if Iſidorus is to be credited, were firſt brought to Europe, and thence called by the Greeks *Phaſiani*. The other rivers of Colchis are conſiderable.

The whole kingdom of Colchis was in ancient times very pleaſant and fruitful, as it is ſtill where duly cultivated; abounded in all neceſſaries of life; and was enriched with many mines of gold, which gave occaſion to the fable of the Golden Fleece and the Argonautic expedition, ſo much celebrated by the ancients.

Sir John Chardin tells us, that this country extends above 100 miles in length and 60 in breadth; being not near ſo extenſive as the ancient Colchis, which reached from the frontiers of Iberia or Georgia Proper, weſtward to the Palus Mæotis: that it is beautifully diverſified with hills, mountains, valleys, woods, and plains, but badly cultivated: that there are all the kinds of fruits which are found in England, growing wild, but taſteleſs and inſipid for want of culture: that, if the natives underſtood the art of making wines, thoſe of this country would be the fineſt in the world: that there are many rivers which have their ſource in Mount Caucaſus, particularly the Phaſis, now called the *Rione*: that the country abounds in beeves, hogs, wild boars, ſtags, and other veniſon; and in partridges, pheaſants, and quails: that falcons, eagles, pelicans, lions, leopards, tygers, wolves, and jackals, breed on Mount Caucaſus, and ſometimes greatly annoy the country: that the people are generally handſome, the men ſtrong and well made, and the women very beautiful; but both ſexes very vicious and debauched: that they marry their nieces, aunts, or other relations, indifferently; and take two or three wives

Mingrelia.

wives if they pleaſe, and as many concubines as they will: that they not only make a common practice of ſelling their children, but even murder them, or bury them alive, when they find it difficult to bring them up: that the common people uſe a ſort of paſte, made of a plant called *gom*, inſtead of bread; but that of the better ſort conſiſts of wheat, barley, or rice: that the gentry have an abſolute power over their vaſſals, which extends to life, liberty, and eſtate: that their arms are the bow and arrow, the lance, the ſabre or broad-ſword, and the buckler: that they are very naſty, and eat ſitting croſs-legged upon a carpet, like the Perſians; but the poorer ſort upon a mat or bench, in the ſame poſture: that the country is very thin of inhabitants, no leſs than 12,000 being ſuppoſed to be ſold yearly to the Turks and Perſians: that the principal commodities exported from it are, honey, wax, hides, caſtor, martens ſkins, flax ſeed, thread, ſilk, and linen cloth; but that there are no gold or ſilver mines now, and very little money: that the revenue of the prince or viceroy amounts to about 20,000 crowns *per annum*: that the inhabitants call themſelves *Chriſtians*; but that both they and their prieſts are altogether illiterate, and ignorant of the doctrines and precepts of Chriſtianity: that their biſhops are rich, have a great number of vaſſals, and are clothed in ſcarlet and velvet: and that their ſervice is according to the rites of the Greek church, with a mixture of Judaiſm and Paganiſm.

Minho, Miniature.

The cities of moſt note in this country in ancient times were Pityus; Dioſcurias, or Dioſcorias, which was ſo called from Caſtor and Pollux, two of the Argonauts, by whom it is ſuppoſed to have been founded, and who in Greek are ſtyled *Dioſcuroi*, at preſent known by the name of *Savatapoli*; Aea on the Phaſis, ſuppoſed to be the ſame as Hupolis; *Phaſis*, ſo called from the river on which it ſtood; Cyta, at the mouth of the river Cyaneus, the birth place of the famous Medea, called from thence, by the poets, *Cytæis*; Saracæ, Zadris, Surium, Madia, and Zoliſſa. As for modern cities, it does not appear that there are any here conſiderable enough to merit a deſcription; or, if there are, they ſeem to be little, if it all, known to Europeans.

MINHO, a great river in Spain, which taking its riſe in Galicia, divides that province from Portugal, and falls into the Atlantic at Caminha.

MINIATURE, in a general ſenſe, ſignifies repreſentation in a ſmall compaſs, or leſs than the reality.

MINIATURE PAINTING;

A DELICATE kind of painting, conſiſting of little points or dots; uſually done on vellum, ivory, or paper, with very thin, ſimple, water colours.—The word comes from the Latin *minium*, "red lead;" that being a colour much uſed in this kind of painting. The French frequently call it *mignature*, from *mignon*, "fine, pretty," on account of its ſmallneſs and delicacy: and it may be ultimately derived from μικρος "ſmall."

Miniature is diſtinguiſhed from other kinds of painting by the ſmallneſs and delicacy of its figures and faintneſs of the colouring; on which account it requires to be viewed very near.

SECT. I. *Of Drawing and Deſigning.*

To ſucceed in this art, a man ſhould be perfectly ſkilled in the art of deſigning or drawing: but as moſt people who affect the one, know little or nothing of the other, and would have the pleaſure of painting without giving themſelves the trouble of learning to deſign (which is indeed an art that is not acquired without a great deal of time, and continual application), inventions have been found out to ſupply the place of it; by means of which a man deſigns or draws without knowing how to deſign.

The firſt is chalking: that is, if you have a mind to do a print or deſign in miniature, the backſide of it, on another paper, muſt be blackened with ſmall coal, and then rubbed very hard with the finger wrapped in a linen cloth: afterwards the cloth muſt be lightly drawn over the ſide ſo blackened that no black grains may remain upon it to ſoil the vellum you would paint upon; and the print or draught muſt be faſtened upon the vellum with four pins, to keep it from ſhifting. And if it be another paper that is blackened, it muſt be put between the vellum and the print, or draught, with the blackened ſide upon the vellum. Then, with a blunted pin or needle, you muſt paſs over the principal lines or ſtrokes of the print, or draught, the contours, the plaits of the drapery, and over every thing elſe that muſt be diſtinguiſhed; preſſing ſo hard, that the ſtrokes may be fairly marked upon the vellum underneath.

Copying by ſquares is another convenient method for ſuch as are but little ſkilled in the art of deſigning, and would copy pictures, or other things, that cannot be chalked. The method is this: The piece muſt be divided into many equal parts by little ſquares, marked out with charcoal, if the piece be clear and whitiſh, and the black can be fairly ſeen upon it; or with white chalk, if it be too brown and duſky. After which, as many ſquares of equal dimenſions muſt be made on white paper, upon which the piece muſt be deſigned; becauſe, if this be done immediately upon vellum, (as one is apt to miſcarry in the firſt attempt), the vellum may be ſoiled with falſe touches. But when it is neatly done upon paper, it muſt be chalked upon the vellum in the manner before deſcribed. When the original and the paper are thus ordered, obſerve what is in each ſquare of the piece to be deſigned; as a head, an arm, a hand, and ſo forth; and place it in the correſponding part of the paper. And thus finding where to place all the parts of the piece, you have nothing to do but to form them well, and to join them together. By this method you may reduce or enlarge a piece to what compaſs you pleaſe, making the ſquares of your paper greater or leſs than thoſe of the original; but they muſt always be of an equal number.

To copy a picture, or other thing, in the ſame ſize and

Drawing and Designing.

and proportion, another method is, to make uſe of varniſhed paper, or of the ſkin of a hog's bladder, very tranſparent, ſuch as is to be had at the gold-beaters. Talc or iſinglaſs will likewiſe do as well. Lay any one of thoſe things upon your piece; through it you will ſee all the ſtrokes and touches, which are to be drawn upon it with a crayon or pencil. Then take it off; and faſtening it under paper or vellum, ſet up both againſt the light in the manner of a window; and with a crayon, or a ſilver needle, mark out upon the paper or vellum you have put uppermoſt, all the lines and touches you ſhall ſee drawn upon the varniſhed paper, bladder, talc, or iſinglaſs, you have made uſe of, and which will plainly appear through this window.

After this manner, making uſe of the window, or of glaſs expoſed to the light, you may copy all ſorts of prints, deſigns, and other pieces on paper or vellum: laying and faſtening them under the paper or vellum upon which you would draw them. And it is a very good and a very eaſy contrivance for doing pieces of the ſame ſize and proportion.

If you have a mind to make pieces look another way, there is nothing to be done but to turn them; laying the printed or drawn ſide upon the glaſs, and faſtening the paper or vellum upon the back of it; remembering to let your lights fall on the left ſide.

A good method likewiſe to take a true copy of a picture in oil, is to give a touch of the pencil upon all the principal ſtrokes, with lake tempered with oil; and to clap upon the whole a paper of the ſame ſize: then paſſing the hand over it, the touches of the lake will ſtick and leave the deſign of your piece expreſſed upon the paper, which may be chalked like other things, But you muſt remember to take off with the crumb of bread what remains of the lake upon the picture before it be dry.

You muſt likewiſe make uſe of pounce, made of powdered charcoal put in a linen rag; with which the piece you would copy muſt be rubbed, after you have pricked all the principal ſtrokes or touches, and faſtened white paper or vellum underneath.

When the piece is marked out upon the vellum you muſt paſs with a pencil of very clear carmine over all the traces, that they may not be effaced as you work: then clean your vellum with the crumb of bread, that no black may remain upon it.

The vellum muſt be paſted upon a plate of braſs or wood, of the ſize you would make your piece, to keep it firm and tight. But this paſting muſt be on the edges of your vellum only, and behind the plate, for which purpoſe your vellum muſt exceed your plate above an inch on every ſide; for the part you paint upon muſt never be paſted; becauſe it would not only give it an ill look, but you could not take it off if you would. Cut off the little ſhags and locks of the vellum; and wetting the fair ſide with a linen cloth dipped in water, clap the other upon the plate with a clean paper between them: ſo much as hangs over muſt be paſted upon the back of the plate, drawing it equally on all ſides, and hard enough to ſtretch it well.

Sect. II. *Of Materials.*

The chief colours made uſe of for painting in miniature are,

Colours, &c.

Carmine.
Venice and Florence lake.
Roſe pink.
Vermilion.
Red lead.
Brown red.
Red orpiment.
Ultramarine.
Verditer.
Indigo.
Gall ſtone.
Yellow ochre.
Dutch pink.
Gamboge.
Naples yellow.
Pale maſticot.
Deep yellow maſticot.
Ivory black.
Lamp black.
True Indian ink.
Biſtre, or wood ſoot.
Raw umber.
Burnt umber.
Sap green.
Verdigris.
Flake white.
Crayons of all colours.
Gold and ſilver ſhells.
Leaf gold and leaf ſilver.

The ſeven tranſparent colours, which are uſed where writing is ſeen through the colour.

Liquid { Lake. Blue. Yellow. Graſs-green. Dark-green. Purple colour. Brown.

Moſt of theſe colours neceſſary for miniature painting may eaſily be prepared by attending to the directions given under the article *Colour-Making*.

As colours taken from earth and other heavy matter are always too coarſe be they never ſo well ground, eſpecially for delicate work, becauſe of a certain ſand remaining in them; the fineſt parts may be drawn out by diluting them with the finger in a cup of water. When they are well ſteeped, let them ſettle a while: then pour out the cleareſt, which will be at top, into another veſſel. This will be the fineſt, and muſt be let dry; and when it is uſed, muſt be diluted with gum water.

If you mix a little of the gall of an ox, a carp, or an eel, particularly of the laſt, in green, black, gray, yellow, and brown, colours, it will not only take away their greaſy nature, but alſo give them a luſtre and brightneſs they have not of themſelves. The gall of eels muſt be taken out when they are ſkinned, and hung upon a nail to dry; and when you would uſe it, it muſt be diluted with brandy; add a little of it mixed with the colour you have diluted already. This likewiſe makes the colour ſtick better to the vellum, which it hardly does when it is greaſy: moreover, this gall hinders it from ſcaling.

Some

Colours, &c.

Some colours are made clearer by fire; as yellow ochre, brown red, ultramarine, and umber: all others are darkened by it. But if you heat the said colours with a sharp fire, they change; for the brown red becomes yellow; yellow ochre becomes red; umber reddens also. Cerufs by fire takes the colour of citron, and is often called *masticot*. Observe, that yellow ochre heated, becomes more tender than it was, and softer than brown red. Likewise brown red heated becomes softer than fine yellow ochre. Both are very proper. The finest and truest ultramarine, heated upon a red-hot iron, becomes more glittering; but it wastes, and is coarser and harder to work with in miniature.

All these colours are diluted in little cups of ivory, made on purpose, or in sea shells, with water in which gum arabic and sugarcandy are put. For instance, in a glass of water put a piece of gum as big as a walnut, and half that quantity of sugarcandy. This last hinders the colours from scaling when they are laid on, which they generally do when they want it, or the vellum is greasy.

This gum water must be kept in a neat bottle corked; and you never must take any out of it with a pencil that has colour upon it, but with a quill or some such thing.

Some of this water is put in the shell with the colour you would temper, and diluted with the finger till it be very fine. If it be too hard, you must let it soften in the shell with the said water before you dilute it. Afterwards let it dry; and do thus with every colour, except lily-green, sap-green, and gamboge, which must be tempered with fair water only. But ultramarine, lake, and bistre, are to be more gummed than other colours.

If you make use of sea shells, you must let them steep two or three days beforehand in water: then cleanse them in boiling hot water, mixed with vinegar, in order to carry off a certain salt, which otherwise sticks to them, and spoils the colours that are put to them.

To know whether colours are sufficiently gummed, you have nothing to do but to give a stroke of the pencil upon your hand when they are diluted, which dries immediately: if they chap and scale, there is too much gum; if they rub out by passing the finger over them, there is too little. It may be seen likewise when the colours are laid on the vellum, by passing the finger over them. If they stick to it like a powder, it is a sign there is not gum enough, and more must be put to the water with which you temper them: but take care you do not put too much; for that makes the colour extremely hard and dry. It may be known likewise by their glueiness and brightness: so the more they are gummed, the darker they paint; and when you have a mind to give a greater strength to a colour than it has of itself, you have nothing to do but to give it a great deal of gum.

Provide yourself with an ivory pallet, very smooth, as big as your hand; on one side of which the colours for the carnation, or naked parts of a picture, are to be ranged in the following manner. In the middle put a great deal of white, pretty largely spread; because it is the colour most made use of: and upon the edge, from the left to the right, place the following colours at a little distance from the white.

Colours, &c.

Masticot.
Dutch pink.
Orpiment.
Yellow ochre.
Green; composed of verditer, Dutch pink, and white, in equal quantities.
Blue; made of ultramarine, indigo, and white, to a great degree of paleness.
Vermilion.
Carmine.
Bistre, and
Black.

On the other side of the pallet, spread some white in the same manner as for the carnation. And when you have a mind to paint draperies, or other things, place near the white the colour you would make them of, in order to work, as shall be shown hereafter.

The use of good pencils is a great matter. In order to make a good choice, wet them a little; and if the hairs keep close together as you turn them upon the finger, and make but one point, they are good: but if they close not together, but make several points, and some are longer than others, they are good for nothing. When they are too sharp pointed, with only four or five hairs longer than the rest, yet closing all together, they are, notwithstanding, good; but they must be blunted with a pair of scissars, taking care at the same time you do not clip away too much. It is proper to have two or three sorts of them; the largest for laying the grounds and dead colouring, and the smallest for finishing.

To bring the hairs of your pencil to join close together and make a good point, you must often put the pencil just between your lips when you are at work; moistening and pressing it close with the tongue, even when there is colour upon it; for if there be too much, some of it is taken off by this means, and enough left for giving fine and equal touches. You need not apprehend this will do you any harm. None of the colours for miniature, except orpiment, when they are prepared, have either ill taste or ill quality. This expedient must especially be used for dotting, and for finishing, particularly the naked parts of a picture, that the touches may be neat and fair, and not too much charged with colour. As for draperies and other things, as well in dead colouring as in finishing, it is sufficient, in order to make the hairs of your pencil join well, and to unload it when it has too much colour, to draw it upon the edge of the shell, or upon the paper you must put upon your work to rest your hand on, giving some strokes upon it before you work upon your piece.

To work well in miniature, you must do it in a room that has but one window, and fix yourself very near it, with a table and desk almost as high as the window; placing yourself in such a manner, that the light may always come in on the left side, and never forward or on the right.

When you would lay a colour on all parts equally strong, as for a ground, you must make your mixtures in shells, and put in enough for the thing you design to paint; for if there be not enough, it is a great chance but the colour you mix afterwards is too dark or too light.

Of Working.

Sect. III. *Of Working.*

After having ſpoke of vellum, pencils, and colours, let us now ſhow how they are to be employed. In the firſt place, then, when you would paint a piece, be it carnation, drapery, or any thing elſe, you muſt begin by dead-colouring; that is to ſay, by laying your colours on with liberal ſtrokes of the pencil, in the ſmootheſt manner you can, as the painters do in oil; not giving it all the force it is to have for a finiſhing; that is, make the lights a little brighter, and the ſhades leſs dark, than they ought to be; becauſe in dotting upon them, as you muſt do after dead-colouring, the colour is always fortified, and would at laſt be too dark.

There are ſeveral ways of dotting; and every painter has his own. Some make their dots perfectly round; others make them a little longiſh; others hatch by little ſtrokes that croſs each other every way, till the work appears as if it had been wrought with dots. This laſt method is the beſt, the boldeſt, and the ſooneſt done: wherefore ſuch as would paint in miniature ought to uſe it, and to inure themſelves from the firſt to dot in the plump and the ſoft way; that is to ſay, where the dots are loſt, in a manner, in the ground upon which you work, and only ſo much appears as is ſufficient to make the work ſeem dotted. The hard and the dry way is quite the reverſe, and always to be avoided. This is done by dotting with a colour much darker than your ground, and when the pencil is not moiſtened enough with the colour, which makes the work ſeem rough and uneven.

Study likewiſe carefully to loſe and drown your colours one in another, ſo that it may not appear where they disjoin; and to this end, ſoften or allay your touches with colours that partake of both, in ſuch ſort that it may not appear to be your touches which cut and disjoin them. By the word *cut*, we are to underſtand what manifeſtly ſeparates and divides, and does not run in and blend itſelf with the neighbouring colours; which is rarely practiſed but upon the borders of drapery.

When your pieces are finiſhed, to heighten them a little, give them a fine air; that is to ſay, give, upon the extremity of the lights, ſmall touches with a colour yet lighter, which muſt be loſt and drowned with the reſt.

When the colours are dry upon your pallet or in your ſhells, in order to uſe them, they muſt be diluted with water. And when you perceive they want gum, which is ſeen when they eaſily rub off the hand or the vellum if you give a touch with them upon either, they muſt be tempered with gum water inſtead of pure water, till they are in condition.

There are ſeveral ſorts of grounds for pictures and portraitures. Some are wholly dark, compoſed of biſtre, umbre, and Cologn earth, with a little black and white; others more yellow, in which is mixed a great deal of ochre; others grayer, which partake of indigo. In order to paint a ground, make a waſh of the colour or mixture you would have it, or according to that of the picture or portraiture you would copy; that is to ſay, a very light lay, in which there is hardly any thing but water, in order to ſoak the vellum. Then paſs another lay over that, ſomewhat thicker, and ſtrike it on very ſmoothly with large ſtrokes as quick as you can, not touching twice in the ſame place before it be dry; becauſe the ſecond ſtroke carries off what has been laid on at the firſt, eſpecially when you lean a little too light upon the pencil.

Other dark grounds are likewiſe made of a colour a little greeniſh; and thoſe are moſt in uſe, and the propereſt to lay under all ſorts of figures and portraitures; becauſe they make the carnation, or naked parts of a picture, appear very fine; are laid on very eaſily, and there is no occaſion to dot them, as one is often obliged to do the others, which are rarely made ſmooth and even at the firſt; whereas in theſe one ſeldom fails of ſucceſs at the firſt bout. To make them, you muſt mix black, Dutch pink, and white, all together: more or leſs of each colour, according as you would have them darker or lighter. You are to make one lay very light, and then a thicker, as of the firſt grounds. You may alſo make them of other colours, if you pleaſe; but theſe are the moſt common.

When you paint a holy perſon upon one of theſe grounds, and would paint a ſmall glory round the head of your figure, you muſt not lay the colour too thick in that part, or you may even lay none at all, eſpecially where this glory is to be very bright; but lay for the firſt time with white and a little ochre mixed together, of a ſufficient thickneſs; and in proportion as you go from the place of the head, put a little more ochre; and to make it loſe itſelf, and die away with the colour of the ground, hatch with a free ſtroke of the pencil, following the round of the glory ſometimes with the colour of which it is made, and ſometimes with that of the ground, mixing a little white or ochre with the laſt when it paints too dark to work with: and do this till one be inſenſibly loſt in another, and nothing can be ſeen to disjoin them.

To fill an entire ground with a glory, the brighteſt part is laid on with a little ochre and white, adding more of the firſt in proportion as you come nearer the edges of the picture: and when the ochre is not ſtrong enough (for you muſt always paint darker and darker), add gall ſtone, afterwards a little carmine, and laſtly biſtre. This firſt laying, or dead colouring, is to be made as ſoft as poſſible; that is to ſay, let theſe ſhadowings loſe themſelves in one another without gap or interſection. Then the way is to dot upon them with the ſame colours, in order to drown the whole together; which is pretty tedious, and a little difficult, eſpecially when there are clouds of glory on the ground. Their lights muſt be fortified in proportion as you remove from the figure, and finiſhed as the reſt, by dotting and rounding the clouds; the bright and obſcure parts of which muſt run inſenſibly into one another.

For a day ſky, take ultramarine and a good deal of white, and mix them together. With this make a lay, as ſmooth as you can, with a large pencil and liberal ſtrokes, as for grounds; applying it paler and paler as you deſcend towards the horizon; which muſt be done with vermilion or red lead, and with white of the ſame ſtrength with that where the ſky ends, or ſomething leſs; making this blue loſe itſelf in the red, which you bring down to the ſkirts of the earth, or tops of houſes; mixing towards the end gall ſtone and

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Of Working.

a good deal of white, in ſuch a manner that the mixture be ſtill paler than the former, without any viſible interſection or parting between all theſe colours of the ſky.

When there are clouds in the ſky, you may ſpare the places where they are to be; that is to ſay, you need not lay on any blue there, but form them, if they are reddiſh, with vermilion gall ſtone, and white, with a little indigo; and if they are more upon the black, put in a good deal of the laſt; painting the lights of one and the other with maſticot, vermilion, and white, more or leſs of any of theſe colours, according to the ſtrength you would give them, or according to that of the original you copy; rounding the whole as you dot; for it is a difficult matter to lay them very ſmooth at the firſt painting: and if the ſky is not even enough, you muſt dot it alſo.

It is at your pleaſure to exempt the places of the clouds, for you may lay them upon the ground of the ſky; heightening the bright parts by putting a good deal of white, and fortifying the ſhadows by uſing leſs. This is the ſhorteſt way.

A night or ſtormy ſky, is done with indigo, black, and white, mixed together; which is laid as for a day ſky. To this mixture muſt be added ochre, vermilion, or brown red, for the clouds; the lights of which are to be of maſticot or red lead, and a little white, now redder, now yellower, at diſcretion. And when it is a tempeſtuous ſky, and lightning appears in ſome places, be it blue or red, it is to be done as in a day ſky, drowning and loſing the whole together at the firſt forming or dead colouring, and at the finiſhing.

Sect. IV. *Of Draperies.*

To paint a blue drapery, put ultramarine near the white upon your pallet; and mix a part of the one with the other, till it makes a fine pale, and has a body. With this mixture you muſt form the brighteſt parts; and then adding more ultramarine, form ſuch as are darker; and go on after this manner till you come to the deepeſt plaits and the thickeſt ſhades, where you muſt lay pure ultramarine: and all this muſt be done as for a firſt forming or dead colouring; that is to ſay, laying the colour on with free ſtrokes of the pencil, yet as ſmooth as you can; loſing the lights in the ſhadows with a colour neither ſo pale as the light nor ſo dark as the ſhades. Then dot with the ſame colour as in the firſt forming, but a ſmall matter deeper; that the dots may be fairly ſeen. All the parts muſt be drowned one in another, and the plaits appear without interſection. When the ultramarine is not dark enough to make the deeper ſhadows, how well ſoever it be gummed, mix a little indigo with it to finiſh them. And when the extremities of the lights are not bright enough, heighten them with white and a very little ultramarine.

A drapery of carmine is done in the ſame manner as the blue; except that in the darkeſt places there is to be a lay of pure vermilion, before you dead colour with carmine, which muſt be applied at top; and in the ſtrongeſt ſhades, it muſt be gummed very much. To deepen it the more, mix a little biſtre with it.

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There is likewiſe made another red drapery, which is firſt drawn with vermilion, mixing white with it to dead colour the bright places, laying it pure and unmixed for thoſe that are darker, and adding carmine for the grand ſhades. It is finiſhed afterwards, like other draperies, with the ſame colours. And when the carmine with the vermilion do not darken enough, work with the firſt alone, but only in the deepeſt of the ſhades.

A drapery of lake is made in the ſame manner with that of carmine; mixing a good deal of white with it for the bright places, and very little for thoſe that are dark. It is finiſhed likewiſe with dotting; but you have nothing to do with vermilion in it.

Violet draperies are likewiſe done after this manner; after making a mixture of carmine and ultramarine, putting always white for the bright parts. If you would have your violet be columbine or dove colour, there muſt be more carmine than ultramarine: but if you would have it bluer and deeper, put more ultramarine than carmine.

A drapery is made of a fleſh colour, beginning with a lay made of white, vermilion, and very pale lake; and making the ſhades with the ſame colours, uſing leſs white in them. This drapery muſt be very pale and tender, becauſe the ſtuff of this colour is thin and light; and even the ſhades of it ought not to be deep.

To make a yellow drapery, put a lay of maſticot over all; then one of gamboge upon that, excepting the brighteſt places, where the maſticot muſt be left entire; the dead colour with ochre, mixed with a little gamboge and maſticot, putting more or leſs of the laſt according to the ſtrength of the ſhades. And when theſe colours do not darken enough, add gall ſtone. And gall ſtone pure and unmixed is uſed for the thickeſt ſhades; mixing a little biſtre with it, if there be occaſion to make them ſtill darker. You finiſh by dotting with the ſame colours you dead-coloured with, and loſing the lights and the ſhades in one another.

If you put Naples yellow, or Dutch pink, in lieu of maſticot and gamboge, you will make another ſort of yellow.

The green drapery is made by a general lay of verditer; with which, if you find it too blue, mix maſticot for the lights, and gamboge for the ſhades. Afterwards add to this mixture lily-green or ſap-green, to ſhadow with; and as the ſhades are thicker, put more of theſe laſt greens, and even work with them pure and unmixed where they are to be extremely dark. You finiſh with the ſame colours, a little darker.

By putting more yellow, or more blue, in theſe colours, you may make different ſorts of green as you pleaſe.

To make a black drapery, you dead colour with black and white, and finiſh with the ſame colour, putting more black as the ſhades are thicker; and for the darkeſt, mix indigo with it, eſpecially when you would have the drapery appear like velvet. You may always give ſome touches with a brighter colour, to heighten the lights of any drapery whatſoever.

A white woollen drapery is made by a lay of white, in which there muſt be a very ſmall matter of ochre, orpiment, or gall ſtone, that it may look a little yellowiſh.

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lowiſh. Then dead-colour, and finiſh the ſhades with blue, a little black, white, and biſtre; putting a great deal of the laſt in the darkeſt.

The light gray is begun with black and white, and finiſhed with the ſame colour deeper.

For a brown drapery, make a lay of biſtre, white, and a little brown red; and ſhadow with this mixture, made a little darker.

There are other draperies, called *variable*, becauſe the lights are of a different colour from the ſhades. Theſe are moſtly uſed for the veſtments of angels, for young and gay people, for ſcarfs and other airy attire, admitting of a great many folds, and flowing at the pleaſure of the wind. The moſt common are the violets: of which they make two ſorts; one, where the lights are blue; and the other, where they are yellow.

For the firſt, put a lay of ultramarine and very pale white upon the lights; and ſhadow with carmine, ultramarine, and white, as for a drapery wholly violet; ſo that only the grand lights appear blue. Yet they muſt be dotted with violet, in which there is a great deal of white, and loſt inſenſibly in the ſhades.

The other is done by putting upon the lights only, inſtead of blue, a lay of maſticot; working the reſt as in the drapery all violet, excepting that it muſt be dotted, and the light parts blended with the ſhadowy, that is, the yellow with the violet, with a little gamboge.

The carmine red is done like the laſt; that is, let the lights be done with maſticot, and the ſhades with carmine; and to loſe the one in the other, make uſe of gamboge.

The lake red is done like that of carmine.

The green is done as the lake: always mixing verditer with lily or ſap green, to make the ſhades; which are not very dark.

Several other ſorts of draperies may be made at diſcretion, always taking care to preſerve the union of the colours, not only in one ſort of cloth or ſo, but alſo in a group of ſeveral figures; avoiding, as much as the ſubject will allow, the putting of blue near the colour of fire, of green againſt black; and ſo of other colours which cut and disjoin, and whoſe union is not kind enough.

Several other draperies are made of foul colours, as brown red, biſtre, indigo, &c. and all in the ſame manner. Likewiſe of other colours, ſimple and compound; the agreement between which is always to be minded, that the mixture may produce nothing harſh and diſagreeable to the eye. No certain rule can be laid down for this. The force and effect of your colours are only to be known from uſe and experience, and you muſt work according to that knowledge.

Linen cloths are done thus: After drawing the plaits or folds, as is done in a drapery, put a lay of white over all; then dead colour, and finiſh the ſhades with a mixture of ultramarine, black, and white, uſing more or leſs of the laſt, according to their ſtrength or tenderneſs; and in the greateſt deepenings put biſtre, mixed with a little white; giving only ſome touches of this mixture, and even of pure biſtre, upon the extremities of the greateſt ſhadows, where the folds muſt be drawn, and loſt with the reſt.

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They may be done in another manner, by making a general lay of this mixture of ultramarine, black, and very pale white; and dead colour (as has been ſaid before) with the ſame colour, but a little deeper. And when the ſhades are dotted and finiſhed, heighten the lights with pure white, and loſe them with the deepenings of the linen. But of whatever ſort you make them, when they are finiſhed, you muſt give a yellowiſh teint of orpiment and white to certain places; laying it lightly on, and as it were in water; ſo that what is underneath may, notwithſtanding, plainly appear, as well the ſhadows as the dotting.

Yellow linen cloth is done by putting a lay of white, mixed with a little ochre. Then form and finiſh the ſhades with biſtre, mixed with white and ochre; and in the thickeſt ſhades uſe pure biſtre; and before you finiſh, give ſome teints here and there of ochre and white, and others of white and ultramarine, as well upon the ſhades as the lights; but let them be very bright: and drown the whole together in dotting, and it will look finely. As you finiſh, heighten the extremities of the lights with maſticot and white. You may add to this ſort of linen, as well as to the white, certain bars from ſpace to ſpace, as in Turkey mantuas; that is, ſmall ſtripes blue and red with ultramarine and carmine; one of red between two of blue, very bright and clear upon the lights, and deeper upon the ſhades. Virgins are pretty often dreſſed with veils of this ſort (by Popiſh painters), and ſcarfs of this kind are put about necks that are bare; becauſe they become the teint mighty well.

If you would have both theſe ſorts of linen tranſparent, and the ſtuff or other thing that is beneath appear through them, make the firſt lay for them very light and clear, and mix in the colour to ſhadow with, a little of that which is underneath, eſpecially towards the end of the ſhades; and only do the extremities of the lights, for the yellow, with maſticot and white; and for the white, with pure white.

They may be done in another manner, eſpecially when you would have them altogether as clear as muſlin, lawn, or gauze. To this end form and finiſh what is to be beneath, as if nothing was to be put over it. Then mark out the light and clear folds with white or maſticot; and a ſhadowy with biſtre and white, or with black, blue, and white, according to the colour you would make them of; making the reſt ſomewhat fainter: yet this is not neceſſary but for the parts that are not to be ſo clear.

Crape is done the ſame way; excepting that the folds of the ſhades and the lights, and the borders too, are to be marked out with little filaments of black upon what is underneath; which is likewiſe to be finiſhed beforehand.

When you would make a ſtuff like a watered tabby, make the waves upon it with a colour a little lighter, or a little darker, in the lights and the ſhades.

There is a manner of touching draperies which diſtinguiſhes the ſilken from the woollen. The laſt are more terreſtrial and ſenſible; the others more light and fading. But it muſt be obſerved, that this is an effect which depends partly upon the ſtuff and partly upon the colour; and for the employing theſe in a manner ſuitable to the ſubjects and the deepenings of painting, Of Draperies.

painting, we ſhall here touch upon their different qualities.

We have no colour which partakes more of light, nor which comes nearer the air, than white; which ſhows it to be fickle and fleeting. It may, nevertheleſs, be held and brought to by ſome neighbouring colour, more heavy and ſenſible, or by mixing them together.

Blue is a moſt fleeting colour: and ſo we ſee, that the ſky and the remoteſt views of a picture are of this colour; but it will become lighter and fickler in proportion as it is mixed with white.

Pure black is the heavieſt and moſt terreſtrial of all colours; and the more of it you mix with others, the nearer you bring them to the eye.

Nevertheleſs, the different diſpoſitions of black and white make alſo their effects different: for white often makes black diſappear, and black brings white more into view; as in the reflection of globes, or other figures to be made round, where there are always parts that fly as it were from the eye, and deceive it by the craft of art: and under the white are here comprehended all the light colours; as under the black, all the heavy colours.

Ultramarine is then ſoft and light.

Ochre is not ſo much ſo.

Maſticot is very light; and ſo is verditer.

Vermilion and carmine come near this quality.

Orpiment and gamboge not ſo near.

Lake holds a certain mean, rather ſoft than rough.

Dutch pink is an indifferent colour, eaſily taking the quality of others. So it is made terreſtrial by mixing it with colours that are ſo; and, on the contrary, the moſt light and fleeting by joining it with white or blue.

Brown red, umber, dark greens, and biſtre, are the heavieſt and moſt terreſtrial, next to black.

Skilful painters, who underſtand perſpective, and the harmony of colours, always obſerve to place the dark and ſenſible colours on the fore parts of their pictures; and the moſt light and fleeting they uſe for the diſtances and remote views. And as for the union of colours, the different mixtures that may be made of them will learn you the friendſhip or antipathy they have to one another. And upon this you muſt take your meaſures for placing them with ſuch agreement as ſhall pleaſe the eye.

For the doing of lace, French points, or other things of that nature, put over all a lay of blue, black, and white, as for linen: then heighten the flowerwork with pure white: afterwards make the ſhades above with the firſt colour, and finiſh them with the ſame. When they are upon the carnation or naked parts of a picture, or upon any thing elſe that you would ſhow through another, finiſh what is beneath, as if nothing was to be put over it: and at top, make the points or lace with pure white, ſhadowing and finiſhing them with the other mixture.

If you would paint a fur, you muſt begin with a kind of drapery, done, if it be dark, with biſtre and white, making the ſhadowings of the ſame colour, with leſs white. If the fur be white, do it with blue, white, and a little biſtre. And when this beginning, or firſt forming, is done, inſtead of dotting, draw ſmall ſtrokes, turning, now in one manner, now in another, according to the courſe and flatting of the hair. Heighten the lights of dark furs with ochre and white, and of the other with white and a little blue.

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For doing a building, if it be of ſtone, take indigo, biſtre, and white, with which make the beginning or firſt form of it: and for ſhadowing it, put leſs of this laſt; and more biſtre than indigo, according to the colour of the ſtone you would paint. To theſe you may likewiſe add a little ochre, both for the forming and the finiſhing. But to make it finer, you muſt give, here and there, eſpecially for old fabrics, blue and yellow teints, ſome with ochre, others with ultramarine, mixing always white with them, whether before the firſt forming, provided they appear through the draught, or whether upon it, loſing or drowning them with the reſt when you finiſh.

When the building is of wood, as there are many ſorts, it is done at diſcretion; but the moſt ordinary way is to begin or firſt form with ochre, biſtre, and white, and finiſh without white, or with very little; and if the ſhades are deep, with pure biſtre. In the other they add ſometimes vermilion, ſometimes green or black; in a word, juſt according to the colour they would give it; and they finiſh with dotting, as in draperies and every thing elſe.

Sect. V. *Of Carnations, or the naked parts of a Painting.*

There are in carnation ſo many different colourings, that it would be a difficult thing to give general rules upon ſo variable a ſubject. Nor are they minded, when one has got, by cuſtom and practice, ſome habit of working eaſily: and ſuch as are arrived to this degree, employ themſelves in copying their originals, or elſe they work upon their ideas, without knowing how: inſomuch, that the moſt ſkilful, who do it with leſs reflection and pains than others, would likewiſe be more put to it to give an account of their maxims and knowledge in the matter of painting, if they were to be aſked what colours they made uſe of for ſuch and ſuch a colouring, a teint here, and another there.

Nevertheleſs, as beginners want ſome inſtruction at the firſt, we will ſhew in general after what manner ſeveral carnations are to be done.

In the firſt place, After having drawn your figure with carmine, and ordered your piece, apply for women and children, and generally for all tender colourings, a lay of white, mixed with a very little of the blue made for faces, of which we have told the compoſition; but let it hardly be ſeen.

And for men, inſtead of blue, they put in this firſt lay a little vermilion; and when they are old, a little ochre is mixed with it.

Afterwards follow all the traces with vermilion, carmine, and white, mixed together; and begin all the ſhades with this mixture, adding white in proportion as they are weaker; and putting but little in the darkeſt, and none, in a manner, in certain places where ſtrong touches are to be given: for inſtance, in the corner of the eye; under the noſe; at the ears; under the chin; in the ſeparations of the fingers; in all joints; at the corners of the nails; and generally in every part where you would mark out ſeparations in

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in ſhades that are obſcure. Neither need you fear to give to thoſe places all the force and ſtrength they ought to have as ſoon as you begin or firſt form them, becauſe in working at top with green, the red you have put there is always weakened.

After having begun, or firſt formed, or dead-coloured, with red, make blue teints with ultramarine and a great deal of white, upon the parts which fly from the eye; that is to ſay, upon the temples; under and in the corners of the eyes; on both ſides the mouth, above and below; a little upon the middle of the forehead; between the noſe and the eyes; on the ſide of the cheeks; on the neck and other places where the fleſh aſſumes a bluiſh caſt. Yellowiſh teints are likewiſe made with ochre or orpiment, and a little vermilion mixed with white, under the eyebrows, on the ſides of the noſe towards the bottom, a little underneath the cheeks, and upon the other parts which riſe and come nearer the eye. It is eſpecially from theſe teints that the natural complexion is to be obſerved, in order to catch it; for painting being an imitation of nature, the perfection of the art conſiſts in the juſtneſs and ſimplicity of the repreſentation, eſpecially in face painting.

When, therefore, you have done your firſt lay, your dead-colouring, and your teints, you muſt work upon the ſhades, dotting with green for the carnations or naked parts, mixing, according to the rule we have given for the teints, a little blue for the parts which fly from the eye; and, on the other hand, making it a little yellower for thoſe that are more ſenſible; that is to ſay, which riſe, and come nearer the eye: and at the end of the ſhades, on the ſide of the light, you muſt blend and loſe your colour inſenſibly in the ground of the carnation with blue, and then with red, according to the places where you paint. If this mixture of green does not work dark enough at firſt, paſs over the ſhades ſeveral times, now with red, and now with green; always dotting: and this do till they are as they ſhould be.

And if you cannot with theſe colours give the ſhades all the force they ought to have, finiſh, in the darkeſt, with biſtre mixed with orpiment, ochre, or vermilion, and ſometimes with pure biſtre, according to the colouring you would make, but lightly, laying on your colour very clear.

You muſt dot upon the clear and bright places with a little vermilion or carmine, mixed with much white, and a very ſmall matter of ochre, in order to loſe them with the ſhadowy, and to make the teints die away inſenſibly into one another; taking care, as you dot, or hatch, to make your ſtrokes follow the turnings and windings of the fleſhy parts. For though the rule be to croſs always, this dotting or hatching ought to appear a little more here, becauſe it rounds the parts. And as this mixture might make a colouring too red, if it was always to be uſed, they work likewiſe in every part, to blend the teints and the ſhades with blue and a little green, and much white, ſo mixed as to be very pale; excepting, neverthelеſs, that this colour muſt not be put upon the cheeks, nor upon the extremities of the clear parts, no more than the other mixture upon theſe laſt, which muſt be left with all their light; as certain places of the chin, of the noſe, and of the forehead, and upon the cheeks; which, and the cheeks, ought nevertheleſs to be redder than the reſt, as well as the feet, the hollows of the hands, and the fingers of both.

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Obſerve, that theſe two laſt mixtures ought to be ſo pale, that the work ſhall hardly be viſible; for they ſerve only to ſoften it; to unite the teints with one another, and the ſhades with the lights, and to drown the traces. Care muſt likewiſe be taken that you work not too much with the red mixture upon the blue teints, nor with the blue upon the others; but change the colour from time to time, when you perceive it works too blue or too red, till the work be finiſhed.

The white of the eyes muſt be ſhadowed with this ſame blue, and a little fleſh colour; and the corners, on the ſide of the noſe, with vermilion and white; giving them a little touch of carmine. The whole is ſoftened with this mixture of vermilion, carmine, white, and a very ſmall matter of ochre.

The apples or balls of the eyes are done with the mixture of ultramarine and white; the laſt prevailing a little; adding a little biſtre, if they are yellowiſh; or a little black, if they are gray. Make the little black circle in the middle, called the *cryſtal of the eye;* and ſhadow the balls with indigo, biſtre, or black, according to the colour they are of; giving to each a ſmall touch of pure vermilion round the cryſtal; which muſt be loſt with the reſt at the finiſhing. This gives vivacity to the eye.

The round or circumference of the eye is done with biſtre and carmine; that is to ſay, the ſlits or partings, and the eyelids, when they are large and bold; eſpecially the upper ones; which muſt afterwards be ſoftened with the red or blue mixtures we have mentioned before, to the end they may be loſt in one another, and nothing ſeem interſected. When this is done, give a little touch of pure white upon the cryſtal, on the ſide of the lights. This makes the eye ſhine, and gives life to it.

The mouth is dead-coloured with vermilion, mixed with white; and finiſhed with carmine, which is ſoftened as the reſt. And when the carmine does not work dark enough, mix a little biſtre with it. This is to be underſtood of the corners in the ſeparation of the lips; and particularly, of certain mouths half open.

The hands, and all the other parts of carnation, are done in the ſame manner as the faces; obſerving, that the ends of the fingers be a little redder than the reſt. When your whole work is formed and dotted, mark the ſeparations of all the parts with little touches of carmine and orpiment mixed together, as well in the ſhadowy as the light places; but a little deeper and ſtronger in the firſt, and loſe them in the reſt of the carnation.

The eyebrows and the beard are dead-coloured, as are the ſhades of carnations; and finiſhed with biſtre, ochre, or black, according to the colour they are of, drawing them by little ſtrokes the way they ought to go; that is to ſay, give them all the nature of hair. The lights of them muſt be heightened with ochre and biſtre, a little vermilion, and much white.

For the hair of the head, make a lay of biſtre, ochre, and white, and a little vermilion. When it is very dark coloured, uſe black inſtead of ochre. Afterwards form the ſhadowy parts with the ſame colours, putting

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less white in them; and finish with pure bistre, or mixed with ochre or black, by small strokes very fine, and close to each other, waving and buckling them according to the curling of the hair. The light parts must also be heightened by little strokes with ochre or orpiment, white, and a little vermilion. After which, lose the lights and the shades in each other, by working sometimes with a dark and sometimes with a light colour.

And for the hair about the forehead, through which the skin is seen, it must be first formed with the colour thereof, and that of the carnation, working and shadowing with one and the other, as if you designed to paint none. Then form it, and finish with bistre. The lights are to be heightened as the other. Gray hair is dead-coloured with white, black, and bistre, and finished with the same colour, but deeper; heightening the bright and clear parts of the hair, as well as those of the eyebrows and the beard, with white and very pale blue, after having formed them as the others, with the colour of the flesh or skin; and finish with bistre.

But the most important thing is to soften one's work; to blend the teints in one another, as well as the beard and the hair about the forehead, with the other hair and the carnation; taking especial care not to work rough and dry; and that the traces, turnings, and windings of the carnation or naked parts, be not interfected. You must likewise accustom yourself to put white in your colours only in proportion as you work lighter or darker; for the colour you use the second time must be always a little stronger and deeper than the first, unless it be for softening.

Different colourings are easily made, by putting more or less of red, or blue, or yellow, or bistre, whether for the dead-colouring, or for the finishing.— That for women ought to be bluish; that for children a little red; and both fresh and florid. That for men ought to be yellower; especially when they are old.

To make a colouring of death, there must be a first lay of white and orpiment, or a very pale ochre: dead-colour with vermilion, and lake, instead of carmine, and a good deal of white; and afterwards work over it with a green mixture, in which there is more blue than any other colour, to the end the flesh may be livid and of a purple colour. The tints are done the same way as in another colouring; but there must be a great many more blue than yellow ones, especially upon the parts which fly from the sight, and about the eyes; and the last are only to be upon the parts which rise and come nearer the eye. They are made to die away in one another, according to the ordinary manner; sometimes with very pale blue, and sometimes with ochre and white, and a little vermilion; softening the whole together. The parts and contours must be rounded with the same colours. The mouth is to be, in a manner, of a quite violet. It is dead-coloured, however, with a little vermilion, ochre, and white; but finished with lake and blue; and to give it the deep strokes, they take bistre and lake, with which they likewise do the same to the eyes, the nose, and the ears. If it be a crucifix, or some martyr, upon whom blood is to be seen, after the finishing the carnation, form it with vermilion, and finish it with carmine, making in the drops of blood a little bright reflecting spark, to round them. For the crown of thorns, make a lay of sea green and masticot; shadow it with bistre and green; and heighten the clear and light parts with masticot.

Of Landscapes.

Iron is formed, or first laid, with indigo, a little black and white; and finished with pure indigo, heightening it with white.

For painting fire and flames, the lights are done with masticot and orpiment; and for the shades, they mix vermilion and carmine.

A smoke is done with black, indigo, and white, and sometimes with bistre; one may likewise add vermilion or ochre, according to the colour it is to be of.

Pearls are painted by putting a lay of white, and a little blue: they are shadowed and rounded with the same colour, deeper; a small white dot is made almost in the middle on the side of the light; and on the other side, between the shadow and the edge of the pearl, they give a touch with masticot, to make the reflection; and under the pearls is made a little shadow of the colour of the ground they are upon.

Diamonds are made with pure black; then they heighten them with little touches of white on the side of the light. It is the same thing for any other jewels you have a mind to paint: there is nothing to be done but to change the colour.

For making a figure of gold, put a lay of shell-gold, and shadow it with gallstone. Silver is done the same way; excepting that it must be shadowed with indigo.

One great means of acquiring a perfection in the art, is to copy excellent originals. We enjoy with pleasure and tranquillity the labour and pains of others. But a man must copy a great number before he is able to produce as fine effects; and it is better to be a good copier than a bad author.

Sect. VI. *Of Landscapes.*

In the first place, After having ordered the economy of your landscape as of your other pieces, you must form the nearest grounds or lands, when they are to appear dark, with sap or lily-green, bistre, and a little verditer, to give a body to your colour; then dot with this mixture, but a little darker, adding sometimes a little black to it.

For such pieces of ground as the light falls upon, and which are therefore clear and bright, make a lay of ochre and white, then shadow and finish with bistre. In some they mix a little green, particularly for shadowing and finishing.

There are sometimes upon the fore part certain reddish lands; which are dead-coloured with brown-red, white, and a little green; and finished with the same, putting a little more green in them.

For the making of grass and leaves upon the foreground, you must, when that is finished, form with sea-green, or verditer, and a little white; and for those that are yellowish, mix masticot. Afterwards shadow them with lily-green, or bistre and gallstone, if you would have them appear withered.

The grounds or lands at a little distance are formed with

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with verditer, and ſhadowed and finiſhed with ſap-green, adding biſtre for ſome of the touches here and there.

Such as are at a greater diſtance, are done with ſea-green and a little blue; and ſhadowed with verditer.

In a word, the farther they go, the more bluiſh they are to be made; and the fartheſt diſtance ought to be of ultramarine and white; mixing in ſome places ſmall touches of vermilion.

Water is painted with indigo and white, and ſhadowed with the ſame colour, but deeper; and to finiſh it, inſtead of dotting, they do nothing but make ſtrokes and traces without croſſing; giving them the ſame turn with the waves, when there are any. Sometimes a little green muſt be mixed in certain places, and the light and clear parts heightened with pure white, particularly where the water foams.

Rocks are dead-coloured like buildings of ſtone; excepting that a little green is mixed for forming and ſhadowing them. Blue and yellow teints are made upon them, and loſt with the reſt in finiſhing. And when there are ſmall branches, with leaves, moſs, or graſs, when all is finiſhed, they are to be raiſed at top with green and maſticot. They may be made yellow, green, and reddiſh, for appearing dry in the ſame manner as on the ground. Rocks are dotted as the reſt; and the farther they are off the more grayiſh they are made.

Caſtles, old houſes, and other buildings of ſtone and wood, are done in the manner above mentioned; ſpeaking of thoſe things, when they are upon the firſt lines. But when you would have them appear at a diſtance, you muſt mix brown-red and vermilion, with much white; and ſhadow very tenderly with this mixture; and the farther they are off, the weaker are the ſtrokes to be for the ſeparations. If they are covered with ſlate, it is to be made bluer than the reſt.

Trees are not done till the ſky be finiſhed; one may, nevertheleſs, ſpare the places of them when they contain a good number; and however it be, ſuch as come near the eye, are to be dead-coloured with verditer, mixing ſometimes ochre; and ſhadowed with the ſame colours, adding lily-green. Afterwards you muſt work leaves upon them by dotting without croſſing: for this muſt be done with ſmall longiſh dots, of a darker colour, and pretty full of it, which muſt be conducted on the ſide the branches go, by little tufts of a little darker colour. Then heighten the lights with verditer or ſea-green, and maſticot, making leaves in the ſame manner; and when there are dry branches or leaves, they are dead-coloured with brown-red or gallſtone, with white; and finiſhed with gallſtone, without white, or with biſtre.

The trunks of trees are to be dead-coloured with ochre, white, and a little green, for the light and clear parts; and for the dark, they mix black, adding biſtre and green for ſhadowing one and the other.—Blue and yellow tints are likewiſe made upon them and little touches given here and there with white and maſticot; ſuch as you ordinarily ſee upon the bark of trees.

The branches which appear among the leaves are done with ochre, verditer, and white; or with biſtre and white; according to the light they are placed in. They muſt be ſhadowed with biſtre and lily-green.

Trees, which are at a little diſtance, are dead-coloured with verditer and ſea-green; and are ſhadowed and finiſhed with the ſame colours, mixed with lily-green. When there are ſome which appear yellowiſh, lay with ochre and white, and finiſh with gallſtone.

For ſuch as are in the diſtances and remote views, you muſt dead-colour with ſea-green; with which, for finiſhing, you muſt mix ultramarine. Heighten the lights of one and the other with maſticot, by ſmall diſjoined leaves.

It is the moſt difficult part of landſcape, in manner of miniature, to leaf a tree well. To learn, and break one's hand to it a little, the way is to copy good ones; for the manner of touching them is ſingular, and cannot be acquired but by working upon trees themſelves; about which you muſt obſerve to make little boughs, which muſt be leafed, eſpecially ſuch as are below and toward the ſky.

And generally, let your landſcapes be coloured in a handſome manner, and full of nature and truth; for it is that which gives them all their beauty.

Of Flowers.

Sect. VII. *Of Flowers.*

It is an agreeable thing to paint flowers, not only on account of the ſplendour of their different colours, but alſo by reaſon of the little time and pains that are beſtowed in trimming them. There is nothing but delight in it; and, in a manner, no application. You maim and bungle a face, if you make one eye higher than another; a ſmall noſe with a large mouth; and ſo of other parts. But the fears of theſe diſproportions conſtrain not the mind at all in flower painting; for unleſs they be very remarkable, they ſpoil nothing. For this reaſon, moſt perſons of quality, who divert themſelves with painting, keep to flowers. Nevertheleſs, you muſt apply yourſelf to copy juſtly; and for this part of miniature, as for the reſt, we refer you to nature, for ſhe is your beſt model. Work, then, after natural flowers; and look for the tints and different colours of them upon your pallet: a little uſe will make you find them eaſily; and to facilitate this to you at the firſt, we ſhall, in the continuance of our deſign, ſhow the manner of painting ſome; for natural flowers are not always to be had; and one is often obliged to work after prints, where nothing is ſeen but graving.

It is a general rule, that flowers are deſigned and laid like other figures; but the manner of forming and finiſhing them is different: for they are firſt formed only by large ſtrokes and traces, which you muſt turn at the firſt the way the ſmall ones are to go, with which you finiſh; this turning aiding much thereto. And for finiſhing them, inſtead of hatching or dotting, you draw ſmall ſtrokes very fine, and very cloſe to one another, without croſſing; repaſſing ſeveral times, till your dark and your clear parts have all the force you would give them.

Of Roses.—After making your firſt ſketch, draw with carmine the red roſe, and apply a very pale lay of carmine and white. Then form the ſhades with the ſame colour, putting leſs white in it: and laſtly, with

pure

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pure carmine, but very bright and clear at the firſt; fortifying it more and more as you proceed in your work, and according to the darkneſs of the ſhades. This is done by large ſtrokes. Then finiſh; working upon it with the ſame colour by little ſtrokes, which you muſt make go the ſame way with thoſe of the graving, if it be a print you copy; or the way the leaves of the roſe turn, if you copy after a painting, or after nature; loſing the dark in the clear parts, and heightening the greateſt lights, and the brighteſt or moſt lightſome leaves, with white and a little carmine. You muſt always make the hearts of roſes, and the ſide of the ſhadow darker than the reſt; and mix a little indigo for ſhadowing the firſt leaves, particularly when the roſes are blown, to make them ſeem faded. The ſeed is dead-coloured with gamboge; with which a little ſap-green is mixed for ſhadowing. Roſes ſtreaked with ſeveral colours, ought to be paler than others, that the mixture of colours may be better ſeen; which are done with carmine; a little darker in the ſhades, and very clear in the lights; always hatching by ſtrokes. For white roſes you muſt put a lay of white, and form and finiſh them as the red; but with black, white, and a little biſtre; and make the ſeed a little yellower. Yellow roſes are done by putting in every part a lay of maſticot, and ſhadowing them with gamboge, gallſtone, and biſtre; heightening the clear and light places with maſticot and white.

The ſtiles, the leaves, and the buds of all ſorts of roſes are formed with verditer, with which is mixed a little maſticot and gamboge; and for ſhadowing them, they add ſap green, putting leſs of the other colours when the ſhades are deep. The outſide of the leaves ought to be bluer than the inſide; wherefore it muſt be dead-coloured with ſea green, and ſap green mixed with that for ſhadowing, making the veins or fibres on this ſide clearer than the ground, and thoſe on the other ſide darker. The prickles which are upon the ſtiles and buds of roſes, are done with little touches of carmine, which are made to go every way; and for thoſe that are upon the ſtalks, they are formed with verditer and carmine, and ſhadowed with carmine and biſtre: making the bottom of the ſtalks more reddiſh than the top, i. e. you muſt mix with the green carmine and pure biſtre.

Of Tulips.—As there is an infinity of tulips, different from one another, one cannot pretend to mention the colours with which they are all done. We will only touch upon the handſomeſt, called *ſtreaked;* and theſe ſtreaks are dead-coloured with very clear carmine in ſome places, and with darker in others; finiſhing with the ſame colour by little ſtrokes, which muſt be carried the ſame way with the ſtreaks. And in others is put firſt a lay of vermilion. Then they form them by mixing carmine, and finiſh them with pure carmine. In ſome they put Florence lake over the vermilion inſtead of carmine. Some are done with lake and carmine mixed together, and with lake alone, or with white and lake for the firſt forming; whether it be roſepink or Florence lake. There are ſome of a purple colour, which are formed with ultramarine, carmine, or lake, ſometimes bluer and ſometimes redder. The manner of doing both one and the other is the ſame; there is no difference but in the colours. You muſt, in certain places, as between the ſtreaks of vermilion, carmine, or lake, ſometimes put blue made of ultramarine and white, and ſometimes a very bright purple, which is finiſhed by ſtrokes as the reſt, and loſt with the ſtreaks. There are ſome likewiſe that have ſallow tints, that are made with lake, biſtre, and ochre, according as they are: but this is only in fine and rare tulips, and not in the common ones. For ſhadowing the bottom of them, they ordinarily take indigo and white for ſuch whoſe ſtreaks are of carmine. For ſuch as are of lake, they take black and white; with which, in ſome, biſtre is mixed, and in others green. Some are likewiſe to be ſhadowed with gamboge and umber, and always by ſtrokes and traces, that turn as the leaves turn. Other tulips are likewiſe done, called *bordered;* that is to ſay, the tulip is not ſtreaked but on the edges of the leaves, where there is a border. It is white in the purple; red in the yellow; yellow in the red; and red in the white. The purple is laid with ultramarine, carmine, and white; ſhadowing and finiſhing it with this mixture. The border is ſpared; that is to ſay, let only a light lay of white be put there, and let it be ſhadowed with very bright indigo. The yellow is formed with gamboge, and ſhadowed with the ſame colour, mixing ochre and umber or biſtre with it. The border is laid with vermilion, and finiſhed with a very ſmall matter of carmine. The red is formed with vermilion, and finiſhed with the ſame colour, mixing carmine or lake with it. The bottom and the border are done with gamboge; and for finiſhing, they add gallſtone and umber, or biſtre. The white is ſhadowed with black, blue, and white. Indian ink is very proper for this. The ſhadowings of it are very tender. It produces alone the effect of blue and white, mixed with the other black. The border of this white tulip is done with carmine. In all theſe ſorts of tulips, they leave a nerve or ſinew in the middle of the leaves that are brighter than the reſt: and the borders are drowned at the bottom by ſmall traces, turning croſſwiſe; for they muſt not appear cut and ſeparated, as the ſtreaked or party-coloured. They make them likewiſe of ſeveral other colours. When they happen to be ſuch whoſe bottoms on the inſide are black, as it were, they form and finiſh them with indigo, as alſo the ſeed about the nozzle or ſtalk. And if the bottom is yellow, it is formed with gamboge, and finiſhed by adding umber or biſtre. The leaves and the ſtalks of tulips are ordinarily formed with ſea green, and ſhadowed and finiſhed with lily green, by large traces all along the leaves. Some may likewiſe be done with verditer, mixing maſticot with it, and ſhadowed with ſap green, that the green of the ſhades may be yellower.

The Anemony, or *Wind flower.*—There are ſeveral ſorts of them, as well double as ſingle. The laſt are ordinarily without ſtreaks. Some are made of a purple colour, with purple and white, ſhadowing them with the ſame colour; ſome redder, others bluer; ſometimes very pale, and ſometimes very dark. Others are formed with lake and white, and finiſhed with the ſame, putting leſs white; ſome without any white at all. Others are formed with vermilion, and ſhadowed with the ſame colour; adding carmine. We ſee likewiſe white ones, and ſome of a citron colour. The laſt are laid with maſticot; and one and the other

ſhadowed

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ſhadowed and finiſhed ſometimes with vermilion, and ſometimes with very brown lake, eſpecially near the ſeed, at the bottom; which is often likewiſe of a blackiſh colour, that is done with indigo, or black and blue, mixing for ſome a little biſtre; and always working by very fine ſtrokes and traces, and loſing the lights in the ſhades. There are others that are brighter and clearer at the bottom than anywhere elſe; and ſometimes they are perfectly white there, though the reſt of the flower be dark. The ſeed of all theſe anemonies is done with indigo and black, with a very little white, and ſhadowed with indigo; and in ſome it is raiſed with maſticot. The double anemonies are of ſeveral colours. The handſomeſt have their large leaves ſtreaked. Some are done, that is, the ſtreaked or party coloured, with vermilion, to which carmine is added for the finiſhing; ſhadowing the reſt of the leaves with indigo; and for the ſmall leaves within, a lay is put of vermilion and white, and they are ſhadowed with vermilion mixed with carmine, mixing here and there ſome ſtronger touches, eſpecially in the heart of the flower, next the great leaves on the ſide of the ſhadow. They finiſh with carmine, by little ſtrokes and traces, turning the ſame way with the mixed or party colours, and the leaves. They form and finiſh the ſtreaks or party colours of ſome others, as well as the ſmall leaves, with pure carmine; leaving, nevertheleſs, in the middle of the laſt, a little circle, in which is laid dark purple, which is loſt with the reſt. And when all is finiſhed, they give ſome touches with this ſame colour round about the ſmall leaves, eſpecially on the ſide of the ſhadow, drowning them with the large ones, the remainder of which is ſhadowed either with indigo or black. In ſome, the ſmall leaves are done with lake or purple, though the party colours of the large ones be done with carmine. There are others, whoſe mixed colours are done with carmine, in the middle of moſt of the large leaves; putting in ſome places vermilion underneath, and loſing theſe colours with the ſhadows of the bottom; which are done with indigo and white. The ſmall leaves are laid with maſticot, and ſhadowed with very dark carmine on the ſide of the ſhade, and with very clear on the ſide of the light, leaving there in a manner pure maſticot, and giving only ſome little touches with orpiment and carmine, to ſeparate the leaves, which may be ſhadowed ſometimes with a very little pale green. There are double anemonies painted all red, and all purple. The firſt are formed with vermilion and carmine, in a manner without white, and ſhadowed with pure carmine, well gummed, that they may be very dark. Purple anemonies are laid with purple, and white, and finiſhed with white. In a word, there are double anemonies as there are ſingle ones, of all colours; and they are done in the ſame manner. The green of one and the other is verditer; with which maſticot is mixed for forming. It is ſhadowed and finiſhed with ſap green. The ſtiles of them are a little reddiſh; wherefore they are ſhadowed with carmine mixed with biſtre, and ſometimes with green, after having laid them with maſticot.

The CARNATION and the PINK.—It is with pinks and carnations as with anemonies and tulips; that is, there are ſome mixt-coloured, and others of one ſingle colour. The firſt are ſtreaked and diverſified ſometimes with vermilion and carmine; ſometimes with pure lake, or with white; ſome ſtreaks very dark, and others very pale; ſometimes by little ſtreaks and diverſifications, and ſometimes by large ones. Their bottoms are ordinarily ſhadowed with indigo and white. There are pinks of a very pale fleſh colour, and ſtreaked and diverſified with another, a little deeper, made with vermilion and lake. Others, which are of lake and white, are ſhadowed and ſtreaked without white. Others all red, which are done with vermilion and carmine as dark as poſſible. Others all of lake. And, laſtly, there are others, wherein nature or fancy is the rule. The green of one and the other is ſea green, ſhadowed with lily green or ſap green.

The RED LILY.—It is laid with red lead, formed with vermilion, and in the deepeſt of the ſhades with carmine; and finiſhed with the ſame colour by ſtrokes and traces, turning as the leaves turn. The clear and light parts are heightened with red lead and white. The ſeed is done with vermilion and carmine. The green parts are done with verditer, ſhadowed with lily or ſap green.

The DAY LILY.—There are three ſorts of them:

1. The gridelin, a little red;
2. The gridelin, very pale; and,
3. The white.

For the firſt they put a lay of lake and white, and ſhadow and finiſh with the ſame colour deeper; mixing a little black to deaden it, eſpecially in the darkeſt places.

The ſecond are laid with white, mixed with a very little lake and vermilion, in ſuch a manner that theſe two laſt colours are hardly ſeen. Afterwards they ſhadow with black and a little lake, working redder in the middle of the leaves, next the ſtalks; which ought to be, as alſo the ſeed, of the ſame colour, particularly towards the top; and at the bottom a little greener.

The ſtile of the ſeed is laid with maſticot, and ſhadowed with ſap green.

The other day lilies are done by putting a lay of pure white, and ſhadowing and finiſhing with black and white.

The ſtalks of theſe laſt, and the greens of them all, are done with ſea green, and ſhadowed with ſap green.

The HYACINTH, or *Purple-flower*.—There are four ſorts of them:

The blue, a little dark;
Others paler;
The gridelin;
And the white.

The firſt are laid with ultramarine and white; and ſhadowed and finiſhed with leſs white. Others are laid and ſhadowed with pale blue. The gridelines are formed with lake and white, and a very ſmall matter of ultramarine; and finiſhed with the ſame colour a little deeper. For the laſt they put a lay of white; then they ſhadow them with black, with a little white; and finiſh them all by ſtrokes and traces, following the turnings and windings of the leaves. The green and the ſtalks of ſuch as are blue, are done with ſea and lily green very dark: and in the ſtalks of the firſt may be mixed a little carmine, to make them reddiſh. The ſtalks of the two others, as alſo the green,

are

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are formed with verditer and masticot, and shadowed with sap green.

The PIONY.—A lay of Venice lake and white must be put on all parts, pretty strong: then shadow with less white, and with none at all in the darkest places: after which finish with the same colour by traces, turning them as for the rose; gumming it very much in the deepest of the shades; and raising the lights and the edges of the most lightsome leaves with white and a little lake. Little veins are likewise made, which go like the strokes in hatching, but are more visible. The green of this flower is done with sea green, and shadowed with sap green.

COWSLIPS.—They are of four or five colours. There are some of a very pale purple.

The gridelin. The white and the yellow.

The purple is done with ultramarine, carmine, and white; putting less white for shadowing. The gridelin is laid with Venice lake, and a very small matter of ultramarine, with much white; and shadowed with the same colour deeper. For the white a lay of white must be put; and they must be shadowed with black and white; and finished, as the others, by traces or strokes. The heart of these cowslips is done with masticot in the shape of a star, which is shadowed with gamboge, making a little circle in the middle with sap green. The yellow are laid with masticot, and shadowed with gamboge and umber. The stiles, the leaves, and the buds, are formed with verditer, mixed with a little masticot, and finished with sap green; making the fibres or veins, which appear upon the leaves, with this same colour; and heightening the lights of the largest with masticot.

The RANUNCULUS, or *Crow-foot.*—There are several sorts of them: the finest are the orange-coloured. For the first, they put a lay of vermilion, with a very small matter of gamboge; and add carmine for shadowing; finishing it with this last colour, and a little gallstone. In the others may be put Venice lake instead of carmine, especially in the heart of the flower. The orange-coloured are laid with gamboge, and finished with gallstone, vermilion, and a little carmine; leaving some little yellow streaks. The green of the stalks is done with verditer and very pale masticot; mixing lily green to shadow them. That of the leaves is a little darker.

The CROCUS.—These are of two colours:

Yellow and purple. The yellow are formed with masticot and gallstone, and shadowed with gamboge and gallstone: after which, upon each leaf, on the outside, are made three streaks, separate from one another, with bistre and pure lake; which are lost, by little traces, in the bottom. The outside of the leaves is left all yellow.—The purple is laid with carmine, mixed with a little ultramarine, and very pale white. They are formed and finished with less white; making likewise, in some, purple stripes or streaks, very dark, as in the yellow; and in others only small veins. The seed of both is yellow, and is done with orpiment and gallstone. For the stiles, they put a lay of white, and shadow with black, mixed with a little green. The green of this flower is formed with very pale verditer, and shadowed with sap green.

The IRIS.—The Persian iris is done by putting, for the inside leaves, a lay of white, and shadowing them with indigo and green together, leaving a little white separation in the middle of each leaf; and for those on the outside, they put in the same place a lay of masticot, which is shadowed with gallstone and orpiment; making little dark and longish dots over all the leaf, at a small distance from one another. And at the end of each are made large strains, with bistre and lake in some, and in others with pure indigo, but very black. The rest, and the outside of the leaves, are shadowed with black. The green is formed with sea green, and very pale masticot, and shadowed with sap green. The Susian iris is laid with purple and white, putting a little more carmine than ultramarine; and for the shades, especially in the middle leaves, they put less white; and, on the contrary, more ultramarine than carmine; making the veins of this very colour, and leaving in the middle of the inside leaves a little yellow sinew. There are others which have this very sinew in the first leaves; the end of which only is bluer than the rest. Others are shadowed and finished with the same purple, redder: They have also the middle sinew on the outside leaves; but white and shadowed with indigo. There are likewise yellow ones; which are done by putting a lay of masticot and orpiment; shadowing them with gallstone, and making the veins upon the leaves with bistre. The green of one and the other is done with sea green, mixing a little masticot for the stiles. They are shadowed with sap green.

The JASMINE.—It is done with a lay of white, and shadowed with black and white; and for the outside of the leaves, they mix a little bistre; making the half of each, on this side, a little reddish with carmine.

The TUBEROSE.—For the doing of this, they make a lay of white, and shadow with black, with a little bistre in some places; and for the outside of the leaves they mix a little carmine, to give them a reddish teint, particularly upon the extremities. The seed is done with masticot, and shadowed with sap green. The green of it is laid with verditer, and shadowed with sap green.

The HELLEBORE.—The flower of hellebore is done almost in the same manner; that is, let it be laid with white, and shadowed with black and bistre, making the outside of the leaves a little reddish here and there. The seed is laid with dark green, and raised with masticot. The green of it is foul and rusty, and is formed with verditer, masticot, and bistre; and finished with sap green and bistre.

The WHITE LILY.—It is laid with white, and shadowed with black and white. The seed is done with orpiment and gallstone. And the green is done as in the tuberose.

The SNOW-DROP.—It is formed and finished as the white lily. The seed is laid with masticot, and shadowed with gallstone. And the green is done with sea and sap green.

The JONQUIL.—It is laid with masticot and gallstone, and finished with gamboge and gallstone. The green is formed with sea green, and shadowed with sap green.

The DAFFODIL.—All daffodils, the yellow, the double, and the single, are done by putting a lay of masticot: they are formed with gamboge, and finished by adding umber and bistre; excepting the bell in the middle, which is done with orpiment and gallstone,

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bordered or edged with vermilion and carmine. The white are laid with white, and ſhadowed with black and white; excepting the cup or bell, which is done with maſticot and gamboge. The green is ſea green, ſhadowed with ſap green.

The MARIGOLD.—It is done by putting a lay of maſticot, and then one of gamboge; ſhadowing it with this very colour, after vermilion is mixed with it: and for finiſhing, they add gallſtone and a little carmine. The green is done with verditer, ſhadowed with ſap green.

The AUSTRIAN ROSE.—For making the Auſtrian roſe, they put a lay of maſticot, and another of gamboge. Then they form it, mixing gallſtone; and finiſh it with the laſt colour, adding biſtre and a very ſmall matter of carmine in the deepeſt ſhades.

The INDIAN PINK, or *French Marigold.*—It is done by putting a lay of gamboge; ſhadowing it with this colour, after you have mixed a good deal of carmine and gallſtone with it; and leaving about the leaves a little yellow border of gamboge, very clear in the lights, and darker in the ſhades. The ſeed is ſhadowed with biſtre. The green, as well of the roſe as the pink, is formed with verditer, and finiſhed with ſap-green.

The SUN-FLOWER.—It is formed with maſticot and gamboge, and finiſhed with gallſtone and biſtre. The green is laid with verditer and maſticot, and ſhadowed with ſap green.

The PASSION-FLOWER.—It is done as the roſe, and the green of the leaves likewiſe; but the veins are done with a darker green.

POETICAL PINKS and SWEET WILLIAM.—They are done by putting a lay of lake and white; ſhadowing them with pure lake, with a little carmine for the laſt; which are afterwards dotted on all parts with little round dots, ſeparate from one another; and the threads in the middle are raiſed with white. The green of them is ſea green, which is finiſhed with ſap green.

The SCABIOUS.—There are two ſorts of ſcabious, the red and the purple. The leaves of the firſt are laid with Florentine lake, in which there is a little white; and ſhadowed without white; and for the middle, which is a great boſs or huſk in which the ſeed lies, it is formed and finiſhed with pure lake, with a little ultramarine or indigo to make it darker. Then they make little white longiſh dots over it, at a pretty diſtance from one another, clearer in the light than in the ſhade, making them go every way. The other is done by putting a lay of very pale purple, as well upon the leaves as the boſs in the middle; ſhadowing both with the ſame colour, a little deeper: and inſtead of little white touches for the ſeed, they make them purple; and about each grain they make out a little circle, and this over the whole boſs or huſk in the middle. The green is formed with verditer and maſticot, and ſhadowed with ſap green.

The SWORD or *Day Lily.*—It is laid with Florence lake and very pale white; formed and finiſhed with pure lake, very clear and bright in ſome places, and very dark in others; mixing even biſtre in the thickeſt of the ſhades. The green is verditer, ſhadowed with ſap green.

HEPATICA, or *Liverwort.*—There is red and blue. The laſt is done by putting on all parts a lay of ultramarine, white, and a little carmine or lake: ſhadowing the inſide of the leaves with the mixture, but deeper; excepting thoſe of the firſt rank; for which, and for the outſide of every one of them, they add indigo and white, that the colour may be paler, and not ſo fine. The red is laid with lake columbine and very pale white; and finiſhed with leſs white. The green is done with verditer, maſticot, and a little biſtre; and ſhadowed with ſap green, and a little biſtre, eſpecially on the outſide of the leaves.

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The POMEGRANATE.—The flower of the pomegranate is laid with red lead ſhadowed with vermilion and carmine; and finiſhed with this laſt colour. The green is laid with verditer and maſticot, and ſhadowed with ſap green.

The flower of the Indian BEAN.—It is done with a lay of Levant lake and white; ſhadowing the middle leaves with pure lake; and adding a little ultramarine for the others. The green is verditer, ſhadowed with ſap green.

The COLUMBINE.—There are columbines of ſeveral colours: the moſt common are the purple, the gridelin, and the red. For the purple, they lay with ultramarine, carmine, and white; and ſhadow with this mixture deeper. The gridelin are done the ſame way, putting a great deal leſs ultramarine than carmine. The red are done with lake and white, finiſhing with leſs white. There are ſome mixed flowers of this kind, of ſeveral colours; which muſt be formed and finiſhed as the others, but paler, making the mixtures of a little darker colour.

The LARK'S HEEL.—Theſe are of different colours, and of mixed colours: the moſt common are the purple, the gridelin and the red; which are done as the columbines.

VIOLETS and PANSIES.—Violets and panſies are done the ſame way; excepting that in the laſt the two middle leaves are bluer than the others, that is, the borders or edges; for the inſide of them is yellow: and there little back veins are made, which take their beginning from the heart of the flower, and die away towards the middle.

The MUSCIPULA, or *Catch-fly.*—There are two ſorts of it, the white and the red; the laſt is laid with lake and white, with a little vermilion, and finiſhed with pure lake. As for the knot or nozzle of the leaves, it is formed with white and a very ſmall matter of vermilion, mixing biſtre or gallſtone to finiſh it. The leaves of the white are laid with white; adding biſtre and maſticot upon the knots which are ſhadowed with pure biſtre, and the leaves with black and white. The green of all theſe flowers is done with verditer and maſticot, and ſhadowed with ſap green.

The CROWN IMPERIAL,—which is of two colours, the yellow and the red. The firſt is done by putting a lay of orpiment, and ſhadowing it with gallſtone and orpiment with a little vermilion. The other is laid with orpiment and vermilion, and ſhadowed with gallſtone and vermilion; making the beginning of the leaves next the ſtile, with lake and biſtre, very dark; and veins with this mixture both in one and the other, all along the leaves. The green is done with verditer and maſticot, ſhadowed with ſap green and gamboge.

The CYCLAMEN, or *Sowbread.*—The red is laid with

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with carmine, a little ultramarine, and much white; and finished with the same colour, deeper; putting, in a manner, only carmine in the middle of the leaves, next the heart, and in the rest add a little more ultramarine. The other is laid with white, and shadowed with black. The stalks of one and the other ought to be a little reddish; and the green, verditer and sap green.

The GILLIFLOWER.—There are several sorts of gilliflowers; the white, the yellow, the purple, the red, and the mixed of various colours. The white are laid with white, and shadowed with black, and with a little indigo in the heart of the leaves. The yellow, with masticot, gamboge, and gallstone. The purple are formed with purple and white; and finished with less white; making the colour brighter in the heart, and even a little yellowish. The red with lake and white; finishing them with white. The mixed coloured are laid with white, and the mixtures are sometimes made with purple, in which there is much ultramarine; others again, in which there is more carmine. Sometimes they are of lake, and sometimes of carmine. Some are done with white, and others without white; shadowing the rest of the leaves with indigo. The seed of all is formed with verditer and masticot, and finished with sap green. The leaves and stiles are laid with the same green, mixing sap green to finish them.

FRUITS, fishes, serpents, and all sorts of reptiles, are to be touched in the same manner as the figures of men are; that is, hatched or dotted.

Birds and all other animals are done like flowers, by strokes or traces.

Never make use, for any of these things, of white lead. It is only proper in oil. It blackens like ink, when only tempered with gum; especially if you set your work in a moist place, or where perfumes are.Ceruss of Venice is as fine, and of as pure a white. Be not sparing in the use of this, especially in forming or dead-colouring; and let it enter into all your mixtures, in order to give them a certain body, which will render your work gluish, and make it appear soft, plump, and strong.

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The taste of painters is, nevertheless, different in this point. Some use a little of it, and others none at all. But the manner of the last is meagre and dry. Others use a great deal; and doubtless it is the best method, and most followed among skilful persons; for besides that it is speedy, one may by the use of it copy all sorts of pictures; which would be almost impossible otherwise; notwithstanding the contrary opinion of some, who say, that in miniature we cannot give the force and all the different teints we see in pieces in oil. But this is not true, at least of good painters; and effects prove it pretty plainly: for we see figures, landscapes, pictures, and every thing else in miniature, touched in as grand, as true, and as noble a manner (though more tender and delicate), as they are in oil.

However, painting in oil has its advantages; were they only these, that it exhibits more work, and takes up less time. It is better defended likewise against the injuries of time; and the right of birth must be granted it, and the glory of antiquity.

But miniature likewise has its advantages; and without repeating such as have been mentioned already, it is neater and more commodious. You may easily carry all your implements in your pockets, and work when and wherever you please, without such a number of preparations. You may quit and resume it when and as often as you will; which is not done in the other; in which one is rarely to work dry.

To conclude: In the art of painting, excellence does not depend upon the greatness of the subject, but upon the manner in which it is handled. Some catch the airs of a face well; others succeed better in landscapes: some work in little, who cannot do it in large: some are skilled in colours, who know little of design: others, lastly, have only a genius for flowers: and even the Bassans got themselves a fame for animals; which they touched in a very fine manner, and better than any thing else.

M I N

Minim ‖ Minister.

MINIM, in *Music*, a note equal to two crotchets, or half a semibreve. See MUSIC.

MINIMS, a religious order in the church of Rome, founded by St Francis de Paula, towards the end of the 15th century. Their habit is a coarse black woollen stuff, with a woollen girdle, of the same colour, tied in five knots. They are not permitted to quit their habit and girdle night nor day. Formerly they went barefooted, but are now allowed the use of shoes.

MINIMUM, in the higher geometry, the least quantity attainable in a given case.

MINISTER, a person who preaches, performs religious worship in public, administers the sacraments, &c.

MINISTER of State, a person to whom the prince intrusts the administration of government. See COUNCIL.

Minister ‖ Minnin.

Foreign MINISTER, is a person sent into a foreign country, to manage the affairs of his province or of the state to which he belongs. Of these there are two kinds: those of the first rank are ambassadors and envoys extraordinary, who represent the persons of their sovereigns; the ministers of the second rank are the ordinary residents.

MINIUM, or RED-LEAD. See CHEMISTRY *Index*.

MINNIN, a stringed instrument of music among the ancient Hebrews, having three or four chords to it, although there is reason to question the antiquity of this instrument; both because it requires a hair bow, which was a kind of plectrum not known to the ancients, and because it so much resembles the modern viol. Kircher took the figures of this, the machul, chinnor, and psaltery, from an old book in the Vatican library.

MINOR,

Minor, Minorca.

MINOR, a Latin term, literally denoting *lefs*; ufed in oppofition to *major*, greater.

MINOR, in *Law*, denotes a perfon under age; or who, by the laws of the country, is not yet arrived at the power of adminiftering his own affairs, or the poffeffion of his eftate. Among us, a perfon is a minor till the age of twenty-one, before which time his acts are invalid. See AGE, and INFANT.

It is a maxim in the common law, that in the king there is no minority, and therefore he hath no legal guardian; and his royal grants and affents to acts of parliament are good, though he has not in his natural capacity attained the legal age of twenty-one. It is alfo provided by the cuftom and law of parliament, that no one fhall fit or vote in either houfe, unlefs he be twenty-one years of age. This is likewife exprefsly declared by ftat. 7. and 8 Will. III. cap. 25. with regard to the houfe of commons.

MINOR, in *Logic*, is the fecond propofition of a formal or regular fyllogifm, called alfo the *affumption*.

MINOR, in *Mufic*, is applied to certain concords, which differ from or are lower than others of the fame denomination by a leffer femitone or four commas.—Thus we fay, a third minor, or leffer third, or a fixth major and minor. Concords that admit of major and minor, i. e. greater and lefs, are faid to be imperfect concords.

MINORCA, an ifland of the Mediterranean, fituated between 39 and 40 degrees of north latitude, and near four degrees of eaft longitude. It is about 33 miles in length from north-weft to fouth-eaft, in breadth from eight to twelve, but in general about ten miles; fo that in fize it may nearly equal the county of Huntingdon or Bedfordfhire. The form is very irregular; and the coafts are much indented by the fea, which forms a great number of little creeks and inlets, fome of which might be very advantageous.

This ifland is one of thofe called by the ancient Romans *Balcares*, which arofe from the dexterity of the inhabitants in ufing the fling. It fell under the power of the Romans, afterwards of the northern barbarians, who deftroyed that empire. From them it was taken by the Arabs; who were fubdued by the king of Majorca, and he by the king of Spain. The Englifh fubdued it in 1708; it was afterwards retaken by the French in 1756, but reftored to Britain by the treaty of Paris in 1763. The Spaniards took it in 1782; and in 1798, it again became fubject to Great Britain.

The air of this ifland is much more clear and pure than in Britain; being feldom darkened with thick fogs: yet the low valleys are not free from mifts and unwholefome vapours; and in windy weather the fpray of the fea is driven over the whole ifland. Hence it happens that utenfils of brafs or iron are extremely fufceptible of ruft, in fpite of all endeavours to preferve them; and houfehold furniture becomes mouldy. The fummers are dry, clear, calm, and exceffively hot; the autumns moift, warm, and unequal; at one time perfectly ferene, at another cloudy and tempeftuous. During the winter there are fometimes violent ftorms, though neither frequent nor of long continuance; and whenever they ceafe, the weather returns to its ufual ferenity. The fpring is always variable, but refembles the winter more than the fummer. The changes of heat and cold are neither fo great nor fo fudden in this climate as in many others. In the compafs of a year, the thermometer feldom rifes much above the 80th, or falls below the 48th degree. In fummer there is fcarcely ever a difference of four or five degrees between the heat of the air at noon and at night: and in winter the variation is ftill lefs confiderable. But this muft be underftood of a thermometer fhaded from the influence of the folar beams: for if expofed to them it will often rife 12, 14, or 16 degrees higher than what we have mentioned; and in other feafons the difference between the heat of the air in the fun and the fhade is much greater. Yet even in the dog-days, the heat of the atmofphere, at leaft in open places, feldom furpaffes that of human blood. The winds are very boifterous about the equinoxes, and fometimes during the winter. At other times they are generally moderate, and, according to the obfervations of feamen, they rarely blow in the fame direction near the iflands adjacent to the gulf of Lyons as in the open fea. During the fummer there is commonly a perfect calm in the mornings and evenings; but the middle of the day is cooled by refrefhing breezes which come from the eaft, and, following the courfe of the fun, increafe gradually till two or three in the afternoon, after which they infenfibly die away as night approaches. This renders the heat of the fun lefs dangerous and inconvenient; and if thefe breezes intermit for a day or two, the natives grow languid and inactive from the heat. The northerly winds in general are clear and healthy, difpel the mifts, and make a clear blue fky; whilft thofe which blow from the oppofite quarter, render the air warm, moift, and unhealthy. The north wind is fuperior in power to all the reft; which appears from hence, that the tops of all the trees incline to the fouth, and the branches on the north fide are bare and blafted. The next to it in force is the north-weft. Both are frequent towards the clofe of winter and in the fpring; and, being dry and cold, they fhrivel up the leaves of the vegetables, deftroy their tender fhoots, and are often exceffively detrimental to the vineyards and rifing corn. The piercing blafts at that feafon from the north-eaft, as they are more moift, and more frequently attended with rain, are lefs prejudicial. The fouth and fouth-eaft winds are by much the moft unhealthy. In whatever feafons they blow, the air is foggy, and affects the breathing; but in the fummer feafon they are fultry and fuffocating. An exceffive dejection of fpirits is then a univerfal complaint; and on expofing the thermometer to the rays of the fun, the mercury has frequently rifen above the 100th degree. The weft wind is ufually drier than the fouth: the eaft is cold and bluftering in the fpring, and fultry in the fummer.

The weather in Minorca is generally fair and dry; but when it rains, the fhowers are heavy, though of fhort continuance, and they fall moft commonly in the night. The fky in fummer is clear, and of a beautiful azure, without clouds or rain; but moderate dews defcend regularly after funfet. In autumn the weather becomes lefs ferene; whirlwinds and thunder become frequent; and in the night time lightning, and thofe meteors called *falling ftars*, are very common. Water fpouts alfo are often feen at that feafon, and frequently break upon the fhore. A fudden alteration in the weather takes place about the autumnal equinox; the fkies are

are darkened with clouds, and the rains fall in fuch quantities, that the torrents thereby occafioned, pouring down from the hills, tear up trees by the root, carry away cattle, break down fences, and do confiderable mifchief to the gardens and vineyards. But thefe anniverfary rains are much more violent than lafting; always falling in fudden and heavy fhowers, with intervals of fair weather. They are accompanied with thunder, lightning, and fqualls of wind, moft commonly from the north. Hail and fnow are often intermixed with the rains which fall in winter and in fpring; but the fnow, for the moft part, diffolves immediately; and ice is here an uncommon appearance.

The whole coaft of Minorca lies low; and there are only a few hills near the centre, of which the moft confiderable, named *Toro* by the inhabitants, may be feen at the diftance of 12 or 14 leagues from the land. The furface of the ifland is rough and unequal; and in many places divided by long narrow vales of a confiderable depth, called *barancoes* by the natives. They begin towards the middle of the ifland, and after feveral windings terminate at the fea. The fouth-weft fide is more plain and regular than towards the north eaft; where the hills are higher, with low marfhy valleys betwixt them, the foil lefs fruitful, and the whole tract unhealthy to man and beaft. Near the towns and villages the fields are well cultivated, and enclofed with ftone walls; but the reft for the moft part are rocky, or covered with woods and thickets. There are fome pools of ftanding water, but very few rivulets, which is the greateft defect about the ifland, as the inhabitants have fcarcely any wholefome water excepting what is faved from the clouds.

The foil is light, thin, and very ftony, with a good deal of fea falt, and, in fome places, of calcareous nitre intermixed. In moft places there is fo little earth, that the ifland appears to be but one large irregular rock, covered here and there with mould, and an infinite variety of ftones. Notwithftanding this, however, it is not only extremely proper for vineyards, but produces more wheat and barley than could at firft fight be imagined; and if the peafants may be credited, it would always yield a quantity of corn and wine fufficient for the natives, did not the violence of the winds, and the exceffive drought of the weather, frequently fpoil their crops. The fields commonly lie fallow for two years, and are fown the third. About the latter end of winter, or the beginning of fpring, they are firft broke up: and next autumn, as foon as the rains fall, they are again ploughed and prepared for receiving the proper feeds. The tillage is very eafily performed; for a plough fo light as to be tranfported from place to place on the ploughman's fhoulder, and to be drawn by a heifer, or an afs fometimes affifted by an hog, is fufficient for opening fo thin a foil. The later the harveft happens, the more plentiful it proves. The barley is ufually cut down about the 20th of May and the wheat is reaped in June. fo that the whole harveft is commonly got in by Midfummer day. The grain is not thrafhed with flails as in this country, but trodden out on a fmooth piece of rock by oxen and affes, according to the cuftom of the eaftern nations.

The natives of Minorca are commonly lean, thin, and well-built, of a middle ftature, and olive complexion; but their character is by no means agreeable. Such is the natural impetuofity of their temper, that the flighteft caufe provokes them to anger, and they feem to be incapable of forgiving or forgetting an injury. Hence quarrels break out daily, even among neighbours and relations: and family difputes are tranfmitted from father to fon; and thus, though lawyers and pettifoggers are very numerous in this country, there are ftill too few for the clients. Both fexes are, by conftitution, extremely amorous: they are often betrothed to each other while children, and marry at the age of 14. The women have eafy labours, and commonly return in a few days to their ufual domeftic bufinefs; but, left the family fhould become too numerous for their income, it is a practice among the poorer fort to keep their children at the breaft for two or three years, that by this means the mothers may be hindered from breeding.

Bread of the fineft wheat flour, well fermented and well baked, is more than half the diet of people of all ranks. Rice, pulfe, vermicelli, herbs and roots from the garden, fummer fruits, pickled olives and pods of the Guinea pepper, make up almoft all the other half, fo that fcarce a fifth of their whole food is furnifhed from the animal kingdom, and of this fifh makes by much the moft confiderable portion. On Fridays, and other faft days, they abftain entirely from flefh; and during Lent they live altogether on vegetables and fifh, excepting Sundays, when they are permitted the ufe of eggs, cheefe, and milk. Moft of their difhes are high-feafoned with pepper, cloves, cinnamon, and other fpices; and garlic, onions, or leeks, are almoft conftant ingredients. They eat a great deal of oil, and that none of the fweeteft or beft flavoured; ufing it not only with falads, but alfo with boiled and fried fifh, greens, pulfe, &c. inftead of butter. A flice of bread foaked in boiled water, with a little oil and falt, is the common breakfaft of the peafants, well known by the name of *oleagua*. Their ordinary meals are very frugal, and confift of very little variety; but on feftivals and other folemn occafions their entertainments are to the laft degree profufe and extravagant, infomuch that the bill of fare of a country farmer's wedding dinner would fcarce be credited.

With regard to other matters, the Minorquins are accufed of prodigious indolence in the way of bufinefs, and neglect of the natural advantages they poffefs. In the bowels of the earth are iron, copper, and lead ores, of none of which any ufe hath been made except the laft. A lead mine was worked to advantage fome time ago, and the ore fent into France and Spain for the ufe of the potteries in thofe countries. The proprietor difcontinued his work on fome fmall difcouragement; and indeed it is faid, that thefe people are of all mankind the moft eafily put out of conceit with an undertaking that does not bring them in mountains of prefent gain, or that admits of the flighteft probability of difappointing their moft fanguine expectations: nor will their purfe admit of many difappointments; and thus their poverty co-operating with their natural defpondence and love of eafe, is the principal caufe of their backwardnefs to engage in projects, though ever fo promifing, for the improvement of their private fortune, and the advantage of the commerce of their country.

Minorca. country. This lead ore went under the name of *vernis* among the natives, as it was wholly uſed by the potters in varniſhing and glazing their earthen veſſels.

There are few exports of any account, and they are obliged to their neighbours for near one-third of their corn, all their oil, and ſuch a variety of articles of leſs conſideration, that nothing could preſerve them from a total bankruprcy, but the Engliſh money circulated by the troops, which is exchanged for the daily ſupplies of proviſions, increaſed by the multiplication of vineyards, the breeding of poultry, and the production of vegetables, in a proportion of at leaſt five to one ſince the iſland has been in our poſſeſſion. It will not require many words to enumerate their exports: they make a ſort of cheeſe, little liked by the Engliſh, which ſells in Italy at a very great price; this, perhaps, to the amount of 800l. *per annum*.—The wool they ſend abroad may produce 900l. more.—Some wine is exported; and, if we add to its value that of the home conſumption, which has every merit of an export, being nine parts in ten taken off by the troops for ready money, it may well be eſtimated at 16,000l. a-year. In honey, wax, and ſalt, their yearly exports may be about 400l. and this comes pretty near the ſum of their exports, which we eſtimate together at 18,100l. ſterling *per annum*.

A vaſt balance lies againſt them, if we conſider the variety and importance of the articles they fetch from other countries, for which they muſt pay ready caſh. Here it may be neceſſary to withdraw ſome things from the heap, ſuch as their cattle, ſheep, and fowls, on which they get a profit; for the country does not produce them in a ſufficient abundance to ſupply them, eſpecially when we have a fleet of men of war ſtationed there.

Their imports are, corn, cattle, ſheep, fowls, tobacco, oil, rice, ſugar, ſpices, hardware, and tools of all kinds; gold and ſilver lace; chocolate, or cocoa to make it; tobacco, timber, plank, boards, millſtones, tobacco pipes, playing cards, turnery ware, ſeeds, ſoap, ſaddles; all manner of cabinetmakers work, iron ſpikes, nails, fine earthen ware, glaſs lamps, braſiery; paper, and other ſtationary wares; copperas, galls, dye ſtuffs, painters bruſhes and colours; muſical inſtruments, muſic, and ſtrings; watches, wine, fruit; all manner of fine and printed linens, muſlins, cambrics, and laces; bottles, corks, ſtarch, indigo, fans, trinkets, toys, ribbands, tape, needles, pins, ſilk, mohair, lanthorns, cordage, tar, pitch, roſin, drugs, gloves, fire-arms, gunpowder, ſhot, and lead; hats, caps, velvet, cotton ſtuffs, woollen cloths, ſtockings, capes, medals, veſtments, luſtres, pictures, images, agnus dei's, books, pardons, bulls, relicks, and indulgencies.

The iſland is divided into what they ſtyle *terminos*, of which there were anciently five, now reduced to four, and reſemble our counties. The termino of Ciudadella, at the north-weſtern extremity of the iſland, is ſo ſtyled from this place, which was once a city, and the capital of Minorca. It makes a venerable and majeſtic figure, even in its preſent ſtate of decay, having in it a large Gothic cathedral, ſome other churches and convents, the governor's palace, and an exchange, which is no contemptible pile.—There are in it 600 houſes, which before the ſeat of government and the courts of juſtice were removed to Mahon, were fully inhabited; and there are ſtill more gentlemen's families here than in all the reſt of the iſland. It hath a port commodious enough for the veſſels employed in the trade of this country, which, though in the poſſeſſion of a maritime power, is leſs than it formerly was. It is ſtill, in the ſtyle of our officers, *the beſt quarters* (and there are none bad) in the country; and if there was a civil government, and the place made a free port, the beſt judges are of opinion it would very ſoon become a flouriſhing place again; and the fortifications, if it ſhould be found neceſſary, might then alſo be eaſily reſtored and improved. Minorca.

The termino of Fererias is the next, a narrow ſlip reaching croſs from ſea to ſea, and the country little cultivated; it is therefore united to Mercandal. In this laſt termino ſtands Mont-toro in the very centre of the iſle, and the higheſt ground, ſome ſay the only mountain in it; on the ſummit of which there is a convent, where even in the hotteſt months the monks enjoy a cool air, and at all times a moſt delightful proſpect. About ſix miles north from Mont-toro ſtands the caſtle that covers Port Fornelles, which is very ſpacious harbour on the eaſt ſide of the iſland. There are in it ſhoals and foul ground, which, to thoſe who are unacquainted with them, render it difficult and dangerous; yet the packets bound from Mahon to Marſeilles frequently take ſhelter therein; and while the Spaniards were in poſſeſſion of the iſle, large ſhips and men of war frequented it. At a ſmall diſtance from this lies another harbour called *Adia*, which runs far into the land; but being reputed unſafe, and being ſo near Fornelles, is at preſent uſeleſs. The country about it is, however, ſaid to be the pleaſanteſt and wholeſomeſt ſpot in the iſland, and almoſt the only one plentifully ſupplied with excellent ſpring water; ſo that the gardens are well laid out, and the richeſt and fineſt fruits grow here in the higheſt perfection. Alaior is the next termino, in which there is nothing remarkable but the capital of the ſame name, well ſituated on an eminence, in a pleaſant and tolerably cultivated country.

The termino of Mahon, at the ſouth-eaſt end of the iſland, is at preſent the moſt conſiderable of them all, containing about 60,000 Engliſh acres, and nearly one-half of the inhabitants in Minorca. The town of Mahon derives its name from the Carthaginian general Mago, who is univerſally allowed to be its founder.—It ſtands on an eminence on the weſt ſide of the harbour, the aſcent pretty ſteep. There are in it a large church, three convents, the governor's palace, and ſome other public edifices. It is large, but the ſtreets are winding, narrow and ill paved. The fortreſs of St Philip ſtands near the entrance of the harbour, which it covers, is very ſpacious, of great ſtrength, with ſubterranean works to protect the garriſon from bombs, large magazines, and whatever elſe is neceſſary to render it a complete fortification, and hath a numerous and well diſpoſed artillery. Port Mahon is allowed to be the fineſt harbour in the Mediterranean, about 90 fathoms wide at its entrance, but within very large and ſafe, ſtretching a league or more into the land. Beneath the town of Mahon there is a very fine quay, one end of which is reſerved for the ſhips of war, and furniſhed with all the accommodations neceſſary for careening and refitting them; the other ſerves for merchantmen.

On

On the other side of the harbour is Cape Mola, where it is generally agreed a fortress might be constructed which would be impregnable, as the castle of St Philip was esteemed before we took it, and bestowed so much money upon it, that, though some works were erected at Cape Mola, it was not judged proper to proceed in the fortifications there at a fresh expence; at least this is the only reason that hath been assigned. Minorca was taken by the Spaniards during the American war, and is now in their possession.

MINORS, or FRIERS MINOR, an appellation which the Franciscans assume, out of show of humility; calling themselves *fratres minores*, i. e. lesser brothers, and sometimes *minorites*. There is also an order of regular minors at Naples, which was established in the year 1588, and confirmed by Sixtus V.

MINOS, in *Fabulous History*, a king of Crete, son of Jupiter and Europa. He flourished about 1432 years before the Christian era. He gave laws to his subjects, which still remained in full force in the age of the philosopher Plato, about 1000 years after the death of the legislator. His justice and moderation procured him the appellation of the favourite of the gods, the confident of Jupiter, and the wise legislator, in every city of Greece; and, according to the poets, he was rewarded for his equity after death with the office of supreme and absolute judge in the infernal regions. In this capacity he is represented sitting in the middle of the shades, and holding a sceptre in his hand. The dead plead their different causes before him; and the impartial judge shakes the fatal urn, which is filled with the destinies of mankind. He married Ithona, by whom he had Lycastes, who was the father of Minos II.

MINOS II. was a son of Lycastes, the son of Minos I. and king of Crete. He married Pasiphae, the daughter of Sol and Perseis, and by her he had many children. He increased his paternal dominions by the conquest of the neighbouring islands; but showed himself cruel in the war which he carried on against the Athenians, who had put to death his son Androgeus. He took Megara by the treachery of Scylla; and not satisfied with victory, he obliged the vanquished to bring him yearly to Crete seven chosen boys and the same number of virgins to be devoured by the MINOTAUR. This bloody tribute was at last abolished when THESEUS had destroyed the monster. When DÆDALUS, whose industry and invention had fabricated the labyrinth, and whose imprudence in assisting Pasiphae in the gratification of her unnatural desires, had offended Minos, fled from the place of his confinement with wings, and arrived safe in Sicily; the incensed monarch pursued the offender, resolved to punish his infidelity. Cocalus, king of Sicily, who had hospitably received Dædalus, entertained his royal guest with dissembled friendship; and, that he might not deliver to him a man whose ingenuity and abilities he so well knew, he put Minos to death. Minos died about 35 years before the Trojan war. He was father of Androgeus, Glaucus, and Deucalion; and two daughters, Phædra, and Ariadne. Many authors have confounded the two Minoses, the grandfather and the grandson; but Homer, Plutarch, and Diodorus, prove plainly that they were two different persons.

MINOTAUR, in *Fabulous History*, a celebrated monster, half a man and half a bull, according to this verse of Ovid,

Semibovemque virum, semivirumque bovem.

It was the fruit of Pasiphae's amour with a bull. Minos refused to sacrifice a white bull to Neptune, an animal which he had received from the god for that purpose. This offended Neptune, and he made Pasiphae the wife of Minos enamoured of this fine bull, which had been refused to his altars. Dædalus prostituted his talents in being subservient to the queen's unnatural desires; and by his means, Pasiphae's horrible passions were gratified, and the Minotaur came into the world. Minos confined in the labyrinth this monster, which convinced the world of his wife's lasciviousness, and reflected disgrace upon his family. The Minotaur usually devoured the chosen young men and maidens which the tyranny of Minos yearly exacted from the Athenians. Theseus delivered his country from this tribute, when it had fallen to his lot to be sacrificed to the voracity of the Minotaur; and by means of Ariadne, the king's daughter, he destroyed the monster, and made his escape from the windings of the labyrinth.—The fabulous tradition of the Minotaur, and of the infamous commerce of Pasiphae with a favourite bull, has been often explained. Some suppose that Pasiphae was enamoured of one of her husband's courtiers called *Taurus*; and that Dædalus favoured the passions of the queen, by suffering his house to become the retreat of the two lovers. Pasiphae some time after brought twins into the world, one of whom greatly resembled Minos and the other Taurus; and in the natural resemblance of their countenance with that of their supposed fathers, originated their name, and consequently the fable of the Minotaur.

MINOW, a very small species of cyprinus, so well known that it needs no description.

MINSTER, (Saxon, *Mynster* or *Mynstre*), anciently signified the church of a monastery or convent.

MINSTREL, an ancient term for a singer and instrumental performer.

The word *minstrel* is derived from the French *menestrier*, and was not in use here before the Norman conquest. It is remarkable, that our old monkish historians do not use the word *citharædus*, *cantator*, or the like, to express a *minstrel* in Latin; but either *mimus*, *histrio*, *joculator*, or some other word that implies *gesture*. Hence it should seem that the minstrels set off their singing by mimicry or action; or, according to Dr Brown's hypothesis, united the powers of melody, poem, and dance.

The Saxons as well as the ancient Danes, had been accustomed to hold men of this profession in the highest reverence. Their skill was considered as something divine, their persons were deemed sacred, their attendance was solicited by kings, and they were everywhere loaded with honours and rewards. In short, poets and their art were held among them in that rude admiration which is ever shown by an ignorant people to such as excel them in intellectual accomplishments. When the Saxons were converted to Christianity, in proportion as letters prevailed among them this rude admiration began to abate, and poetry was no longer a peculiar profession. The poet and the minstrel be-

Minſtrel. came two perſons. Poetry was cultivated by men of letters indiſcriminately, and many of the moſt popular rhymes were compoſed amidſt the leiſure and retirement of monaſteries. But the minſtrels continued a diſtinct order of men, and got their livelihood by ſinging verſes to the harp at the houſes of the great. There they were ſtill hoſpitably and reſpectfully received, and retained many of the honours ſhown to their predeceſſors the Bards and Scalds. And indeed, though ſome of them only recited the compoſitions of others, many of them ſtill compoſed ſongs themſelves: and all of them could probably invent a few ſtanzas on occaſion. There is no doubt but moſt of the old heroic ballads were produced by this order of men. For although ſome of the larger metrical romances might come from the pen of the monks or others, yet the ſmaller narratives were probably compoſed by the minſtrels who ſung them. From the amazing variations which occur in different copies of theſe old pieces, it is evident they made no ſcruple to alter each other's productions, and the reciter added or omitted whole ſtanzas according to his own fancy or convenience.

In the early ages, as is hinted above, this profeſſion was held in great reverence among the Saxon tribes, as well as among their Daniſh brethren. This appears from two remarkable facts in hiſtory, which ſhow that the ſame arts of muſic and ſong were equally admired among both nations, and that the privileges and honours conferred upon the profeſſors of them were common to both; as it is well known their cuſtoms, manners, and even language, were not in thoſe times very diſſimilar.

When King Alfred the Great was deſirous to learn the true ſituation of the Daniſh army, which had invaded his realm, he aſſumed the dreſs and character of a minſtrel; and taking his harp, and only one attendant (for in the earlieſt times it was not unuſual for a minſtrel to have a ſervant to carry his harp), he went with the utmoſt ſecurity into the Daniſh camp. And though he could not but be known to be a Saxon, the character he had aſſumed procured him an hoſpitable reception; he was admitted to entertain the king at table, and ſtaid among them long enough to contrive that aſſault which afterwards deſtroyed them. This was in the year 878.

About 60 years after, a Daniſh king made uſe of the ſame diſguiſe to explore the camp of King Athelſtan. With his harp in his hand, and dreſſed like a minſtrel, Anlaff king of the Danes went among the Saxon tents, and taking his ſtand near the king's pavilion, began to play, and was immediately admitted. There he entertained Athelſtan and his lords with his ſinging and his muſic; and was at length diſmiſſed with an honourable reward, though his ſongs muſt have diſcovered him to have been a Dane. Athelſtan was ſaved from the conſequences of this ſtratagem by a ſoldier, who had obſerved Anlaff bury the money which had been given him, from ſome ſcruple of honour or motive of ſuperſtition. This occaſioned a diſcovery.

From the uniform procedure of both theſe kings, it is plain that the ſame mode of entertainment prevailed among both peoples, and that the minſtrel was a privileged character among both. Even as late as the reign of Edward II. the minſtrels were eaſily admitted into the royal preſence, as appears from a paſſage in Stow, which alſo ſhows the ſplendour of their appearance. Minſtrel.

"In the year 1316, Edward II. did ſolemnize his feaſt of Pentecoſt at Weſtminſter, in the great hall; where ſitting royally at the table with his peers about him, there entered a woman adorned like a minſtrel, ſitting on a great horſe trapped, as minſtrels then uſed, who rode round about the tables, ſhowing paſtime; and at length came up to the king's table and laid before him a letter, and forthwith turning her horſe, ſaluted every one, and departed."—The ſubject of this letter was a remonſtrance to the king on the favours heaped by him on his minions, to the neglect of his knights and faithful ſervants.

The meſſenger was ſent in a minſtrel's habit, as what would gain an eaſy admiſſion; and was a woman concealed under that habit, probably to diſarm the king's reſentment; for we do not find that any of the real minſtrels were of the female ſex; and therefore conclude this was only an artful contrivance peculiar to that occaſion.

In the 4th year of Richard II. John of Gaunt erected at Tetbury in Staffordſhire a court of minſtrels, with a full power to receive ſuit and ſervice from the men of that profeſſion within five neighbouring counties, to enact laws, and determine their controverſies; and to apprehend and arreſt ſuch of them as ſhould refuſe to appear at the ſaid court, annually held on the 16th of Auguſt. For this they had a charter, by which they were empowered to appoint a king of the minſtrels with four officers to preſide over them. Theſe were every year elected with great ceremony; the whole form of which is deſcribed by Dr Plott; in whoſe time, however, they ſeem to have become mere muſicians.

Even ſo late as the reign of King Henry VIII. the reciters of verſes or moral ſpeeches learnt by heart, intruded without ceremony into all companies; not only in taverns, but in the houſes of the nobility themſelves. This we learn from Eraſmus, whoſe argument led him only to deſcribe a ſpecies of theſe men who did not ſing their compoſitions; but the others that did, enjoyed without doubt the ſame privileges.

We find that the minſtrels continued down to the reign of Elizabeth; in whoſe time they had loſt much of their dignity, and were ſinking into contempt and neglect. Yet ſtill they ſuſtained a character far ſuperior to any thing we can conceive at preſent of the ſingers of old ballads.

When Queen Elizabeth was entertained at Killingworth caſtle by the earl of Leiceſter in 1575, among the many devices and pageants which were exhibited for her entertainment, one of the perſonages introduced was that of an ancient minſtrel, whoſe appearance and dreſs are ſo minutely deſcribed by a writer there preſent, and gives us ſo diſtinct an idea of the character, that we ſhall quote the paſſage at large.

"A perſon very meet ſeemed he for the purpoſe, of a xlv. years old, apparelled partly as he would himſelf. His cap off: his head ſeemingly rounded tonſterwiſe: fair kembed, that, with a ſponge daintly dipt in a little capon's greaſe, was finely ſmoothed, to make it ſhine like a mallard's wing. His beard ſnugly ſhaven;

Mint, Minstrel.

shaven: and yet his shirt after the new trink, with ruffs fair starched, sleeked, and glistering like a pair of new shoes marshalled in good order with a setting stick, and strut, 'that' every ruff stood up like a wafer. A side [i. e. long] gown of Kendale green, after the freshness of the year now, gathered at the neck with a narrow gorget, fastened afore with a white clasp and a keeper close up to the chin; but easily, for heat, to undo when he list. Seemingly begirt in a red caddis girdle: from that a pair of capped Sheffield knives hanging a' two sides. Out of his bosom drawn from a lappet of his napkin edged with a blue lace, and marked with a D for Damian; for he was but a bachelor yet.

"His gown had side [i. e. long] sleeves down to midleg, slit from the shoulder to the hand, and lined with white cotton. His doublet sleeves of black worsted: upon them a pair of points of tawny chamlet laced along the wrist with blue threaden pointes. A wealt towards the hands of fustian-a-napes. A pair of red neather stocks. A pair of pumps on his feet, with a cross cut at his toes for corns; not new indeed, yet cleanly blackt with soot, and shining as a shoing horn.

"About his neck a red ribband suitable to his girdle. His harp in good grace, dependent before him. His wrest tyed to a green lace and hanging by: under the gorget of his gown a fair flaggon chain (pewter for) silver, as a Squire Minstrel of Middlesex, that travelled the country this summer season, unto fair and worshipful men's houses. From his chain hung a scutcheon, with metal and colour, resplendent upon his breast, of the ancient arms of Islington."

—This minstrel is described as belonging to that village. We suppose such as were retained by noble families wore their arms hanging down by a silver chain as a kind of badge. From the expression of Squire Minstrel above, we may conclude there were other inferior orders, as Yeomen Minstrels or the like.

This minstrel, the author tells us a little below, "after three lowly courtesies, cleared his voice with a hem . . . and wiped his lips with the hollow of his hand for 'filing his napkin; tempered a string or two with his wrist; and, after a little warbling on his harp for a prelude, came forth with a solemn song, warranted for story out of King Arthur's acts, &c."

Towards the end of the 16th century, this class of men had lost all credit, and were sunk so low in the public opinion, that in the 39th year of Elizabeth a statute was passed by which "minstrels, wandering abroad, were included among "rogues, vagabonds, and sturdy beggars," and were adjudged to be punished as such. This act seems to have put an end to the profession, for after this time they are no longer mentioned.

MINT, the place in which the king's money is coined. See Coinage.

There were anciently mints in almost every county in England; but the only mint at present in the British dominions is that in the tower of London. The officers of the mint are, 1. The warden of the mint, who is the chief; he oversees the other officers, and receives the bullion. 2. The master worker who receives bullion from the wardens, causes it to be melted, delivers it to the moneyers, and, when it is coined, receives it again. 3. The comptroller, who is the overseer of all the inferior officers, and sees that all the money is made to the just assize. 4. The assay master, who weighs the gold and silver, and sees that it is according to the standard. 5. The two auditors who take the accounts. 6. The surveyor of the melting; who, after the assay master has made trial of the bullion, sees that it is cast out, and not altered after it is delivered to the melter. 7. The engraver; who engraves the stamps and dies for the coinage of the money. 8. The clerk of the irons; who sees that the irons are clean and fit to work with. 9. The melter, who melts the bullion before it be coined. 10. The provost of the mint; who provides for and oversees all the moneyers. 11. The blanchers, who anneal and cleanse the money. 12. The moneyers; some of whom forge the money, some share it, some round and mill it, and some stamp and coin it. 13. The porters who keep the gate of the mint.

Mint.

Mint was also a pretended place of privilege, in Southwark, near the King's Bench, put down by statute. If any persons, within the limits of the mint, shall obstruct any officer in the serving of any writ or process, &c. or assault any person therein, so as he receive any bodily hurt, the offender shall be guilty of felony, and be transported to the plantations, &c. Stat. 9. Geo. I.

Mint Marks. It hath been usual, from old time, to oblige the masters and workers of the mint, in the indentures made with them, "to make a privy mark in all the money that they made, as well of gold as of silver, so that another time they might know, if need were, and witte which moneys of gold and silver among other of the same moneys, were of their own making, and which not." And whereas, after every trial of the pix at Westminster, the masters and workers of the mint, having there proved their moneys to be lawful and good, were immediately entitled to receive their *quietus* under the great seal, and to be discharged from all suits or actions concerning those moneys, it was then usual for the said masters and workers to change the privy mark before used for another, that so the moneys from which they were not yet discharged might be distinguished from those for which they had already received their *quietus*: which new mark they then continued to stamp upon all their moneys, until another trial of the pix gave them also their *quietus* concerning those.

The pix is a strong box with three locks, whose keys are respectively kept by the warden, master, and comptroller of the mint; and in which are deposited, sealed up in several parcels, certain pieces taken at random out of every *journey* as it is called; that is, out of every 15 pounds weight of gold, or 60 pounds weight of silver, before the same is delivered to the proprietors. And this pix is, from time to time, by the king's command, opened at Westminster, in the presence of the lord-chancellor, the lords of the council, the lords-commissioners of the treasury, the justices of the several benches, and the barons of the exchequer; before whom a trial is made, by a jury of goldsmiths impannelled and sworn for that purpose, of the collective weights of certain parcels of the several pieces of gold and silver taken at random from those contained in the pix; after which those parcels being severally melted, assays are then made of the

bullion

bullion of gold and silver so produced, by the melting certain small quantities of the same against equal weights taken from the respective trial pieces of gold and silver that are deposited and kept in the exchequer for that use. This is called the *trial of the pix*; the report made by the jury upon that trial is called the *verdict of the pix* for that time; and the indented trial pieces just above mentioned, are certain plates of standard gold and standard silver, made with the greatest care, and delivered in upon oath, from time to time as there is occasion, by a jury of the most able and experienced goldsmiths, summoned by virtue of a warrant from the lords of the treasury to the wardens of the mystery of goldsmiths of the city of London for that purpose; and which plates being so delivered in, are divided each, at this time, into seven parts by indentures, one of which parts is kept in his majesty's court of exchequer at Westminster, another by the said company of goldsmiths, and two more by the officers of his majesty's mint in the tower; the remaining three being for the use of the mint, &c. in Scotland. The pix has sometimes been tried every year, or even oftener, but sometimes not more than once in several years: and from hence is understood how it comes to pass, that, among the pieces that are dated as well as marked, three or more different dates are sometimes found upon pieces impressed with the same mark: and again, that different marks are found upon pieces bearing the same date. These marks are first observable upon the coins of King Edward III.; the words above quoted concerning those marks are from the indentures made with the lord Hastings, master and worker to King Edward IV.; and the marks themselves continued to be stamped very conspicuously upon the moneys, till the coinage by the mill and screw was introduced and settled after the Restoration, in the year 1662: since which time, the moneys being made with far greater regularity and exactness than before, these marks have either been totally laid aside, or such only have been used as are of a more secret nature, and only known to the officers and engravers concerned in the coinage: and indeed the constant practice that has ever since prevailed, of dating all the several pieces, has rendered all such marks of much less consequence than before.

Mint. See Mentha, Botany and Materia Medica, *Index*.

MINTURNÆ, a town of Campania, between Sinuessa and Formiæ. It was in the marshes in this neighbourhood that Marius concealed himself in the mud to avoid the partizans of Sylla. The people condemned him to death; but when his voice alone had terrified the executioner, they showed themselves compassionate and favoured his escape.

MINUET, a very graceful kind of dance, consisting of a coupee, a high step, and a balance: it begins with a beat, and its motion is triple.

The invention of the minuet seems generally to be ascribed to the French, and particularly to the inhabitants of the province of Poictou. The word is said by Menage and Furetiere to be derived from the French *menue* or *menu*, "small, or little;" and in strictness signifies a small pace. The melody of this dance consists of two strains, which, as being repeated, are called *reprises*, each having eight or more bars, but never an odd number. The measure is three crotchets in a bar, and is thus marked $\frac{3}{4}$, though it is commonly performed in the time $\frac{3}{8}$. Walther speaks of a minuet in Lully's opera of *Roland*, each strain of which contains ten bars, the sectional number being 5; which renders it very difficult to dance.

MINUTE, in *Geometry*, the 60th part of a degree of a circle.

Minute of Time, the 60th part of an hour.

Minute, in *Architecture*, usually denotes the 60th, sometimes the 30th, part of a module. See Architecture.

Minute is also used for a short memoir, or sketch of a thing taken in writing.

MINUTIUS Felix. See Felix.

MINYÆ, a name given to the inhabitants of Orchomenos in Bœotia, from Minyas king of the country. Orchomenos the son of Minyas gave his name to the capital of the country; and the inhabitants still retained their original appellation, in contradistinction to the Orchomenians of Arcadia. A colony of Orchomenians passed into Thessaly and settled in Iolchos; from which circumstance the people of the place, and particularly the Argonauts, were called *Minyæ*. This name they received, according to the opinion of some, not because a number of Orchomenians had settled among them, but because the chief and noblest of them were descended from the daughters of Minyas. Part of the Orchomenians accompanied the sons of Codrus when they migrated to Ionia. The descendants of the Argonauts, as well as the Argonauts themselves, received the name of *Minyæ*. They first inhabited Lemnos, where they had been born from the Lemnian women who had murdered their husbands. They were driven from Lemnos by the Pelasgi, about 1160 before the Christian era, and came to settle in Laconia, from whence they passed into Calliste with a colony of Lacedemonians.

MIQUELETS, a name given to the Spaniards who inhabit the Pyrenean mountains on the frontiers of Arragon and Catalonia, and live by robbing.

MIQUELON, a small desert island to the south-west of Cape May in Newfoundland, ceded to the French by the peace of 1763, for drying and curing their fish. W. Long. 54. 30. N. Lat. 47. 22.

MIRABILIS, Marvel of Peru; a genus of plants belonging to the pentandria class; and in the natural method ranking with those of which the order is doubtful. See Botany *Index*.

MIRACLE, in its original sense, is a word of the same import with *wonder*; but in its usual and more appropriate signification, it denotes "an effect contrary to the established constitution and course of things, or a sensible deviation from the known laws of nature."

That the visible world is governed by stated general rules, or that there is an order of causes and effects established in every part of the system of nature which falls under our observation, is a fact which cannot be controverted. If the Supreme Being, as some have supposed, be the only real agent in the universe, we have the evidence of experience, that, in the particular system to which we belong, he acts by stated rules. If he employs inferior agents to conduct the various motions from which the phenomena result, we have the same evidence that he has subjected

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Miracles. ed thofe agents to certain fixed laws, commonly called the *laws of nature*. On either hypothefis, effects which are produced by the regular operation of thefe laws, or which are conformable to the eftablifhed courfe of events, are properly called *natural*; and every contradiction to this conftitution of the natural fyftem, and the correfpondent courfe of events in it, is called a *miracle*.

If this definition of a miracle be juft, no event can be deemed miraculous merely becaufe it is ftrange, or even to us unaccountable; fince it may be nothing more than a regular effect of fome unknown law of nature. In this country earthquakes are rare; and for monftrous births perhaps no *particular* and fatisfactory account can be given: yet an earthquake is as regular an effect of the eftablifhed laws of nature as any of thofe with which we are moft intimately acquainted; and under circumftances in which there would always be the fame kind of production, the monfter is nature's genuine iffue. It is therefore neceffary, before we can pronounce any effect to be a true miracle, that the circumftances under which it is produced be known, and that the common courfe of nature be in fome degree underftood; for in all thofe cafes in which we are totally ignorant of nature, it is impoffible to determine what is, or what is not, a deviation from its courfe. Miracles, therefore, are not, as fome have reprefented them, appeals to our ignorance. They fuppofe fome antecedent knowledge of the courfe of nature, without which no proper judgement can be formed concerning them; though with it their reality may be fo apparent as to prevent all poffibility of a difpute.

Thus, were a phyfician to cure a blind man of a cataract, by anointing his eyes with a chemical preparation which we had never before feen, and to the nature and effects of which we are abfolute ftrangers, the cure would undoubtedly be *wonderful;* but we could not pronounce it *miraculous*, becaufe, for any thing known to us, it might be the natural effect of the operation of the unguent on the eye. But were he to recover his patient merely by commanding him to fee, or by anointing his eyes with fpittle, we fhould with the utmoft confidence pronounce the cure to be a miracle; becaufe we know perfectly that neither the human voice nor human fpittle have, by the eftablifhed conftitution of things, any fuch power over the difeafes of the eye. No one is now ignorant, that perfons apparently dead are often reftored to their families and friends, by being treated in the manner recommended by the Humane Society. To the vulgar, and fometimes even to men of fcience, thefe effects appear very wonderful; but as they are known to be produced by phyfical agency, they can never be confidered as miraculous deviations from the laws of nature. On the other hand, no one could doubt of his having witneffed a real miracle who had feen a perfon that had been four days dead come alive out of his grave at the *call* of another, or who had even beheld a perfon exhibiting all the *fymptoms* of death inftantly refufcitated merely by being *defired* to live.

Thus eafy is it, in all cafes in which the courfe of nature is underftood, to determine whether any particular event be really a miracle; whilft in circumftances where we know nothing of nature and its courfe, even a true miracle, were it performed, could not be admitted as fuch, or carry any conviction to the mind of a philofopher. Miracles.

If miracles be effects contrary to the eftablifhed conftitution of things, we are certain that they will never be performed on trivial occafions. The conftitution of things was eftablifhed by the Creator and Governor of the univerfe, and is undoubtedly the offspring of infinite wifdom purfuing a plan for the beft of purpofes. From this plan no deviation can be made but by God himfelf, or by fome powerful being acting with his permiffion. The plans devifed by wifdom are fteady in proportion to their perfection, and the plans of infinite wifdom muft be abfolutely perfect. From this confideration, fome men have ventured to conclude, that no miracle was ever wrought, or can rationally be expected; but maturer reflection muft foon fatisfy us that all fuch conclufions are hafty.

Man is unqueftionably the principal creature in this world, and apparently the only one in it who is capable of being made acquainted with the relation in which he ftands to his Creator. We cannot, therefore, doubt, but that fuch of the laws of nature as extend not their operation beyond the limits of this earth were eftablifhed chiefly, if not folely, for the good of mankind; and if, in any particular circumftances, that good can be more effectually promoted by an occafional deviation from thofe laws, fuch a deviation may be reafonably expected. Were man, in the exercife of his mental and corporeal powers, fubjected to the laws of phyfical neceffity, the circumftances fuppofed would indeed never occur, and of courfe no miracle could be admitted. But fuch is not the nature of man.

Without repeating what has been faid elfewhere (See METAPHYSICS, Part III. Chap. V.) of neceffity and liberty, we fhall here take it for granted, that the relation between motives and actions is different from that between caufe and effect in phyfics; and that, mankind have fuch command over themfelves, as that by their voluntary conduct, they can make themfelves in a great degree either happy or miferable. We know likewife from hiftory, that, by fome means or other, almoft all mankind were once funk into the groffeft ignorance of the moft important truths; that they knew not the Being by whom they were created and fupported; that they paid divine adoration to ftocks, ftones, and the vileft reptiles; and that they were flaves to the moft impious, cruel, and degrading fuperftitions.

From this depraved ftate it was furely not unworthy of the common "Father of all" to refcue his helplefs creature, to enlighten their underftandings that they might perceive what is right, and to prefent to them motives of fufficient force to engage them in the practice of it. But the underftandings of ignorant barbarians cannot be enlightened by arguments; becaufe of the force of fuch arguments as regard moral fcience they are not qualified to judge. The philofophers of Athens and Rome inculcated, indeed, many excellent moral precepts, and they fometimes ventured to expofe the abfurdities of the reigning fuperftition: but their lectures had no influence upon the multitude; and they had themfelves imbibed fuch erroneous notions refpecting the attributes of the Supreme Being, and the nature of the human foul, and converted thofe notions into firft principles, of which they would not permit

Miracles. permit an examination, that even among them a thorough reformation was not to be expected from the powers of reasoning. It is likewise to be observed, that there are many truths of the utmost importance to mankind, which unassisted reason could never have discovered. Amongst these we may confidently reckon the immortality of the soul, the terms upon which God will be reconciled to sinners, and the manner in which that all-perfect Being may be acceptably worshipped; about all of which philosophers were in such uncertainty, that, according to Plato, "Whatever is set right, and as it should be, in the present evil state of the world, can be so only by the particular interposition of God (A).

An immediate revelation from Heaven, therefore, was the only method by which infinite wisdom and perfect goodness could reform a bewildered and vicious race. But this revelation, at whatever time we suppose it given, must have been made directly either to some chosen individuals commissioned to instruct others, or to every man and woman for whose benefit it was ultimately intended. Were every person instructed in the knowledge of his duty by immediate inspiration, and were the motives to practise it brought home to his mind by God himself, human nature would be wholly changed: men would not be masters of their own actions; they would not be moral agents, nor by consequence be capable either of reward or of punishment. It remains, therefore, that if God has been graciously pleased to enlighten and reform mankind, without destroying that moral nature which is essential to virtue, he can have done it only by revealing his truth to certain chosen instruments, who were the immediate instructors of their contemporaries, and through them have been the instructors of succeeding ages.

Let us suppose this to have been actually the case, and consider how those inspired teachers could communicate to others every truth which had been revealed to themselves. They might easily, if it was part of their duty, deliver a sublime system of natural and moral science, and establish it upon the common basis of experiment and demonstration; but what foundation could they lay for those truths which unassisted reason cannot discover, and which, when they are revealed, appear to have no necessary relation to any thing previously known? To a bare affirmation that they had been immediately received from God, no rational being could be expected to assent. The teachers might be men of known veracity, whose simple assertion would be admitted as sufficient evidence for any fact in conformity with the laws of nature; but as every man has the evidence of his own consciousness and experience that revelations from heaven are deviations from these laws, an assertion so apparently extravagant would be rejected as false, unless supported by some better proof than the mere affirmation of the teacher. In this state of things, we can conceive no evidence sufficient to make such doctrines be received as the truths of God, but the power of working miracles committed to him who taught them. This would, indeed, be fully adequate to the purpose. For if there were nothing in the doctrines themselves impious, immoral, or contrary to truths already known, the only thing which could render the teacher's assertion incredible, would be its implying such an intimate communion with God as is contrary to the established course of things, by which men are left to acquire all their knowledge by the exercise of their own faculties.—Let us now suppose one of those inspired teachers to tell his countrymen, that he did not desire them, on his *ipse dixit*, to believe that he had any preternatural communion with the Deity, but that for the truth of his assertion he would give them the evidence of their own senses; and after this declaration let us suppose him immediately to raise a person from the dead in their presence, merely by calling upon him to come out of his grave. Would not the only possible objection to the man's veracity be removed by this miracle? and his assertions that he had received such and such doctrines from God be as fully credited, as if it related to the most common occurrence? Undoubtedly it would; for when so much preternatural *power* was visibly communicated to this person, no one could have reason to question his having received an equal portion of preternatural *knowledge*. A palpable deviation from the known laws of nature, in one instance, is a sensible proof that such a deviation is possible in another; and in such a case as this, it is the witness of God to the truth of a man.

Miracles, then, under which we include prophecy, are the only direct evidence which can be given of divine inspiration. When a religion, or any religious truth, is to be revealed from heaven, they appear to be absolutely necessary to enforce its reception among men; and this is the only case in which we can suppose them necessary, or believe for a moment that they ever have been or will be performed.

The history of almost every religion abounds with relations of prodigies and wonders, and of the intercourse of men with the gods; but we know of no religious system, those of the Jews and Christians excepted, which appealed to miracles as the sole evidence of its truth and divinity. The pretended miracles mentioned by Pagan historians and poets are not said to have been publicly wrought to enforce the truth of a new religion contrary to the reigning idolatry. Many of them may be clearly shown to have been mere natural events; (see MAGIC.) Others of them are represented as having been performed in secret on the most trivial occasions, and in obscure and fabulous ages long prior to the era of the writers by whom they are recorded. And such of them as at first view appear to be best attested, are evidently tricks contrived for interested purposes; to flatter power, or to promote the prevailing superstitions. For these reasons, as well as on account of the immoral character of the divinities by whom they are said to have been wrought, they are altogether unworthy of examination, and carry in the very nature of them the completest proofs of falsehood and imposture.

But

(A) Ευ γαρ χρη ειδεναι, ὁ τι περ αν σωθη τε και γενηται οιον δει, εν τοιαυτη καταστασει πολιτειων. Θεου μοιραν αυτο σωσαι. De Repub. lib. vi.

Miracle.

But the miracles recorded of Mofes and of Chrift bear a very different character. None of them is reprefented as wrought on trivial occafions. The writers who mention them were eye witneffes of the facts; which they affirm to have been performed publicly, in atteftation of the truth of their refpective fyftems. They are indeed fo incorporated with thefe fyftems, that the miracles cannot be feparated from the doctrines; and if the miracles were not really performed, the doctrines cannot poffibly be true. Befides all this, they were wrought in fupport of revelations which oppofed all the religious fyftems, fuperftitions, and prejudices, of the age in which they were given: a circumftance which of itfelf fets them, in point of authority, infinitely above the Pagan prodigies, as well as the lying wonders of the Romifh church.

It is indeed, we believe, univerfally admitted, that the miracles mentioned in the book of Exodus and in the four Gofpels, might, to thofe who faw them performed, be fufficient evidence of the divine infpiration of Mofes and of Chrift; but to us it may be thought that they are no evidence whatever, as we muft believe in the miracles themfelves, if we believe in them at all, upon the bare authority of human teftimony. Why, it has been fometimes afked, are not miracles wrought in all ages and countries? If the religion of Chrift was to be of perpetual duration, every generation of men ought to have complete evidence of its truth and divinity.

To the performance of miracles in every age and in every country, perhaps the fame objections lie as to the immediate infpiration of every individual. Were thofe miracles univerfally received as fuch, men would be fo overwhelmed with the *number* rather than with the *force* of their authority, as hardly to remain mafters of their own conduct; and in that cafe the very end of all miracles would be defeated by their frequency. The truth, however, feems to be, that miracles fo frequently repeated would not be received as fuch, and of courfe would have *no* authority; becaufe it would be difficult, and in many cafes impoffible, to diftinguifh them from natural events. If they recurred regularly at certain intervals, we could not prove them to be deviations from the known laws of nature, becaufe we fhould have the fame experience for the one feries of events as for the other; for the regular fucceffion of preternatural effects, as for the eftablifhed conftitution and courfe of things.

Be this, however, as it may, we fhall take the liberty to affirm, that for the reality of the Gofpel miracles we have evidence as convincing to the reflecting mind, though not fo ftriking to vulgar apprehenfion, as thofe had who were contemporary with Chrift and his apoftles, and actually faw the mighty works which he performed. To the admirers of Mr Hume's philofophy this affertion will appear an extravagant paradox; but we hope to demonftrate its truth from principles which, confiftently with himfelf, that author could not have denied. He has indeed endeavoured to prove *, that "no teftimony is fufficient to eftablifh a miracle;" and the reafoning employed for this purpofe is, that "a miracle being a violation of the laws of nature which a firm and unalterable experience has eftablifhed, the proof againft a miracle, from the very nature of the fact, is as entire as any argument from experience can be; whereas our experience of human veracity, which (according to him) is the fole foundation of the evidence of teftimony, is far from being uniform, and can therefore never preponderate againft that experience which admits of no exception." This boafted and plaufible argument has with equal candour and acutenefs been examined by Dr Campbell †, who juftly obferves, that fo far is experience from being the fole foundation of the evidence of teftimony, that, on the contrary, teftimony is the fole foundation of by far the greater part of what Mr Hume calls firm and unalterable experience; and that if in certain circumftances we did not give an implicit faith to teftimony, our knowldge of events would be confined to thofe which had fallen under the immediate obfervation of our own fenfes. For a fhort view of this celebrated controverfy, in which the Chriftian fo completely vanquifhes the philofopher, fee the word ABRIDGMENT.

* *Effay on Miracles.*

† *Differtation on Miracles.*

But though Dr Campbell has expofed the fophiftry of his opponent's reafoning, and overturned the *principles* from which he reafons, we are perfuaded that he might fafely have joined iffue with him upon thofe very principles. To us, at leaft, it appears that the teftimony upon which we receive the Gofpel miracles is precifely of that kind which Mr Hume has acknowledged fufficient to eftablifh even a miracle. "No teftimony (fays he) is fufficient to eftablifh a miracle, unlefs the teftimony be of fuch a kind that its falfehood would be more miraculous than the fact which it endeavours to eftablifh. When one tells me that he faw a dead man reftored to life, I immediately confider with myfelf whether it be more probable that this perfon fhould either deceive or be deceived, or that the fact which he relates fhould really have happened. I weigh the one miracle againft the other; and according to the fuperiority which I difcover, I pronounce my decifion, and always reject the greater miracle." In this paffage every reader may remark what did not efcape the perfpicacious eye of Dr Campbell, a ftrange confufion of terms; but as all miracles are equally eafy to the Almighty; and as Mr Hume has elfewhere obferved, that "the raifing of a feather, when the wind wants ever fo little of a force requifite for that purpofe, is as real a miracle as the raifing of a houfe or a fhip into the air;" candour obliges us to fuppofe, that by talking of greater and lefs miracles and of always rejecting the *greater*, he meant nothing more, but that of two deviations from the known laws of nature he always rejects that which in itfelf is leaft probable.

If, then, we can fhow that the teftimony given by the apoftles and other firft preachers of Chriftianity to the miracles of their mafter would, upon their fuppofition that thofe miracles were not really performed, have been as great a deviation from the known laws of nature as the miracles themfelves, the balance muft be confidered as evenly poifed by oppofite miracles; and whilft it continues fo, the judgement muft remain in a ftate of fufpenfe. But if it fhall appear, that in this cafe the falfe teftimony would have been a deviation from the laws of nature lefs probable in itfelf than the miracles recorded in the Gofpels, the balance will be inftantly deftroyed; and by Mr Hume's maxim we fhall be obliged to reject the fuppofition of falfehood in the teftimony of the apoſtles, and admit the miracles of Chriſt to have been really performed.

In this argument we need not waſte time in proving that thoſe miracles, as they are repreſented in the writings of the New Teſtament, were of ſuch a nature, and performed before ſo many witneſſes, that no impoſition could poſſibly be practiſed on the ſenſes of thoſe who affirm that they were preſent. From every page of the Goſpels this is ſo evident, that the philoſophical adverſaries of the Chriſtian faith never ſuppoſe the apoſtles to have been themſelves deceived, but boldly accuſe them of bearing falſe witneſs. But if this accuſation be well founded, their teſtimony itſelf is as great a miracle as any which they record of themſelves or of their Maſter.

It has been ſhown elſewhere (ſee METAPHYSICS, Nº 138.), that by the law of aſſociation, which is one of the laws of nature, mankind, in the very proceſs of learning to ſpeak, neceſſarily learn to ſpeak the truth; that ideas and relations are in the mind of every man ſo cloſely aſſociated with the words by which they are expreſſed in his native tongue, and in every other language of which he is maſter, that the one cannot be entirely ſeparated from the other: that therefore no man can on any occaſion ſpeak falſehood without ſome *effort*; that by no effort can a man give conſiſtency to a unpremeditated detail of falſehood, if it be of any length, and include a number of particulars; and that it is ſtill leſs poſſible for ſeveral men to agree in ſuch a detail, when at a diſtance from each other, and croſs queſtioned by their enemies.

This being the caſe, it follows, if the teſtimony of the apoſtles to their own and their Maſter's miracles be falſe, either that they muſt have concerted a conſiſtent ſcheme of falſehood, and agreed to publiſh it at every hazard; or that God, or ſome powerful agent appointed by him, muſt have diſſolved all the aſſociations formed in their minds between ideas of ſenſe and the words of language, and arbitrarily formed new aſſociations, all in exact conformity to each other, but all in direct contradiction to truth. One or other of theſe events muſt have taken place; becauſe, upon the ſuppoſition of falſehood, there is no other alternative. But ſuch a diſſolution and formation of aſſociations as the latter implies, muſt, to every man who ſhall attentively conſider it, appear to be as real a miracle, and to require as great an exertion of power, as the reſurrection of the dead. Nor is the ſuppoſed voluntary agreement of the apoſtles in a ſcheme of falſehood an event leſs miraculous. When they ſat down to fabricate their pretended revelation, and to contrive a ſeries of miracles to which they were unanimouſly to appeal for its truth, it is plain, ſince they proved ſucceſsful in their daring enterpriſe, that they muſt have clearly foreſeen every poſſible circumſtance in which they could be placed, and have prepared conſiſtent anſwers to every queſtion that could be put to them by their moſt inveterate and moſt enlightened enemies; by the ſtateſman, the lawyer, the philoſopher, and the prieſt. That ſuch foreknowledge as this would have been miraculous, will not ſurely be denied; ſince it forms the very attribute which we find it moſt difficult to allow even to God himſelf. It is not, however, the *only* miracle which this ſuppoſition would compel us to ſwallow. The very *reſolution* of the apoſtles to propagate the belief of falſe miracles in ſupport of ſuch a religion as that which is taught in the New Teſtament, is as great a miracle as human imagination can eaſily conceive.

When they formed this deſign, either they muſt have hoped to ſucceed, or they muſt have foreſeen that they ſhould fail in their undertaking; and in either caſe, they *choſe evil for its own ſake.* They could not, if they foreſaw that they ſhould fail, look for any thing but that contempt, diſgrace, and perſecution, which were then the inevitable conſequences of an unſucceſsful endeavour to overthrow the eſtabliſhed religion. Nor could their proſpects be brighter upon the ſuppoſition of their ſucceſs. As they knew themſelves to be falſe witneſſes and impious deceivers, they could have no hopes beyond the grave; and by determining to oppoſe all the religious ſyſtems, ſuperſtitions, and prejudices of the age in which they lived, they wilfully expoſed themſelves to inevitable miſery in the preſent life, to inſult, and impriſonment, to ſtripes and death. Nor can it be ſaid that they might look forward to power and affluence when they ſhould, through ſufferings, have converted their countrymen; for ſo deſirous were they of obtaining nothing but *miſery*, as the end of their miſſion, that they made their own perſecution a teſt of the truth of their doctrines. They introduced the Maſter from whom they pretended to have received theſe doctrines as telling them, that "they were ſent forth as ſheep in the midſt of wolves; that they ſhould be delivered up to councils, and ſcourged in ſynagogues; that they ſhould be hated of all men for his name's ſake; that the brother ſhould deliver up the brother to death, and the father the child; and that he who took not up his croſs and followed after him was not worthy of him." The very ſyſtem of religion, therefore, which they invented and reſolved to impoſe upon mankind, was ſo contrived, that the worldly proſperity of its firſt preachers, and even their exemption from perſecution, was incompatible with its ſucceſs. Had theſe clear predictions of the Author of that religion, under whom the apoſtles acted only as miniſters, not been verified, all mankind muſt have inſtantly perceived that their pretence to inſpiration was falſe, and that Chriſtianity was a ſcandalous and impudent impoſture. All this the apoſtles could not but foreſee when they formed their plan for deluding the world. Whence it follows, that when they reſolved to ſupport their pretended revelation by an appeal to forged miracles, they wilfully, and with their eyes open, expoſed themſelves to inevitable miſery, whether they ſhould ſucceed or fail in their enterpriſe; and that they concerted their meaſures ſo as not to admit of a poſſibility of recompenſe to themſelves, either in this life or in that which is to come. But if there be a law of nature, for the reality of which we have better evidence than we have for others, it is, that "no man can chooſe miſery for its *own ſake*," or make the acquiſition of it the ultimate end of his purſuit. The exiſtence of other laws of nature we know by teſtimony and our own obſervation of the regularity of their effects. The exiſtence of this law is made known to us not only by theſe means, but alſo by the ſtill clearer and more concluſive evidence of our own conſciouſneſs.

Thus, then, do miracles force themſelves upon our aſſent in every poſſible view which we can take of this intereſting ſubject. If the teſtimony of the firſt preachers

preachers of Chriſtianity was true, the miracles recorded in the Goſpel were certainly performed, and the doctrines of our religion are derived from heaven. On the other hand, if that teſtimony was falſe, either God muſt have miraculouſly effaced from the minds of thoſe by whom it was given all the aſſociations formed between their ſenſible ideas and the words of language, or he muſt have endowed thoſe men with the gift of preſcience, and have impelled them to fabricate a pretended revelation for the purpoſe of deceiving the world, and involving themſelves in certain and foreſeen deſtruction.

The power neceſſary to perform the one ſeries of theſe miracles may, for any thing known to us, be as great as that which would be requiſite for the performance of the other; and, conſidered merely as exertions of preternatural power, they may ſeem to balance each other, and to hold the mind in a ſtate of ſuſpenſe. But when we take into conſideration the different purpoſes for which theſe oppoſite and contending miracles were wrought, the balance is inſtantly deſtroyed. The miracles recorded in the Goſpels, if real, were wrought in ſupport of a revelation which, in the opinion of all by whom it is received, has brought to light many important truths which could not otherwiſe have been made known to men; and which, by the confeſſion of its adverſaries, contains the pureſt moral precepts by which the conduct of mankind was ever directed. The oppoſite ſeries of miracles, if real, was performed to enable, and even to compel, a company of Jews, of the loweſt rank and of the narroweſt education, to fabricate, with the view of inevitable deſtruction to themſelves, a conſiſtent ſcheme of falſehood, and by an appeal to forged miracles to impoſe it upon the world as a revelation from heaven. The object of the former miracles is worthy of a God of infinite wiſdom, goodneſs, and power. The object of the latter is abſolutely inconſiſtent with wiſdom and goodneſs, which are demonſtrably attributes of that Being by whom alone miracles can be performed. Whence it follows, that the ſuppoſition of the apoſtles bearing *falſe* teſtimony to the miracles of their Maſter, implies a ſeries of deviations from the laws of nature, infinitely leſs probable in themſelves than thoſe miracles: and therefore by Mr Hume's maxim, we muſt neceſſarily reject the ſuppoſition of falſehood in the teſtimony, and admit the reality of the miracles. So true it is, that for the reality of the Goſpel miracles we have evidence as convincing to the reflecting mind, as thoſe had who were contemporary with Chriſt and his apoſtles, and were actual witneſſes to their mighty works.

MIRANDA-DE-EBRO, a town of Spain, in Old Caſtile, with a ſtrong caſtle; ſeated in a country that produces excellent wine. W. Long. 3. 10. N. Lat. 42. 52.

MIRANDO-DE-DOURO, or *Duero*, a ſtrong town of Portugal, and capital of the province of Tra-los-Montes, with a biſhop's ſee. It is well fortified, and ſeated on a rock near the confluence of the rivers Douro and Freſna. W. Long. 5. 40. N. Lat. 41. 30.

MIRANDOLA, a town of Italy, and capital of a duchy of the ſame name, ſituated between the duchies of Mantua and Modena; is well fortified, and has alſo a ſtrong citadel and fort. It has ſeveral times taken and retaken. E. Long. 11. 5. N. Lat. 44. 52.

MIRIAM, ſiſter of Aaron and Moſes, makes two or three remarkable appearances in Scripture. It was owing to her that her mother was employed by Pharaoh's daughter as nurſe to Moſes. She put herſelf at the head of the women of Iſrael after their paſſage through the Red ſea, in order to ſing the ſong which the men had ſung before. She joined with her brother Aaron in murmuring againſt Moſes, and was ſeverely chaſtiſed for that action; for ſhe became leprous, and continued ſeparate from the reſt without the camp for ſeven days. She died before her brothers, though in the ſame year with them, and was buried at the public expence.

MIRROR, a name for a looking glaſs, or any poliſhed body, whoſe uſe is to form the images of diſtant objects, by reflection of the rays of light. See REFLECTION.

Mirrors are either plane, convex, or concave. The firſt reflect the rays of light in a direction exactly ſimilar to that in which they fall upon them, and therefore repreſent bodies of their natural magnitude. The convex ones make the rays diverge much more than before reflection, and therefore greatly diminiſh the images of thoſe objects which they ſhow: while the concave ones, by collecting the rays into a focus, not only magnify the objects they ſhow, but will burn very fiercely when expoſed to the rays of the ſun; and hence they are commonly known by the name of *burning mirrors*. See *BURNING Mirrors*.

In ancient times the mirrors were made of ſome kind of metal; and from a paſſage of the Moſaic writings we learn that the mirrors uſed by the Jewiſh women were made of braſs. The Jews certainly had been taught to uſe that kind of mirrors by the Egyptians; from whence it is probable that brazen mirrors were the firſt kind uſed in the world. Any kind of metal, indeed, when well poliſhed, will reflect very powerfully; but of all others ſilver reflects the moſt, though it has been in all countries too expenſive a material for common uſe. Gold alſo is very powerful; and metals, or even wood, gilded and poliſhed, will act very powerfully as burning mirrors. Even poliſhed ivory, or ſtraw nicely plaited together, will form mirrors capable of burning, if on a large ſcale.

Since the invention of glaſs, and the application of quickſilver to it, became generally known, it hath been univerſally employed for thoſe plane mirrors uſed as ornaments to houſes; but in making reflecting teleſcopes, they have been found much inferior to metallic ones. It doth not appear that the ſame ſuperiority belongs to the metalline burning mirrors, conſidered merely as burning glaſſes; ſince the mirror with which M. Macquer melted platina, though only 22 inches diameter, and which was made of quickſilvered glaſs, produced much greater effects than M. Villette's metalline ſpeculum, which conſiderably exceeded it in ſize. It is very probable, however, that this mirror of M. Villette's was by no means ſo well poliſhed as it ought to have been; as the art of preparing the metal for taking the fineſt poliſh has but lately been diſcovered and publiſhed in the Philoſophical Tranſactions by Mr Mudge. See *GLASS-Grinding*.

MIRE-CROW, SEA-CROW, or *Pewit*. See LARUS, ORNITHOLOGY *Index*.

MISADVENTURE, in common language, ſignifies

fies any unlucky accident which takes place without being foreseen.

MISADVENTURE, in *Law*, has an especial signification for the killing a man partly by negligence, and partly by chance. See HOMICIDE.

MISANTHROPY (from μισος, *hatred*, and ανθρωπος, a *man*); a general dislike or aversion to man, and mankind. In which sense it stands opposed to *philanthropy*, or the love of mankind.

MISCARRIAGE. See ABORTION and MIDWIFERY.

MISCHNA, or MISNA, (from שנה, *iteravit*), a part of the Jewish Talmud.

The Mischna contains the text; and the Gemara, which is the second part of the Talmud, contains the commentaries: so that the Gemara is, as it were, a glossary on the Mischna.

The Mischna consists of various traditions of the Jews, and of explanations of several passages of Scripture: these traditions serving as an explication of the written law, and supplement to it, are said to have been delivered to Moses during the time of his abode on the Mount; which he afterwards communicated to Aaron, Eleazar, and his servant Joshua. By these they were transmitted to the 70 elders, by them to the prophets, who communicated them to the men of the great sanhedrim, from whom the wise men of Jerusalem and Babylon received them. According to Prideaux's account, they passed from Jeremiah to Baruch, from him to Ezra, and from Ezra to the men of the great synagogue, the last of whom was Simon the Just; who delivered them to Antigonus of Socho: and from him they came down in regular succession to Simeon, who took our Saviour in his arms; to Gamaliel, at whose feet Paul was educated; and last of all to Rabbi Judah the Holy, who committed them to writing in the Mischna. But Dr Prideaux, rejecting this Jewish fiction, observes, that after the death of Simon the Just, about 299 years before Christ, the Mischnical doctors arose, who, by their comments and conclusions, added to the number of those traditions which had been received and allowed by Ezra and the men of the great synagogue; so that towards the middle of the second century after Christ, under the empire of Antoninus Pius, it was found necessary to commit these traditions to writing; more especially, as their country had considerably suffered under Adrian, and many of their schools had been dissolved, and their learned men cut off; and therefore the usual method of preserving their traditions had failed. Rabbi Judah on this occasion being rector of the school at Tiberias, and president of the sanhedrim in that place, undertook the work, and compiled it in six books, each consisting of several tracts, which altogether make up the number of 63. *Prid. Connex.* vol. ii. p. 468, &c. edit. 9. This learned author computes, that the Mischna was composed about the 150th year of our Lord; but Dr Lightfoot says, that Rabbi Judah compiled the Mischna about the year of Christ 190, in the latter end of the reign of Commodus; or, as some compute, in the year of Christ 220. Dr Lardner is of opinion, that this work could not have been finished before the year 190, or later. Collect. of Jewish and Heathen Testimonies, &c. vol. i. p. 178. Thus the book called the *Mischna* was formed; a book which the Jews have generally received with the greatest veneration. The original has been published with a Latin translation by Surenhusius, with notes of his own, and others from the learned Maimonides, &c. in 6 vol. fol. Amsterd. A. D. 1698—1703. (See TALMUD). It is written in a much purer style, and is not near so full of dreams and visions as the Gemara.

MISDEMEANOUR, in *Law*, signifies a crime. Every crime is a misdemeanour; yet the law has made a distinction between crimes of a higher and a lower nature; the latter being denominated *misdemeanours*, the former *felonies*, &c. For the understanding of which distinction, we shall give the following definition from Blackstone's Commentaries, vol. iv. 5.

"A crime, or misdemeanour, is an act *committed* or *omitted*, in violation of a public law, either forbidding or commanding it. This general definition comprehends both *crimes* and *misdemeanours*; which, properly speaking, are mere synonymous terms; though, in common usage, the word *crime* is made to denote such offences as are of a deeper and more atrocious dye; while smaller faults, and omissions of less consequence, are comprised under the gentler name of *misdemeanours* only."

MISE, in law books, is used in various senses: thus it sometimes signifies costs or expences; in which sense it is commonly used in entering of judgements in actions personal. It is also used for the issue to be tried on the grand assize; in which case, joining of the mise upon the mere right, is putting in issue between the tenant and demandant, Who has the best or clearest right.

MISE, also signifies a tax or tallage, &c. An honorary gift, or customary present from the people of Wales to every new king or prince of Wales, anciently given in cattle, wine, and corn, but now in money, being 5000l. or more, is denominated a *mise*: so was the usual tribute or fine of 3000 merks paid by the inhabitants of the county palatine of Chester at the change of every owner of the said earldom, for enjoying their liberties. And at Chester they have a mise-book, wherein every town and village in the county is rated what to pay towards the mise. The 27 Hen. VIII. c. 26. ordains that lords shall have all such mises and profits of their lands as they had in times past, &c.

MISE, is sometimes also corruptly used for *mease*, in law French *mees*, "a messuage;" as a *mise place*, in some manors, is such a messuage or tenement as answers the lord a heriot at the death of its owner.—2. *Inst.* 528.

MISENUM, or MISENUS, in *Ancient Geography*; a promontory, port, and town in Campania, situated to the south-west of Baiæ, in the Sinus Puteolanus, on the north side. Here Augustus had a fleet, called *Classis Misenensis*, for guarding the Mare Inferum; as he had another at Ravenna for the Superum.

On this peninsula a villa was built by Caius Marius, with a degree of elegance that gave great offence to the more austere among the Romans, who thought it ill suited to the character of so rough a soldier. Upon the same foundation Lucullus the plunderer of the eastern world, erected an edifice, in comparison of which the former house was a cottage; but even his magnificence was eclipsed by the splendour of the palace which the emperors raised upon the same spot. To these proud

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abodes of heroes and monarchs, which have long been levelled to the ground, a few fishing huts, as Mr Swinburne informs us, and a lonely public house, have succeeded: hither boatmen resort to tipple perhaps on the identical site where the voluptuous masters of the world quaffed Chian and Falernian wines.

MISER, a parsimonious person who is at the same time rich; or a wretch covetous to extremity, whom avarice has divested of all the charities of human nature, and made even an enemy to himself.

Of this most unaccountable of all characters, many instances occur; some of them so extraordinary as almost to surpass belief. The following are here selected, as being of recent date, perfectly authentic, and the last of them in particular exhibiting an assemblage of qualities the most singular perhaps that ever existed in the same person. Too little dignified to merit a place in regular biography, yet too curious a variety of human character to pass unnoticed in this work, the present seemed the only title under which it could with propriety be introduced.

1. In December 1790, died at Paris, literally of want, Mr Ostervald, a well known banker. This man, originally of Neufchatel, felt the violence of the disease of avarice (for surely it is rather a disease than a passion of the mind) so strongly, that within a few days of his death, no importunities could induce him to buy a few pounds of meat for the purpose of making a little soup for him. "'Tis true (said he), I should not dislike the soup, but I have no appetite for the meat; what then is to become of that?" At the time that he refused this nourishment, for fear of being obliged to give away two or three pounds of meat, there was tied round his neck a silken bag, which contained 800 assignats of 1000 livres each. At his outset in life, he drank a pint of beer which served him for supper, every night at a house much frequented, from which he carried home all the bottle corks he could come at. Of these, in the course of eight years, he had collected as many as sold for 12 louis d'or, a sum that had laid the foundation of his future fortune, the superstructure of which was rapidly raised by his uncommon success in stock jobbing. He died possessed of three millions of livres (125,000l. sterling).

2. The late John Elwes, Esq. was member for Berkshire in three successive parliaments. His family name was *Meggot;* and his father was a brewer of great eminence, and distinguished by no peculiarity of character: but his mother, though she was left nearly 100,000l. by her husband, starved herself to death! At an early period of life he was sent to Westminster school, where he remained for 10 or 12 years. During that time he certainly had not misapplied his talents; for he was a good classical scholar to the last: and it is a circumstance not a little remarkable, though well authenticated, that he never read afterwards, nor had he ever any knowledge in accounts; to which may in some measure be attributed the total ignorance he was always in as to his affairs. From Westminster school Mr Meggot removed to Geneva, where he soon entered upon pursuits more agreeable to him than study. The riding master of the academy there had then to boast perhaps of three of the best riders in Europe, Mr Worsley, Mr Elwes, and Sir Sidney Meadows. Of the three, Elwes was reckoned the most desperate; the young horses were always put into his hands, and he was the rough rider to the other two.

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On his return to England, after an absence of two or three years, he was to be introduced to his uncle the late Sir Harvey Elwes, who was then living at Stoke in Suffolk, perhaps the most perfect picture of human penury that ever existed. The attempts at saving money were in him so extraordinary, that Mr Elwes perhaps never quite reached them, even at the last period of his life.—Of what temperance can do, Sir Harvey was an instance. At an early period of life he was given over for a consumption, and he lived till betwixt 80 and 90 years of age. On his death, his fortune, which was at least 250,000l. fell to his nephew Mr Meggot, who by will was ordered to assume the name and arms of Elwes. To this uncle, and this property, Mr Elwes succeeded when he had advanced beyond the 40th year of his age. For 15 years previous to this period, he was well known in the more fashionable circles of London. He had always a turn for play; and it was only late in life, and from paying always and not always being paid, that he conceived disgust at it. The theory which he professed, "that it was impossible to ask a gentleman for money," he perfectly confirmed by the practice; and he never violated this feeling to the latest hour of his life.

The manners of Mr Elwes were such—so gentle, so attentive, so gentlemanly, and so engaging—that rudeness could not ruffle them, or strong ingratitude break their observance. He retained this peculiar feature of the old court to the last: but he had a praise beyond this: He had the most gallant disregard of his own person, and all care about himself that can be imagined. The instances in younger life, in the most imminent personal hazard, are innumerable; but when age had despoiled him of his activity, and might have rendered care and attention about himself natural, he knew not what they were: He wished no one to assist him: "He was as young as ever; he could walk; he could ride, and he could dance; and he hoped he should not give trouble even when he was old:" He was at that time 75.

It is curious to remark how he contrived to mingle small attempts at saving with objects of the most unbounded dissipation. After sitting up a whole night at play for thousands with the most fashionable and profligate men of the time, amidst splendid rooms, gilt sofas, wax lights, and waiters attendant on his call, he would walk out about four in the morning, not towards home, but into Smithfield, to meet his own cattle, which were coming to market from Thaydonhall, a farm of his in Essex! There would this same man, forgetful of the scenes he had just left, stand in the cold or rain, bartering with a carcass butcher for a shilling! Sometimes when the cattle did not arrive at the hour he expected, he would walk on in the mire to meet them; and more than once has gone on foot the whole way to his farm without stopping, which was 17 miles from London, after sitting up the whole night. Had every man been of the mind of Mr Elwes, the race of innkeepers must have perished, and post-chaises have been returned back to those who made them; for it was the business of his life to avoid both. He always travelled on horseback. To see him setting out on a journey, was a matter truly curious; his first care was to put two or three eggs, boiled

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boiled hard, into his great coat pocket, or any fcraps of bread which he found; baggage he never took; then mounting one of his hunters, his next attention was to get out of London into that road where turnpikes were the feweft: then, ftopping under any hedge where grafs prefented itfelf for his horfe, and a little water for himfelf, he would fit down and refrefh himfelf and his horfe together.

The chief refidence of Mr Elwes at this period of his life was in Berkfhire, at his own feat at Marcham. Here it was he had two natural fons born, who inherit the greateft part of his property by a will made about the year 1785. The keeping of fox hounds was the only inftance in the whole life of Mr Elwes of his ever facrificing money to pleafure; and may be felected as the only period when he forgot the cares, the perplexities, and the regret, which his wealth occafioned. But even here every thing was done in the moft frugal manner. Scrub, in the Beaux Stratagem, when compared with Mr Elwes's huntfman, had an idle life of it. This famous huntfman might have fixed an epoch in the hiftory of fervants: for in a morning, getting up at four o'clock, he milked the cows; he then prepared breakfaft for Mr Elwes or any friends he might have with him: then flipping on a green coat, he hurried into the ftable, faddled the horfes, got the hounds out of the kennel, and away they went into the field. After the fatigues of hunting, he refrefhed himfelf by rubbing down two or three horfes as quickly as he could; then running into the houfe to lay the cloth, and wait at dinner; then hurrying again into the ftable to feed the horfes—diverfified with an interlude of the cows again to milk, the dogs to feed, and eight hunters to litter down for the night.

In the penury of Mr Elwes there was fomething that feemed like a judgement from heaven. All earthly comforts he voluntarily denied himfelf: he would walk home in the rain in London rather than pay a fhilling for a coach; he would fit in wet clothes fooner than have a fire to dry them; he would eat his provifions in the laft ftage of putrefaction fooner than have a frefh joint from the butchers; and he wore a wig for above a fortnight, which his biographer * faw him pick up out of a rut in a lane where they were riding. This was the laft extremity of laudable economy; for to all appearance it was the caft-off wig of fome beggar!

* Mr Topham; from whofe *Life of John Elwes, Efq.* the particulars of this article are extracted.

Mr Elwes had now refided about 13 years in Suffolk, when the conteft for Berkfhire prefented itfelf on the diffolution of the parliament; and when, to preferve the peace of that county, he was nominated by Lord Craven. Mr Elwes, though he had retired from public bufinefs for fome years, had ftill left about him fome of the feeds of more active life, and he agreed to the propofal. It came farther enhanced to him, by the agreement, that he was to be brought in by the freeholders for nothing. All he did on the occafion was dining at the ordinary at Reading; and he got into parliament for 18 pence!

Though a new man, Mr Elwes could not be called a young member; for he was at this time nearly 60 years old when he thus entered on public life. But he was in poffeffion of all his activity; and, preparatory to his appearance on the boards of St Stephen's Chapel, he ufed to attend conftantly during the races and other public meetings all the great towns where his voters refided. At the different affemblies he would dance among the youngeft to the laft, after riding over on horfeback, and frequently in the rain, to the place of meeting. A gentleman who was one night ftanding by, obferved on the extraordinary agility of fo old a man.—"O! that is nothing (replied another); for Mr Elwes, to do this, rode 20 miles in the rain, with his fhoes ftuck into his boots and his bag-wig in his pocket."

The honour of parliament made no alteration in the drefs of Mr Elwes: on the contrary, it feemed at this time to have attained additional meannefs; and nearly to have reached that happy climax of poverty, which has more than once drawn on him the compaffion of thofe who paffed by him in the ftreet. For the fpeaker's dinners, however, he had one fuit, with which the fpeaker in the courfe of the feffions became very familiar. The minifter likewife was well acquainted with it; and at any dinner of oppofition ftill was his apparel the fame. The wits of the minority ufed to fay, "that they had full as much reafon as the minifter to be fatisfied with Mr Elwes, as he had the fame habit with every body." At this period of his life Mr Elwes wore a wig. Much about the time when his parliamentary life ceafed, that wig was worn out; fo then, being older and wifer as to expence, he wore his own hair, which like his expences was very fmall.

All this time the income of Mr Elwes was increafing hourly, and his prefent expenditure was next to nothing; for the little pleafures he had once engaged in he had now given up. He kept no houfe, and only one old fervant and a couple of horfes: he refided with his nephew: his two fons he had ftationed in Suffolk and Berkfhire, to look after his refpective eftates: and his drefs certainly was no expence to him; for had not other people been more careful than himfelf, he would not have had it even mended.

When he left London, he went on horfeback to his country feats with his couple of hard eggs, and without once ftopping upon the road at any houfe. He always took the moft unfrequented road, and ufed every fhift to avoid turnpikes. Marcham was the feat he now chiefly vifited; which had fome reafon to be flattered with the preference, as his journey into Suffolk coft him only twopence-halfpeny, while that into Berkfhire amounted to fourpence!

As Mr Elwes came into parliament without expence, he performed his duty as a member would have done in the pure days of our conftitution. What he had not bought he never attempted to fell; and he went forward in that ftraight and direct path, which can alone fatisfy a reflecting mind. Amongft the fmaller memorials of the parliamentary life of Mr Elwes may be noted, that he did not follow the cuftom of members in general by fitting on any particular fide of the houfe, but fat as occafion prefented itfelf on either indifcriminately; and he voted much in the fame manner, but never rofe to fpeak. In his attendance at the houfe, he was always early and late; and he never left it for dinner, as he had accuftomed himfelf to fafting, fometimes for 24 hours in continuance.

When he quitted parliament, he was, in the common phrafe, "a fifh out of water!" The ftyle of Mr Elwes's

Mifer. Elwes's life had left him no domeftic fcenes to which he could retire—his home was dreary and poor—his rooms received no cheerfulnefs from fire; and while the outfide had all the appearance of a "Houfe to be Let," the infide was a defert; but he had his penury alone to thank for this, and for the want of all the little confolations which fhould attend old age, and fmooth the paffage of declining life. At the clofe of the fpring of 1785, he wifhed again to vifit, which he had not done for fome years, his feat at Stoke. But then the journey was a moft ferious object to him. The famous old fervant was dead; all the horfes that remained with him were a couple of worn-out brood mares; and he himfelf was not in that vigour of body in which he could ride 60 or 70 miles on the fuftenance of *two boiled eggs*. The mention of a poft chaife would have been a crime—"He afford a poft chaife, indeed! where was he to get the money?" would have been his exclamation. At length he was carried into the country as he was carried into parliament, free of expence, by a gentleman who was certainly not quite fo rich as Mr Elwes. When he reached Stoke—the feat of more active fcenes, of fomewhat refembling hofpitality, and where his fox hounds had fpread fomewhat like vivacity around—he remarked, "he had expended a great deal of money once very foolifhly; but that a man grew wifer by time."

The rooms at this feat, which were now much out of repair, and would have all fallen in but for his fon John Elwes, Efq. who had refided there, he thought too expenfively furnifhed, as worfe things might have ferved. If a window was broken, there was to be no repair but that of a little brown paper, or that of piecing in a bit of broken glafs; which had at length been done fo frequently, and in fo many fhapes, that it would have puzzled a mathematician to fay "what figure they defcribed." To fave fire, he would walk about the remains of an old greenhoufe, or fit with a fervant in the kitchen. During the harveft he would amufe himfelf with going into the fields to glean the corn on the grounds of his own tenants; and they ufed to leave a little more than common to pleafe the old gentleman, who was as eager after it as any pauper in the parifh. In the advance of the feafon, his morning employment was to pick up any ftray chips, bones, or other things, to carry to the fire, in his pocket—and he was one day furprifed by a neighbouring gentleman in the act of pulling down, with fome difficulty, a crow's neft for this purpofe. On the gentleman wondering why he gave himfelf this trouble—"Oh, Sir, (replied old Elwes), it is really a fhame that thefe creatures fhould do fo. Do but fee what wafte they make! They don't care how extravagant they are!"

As no gleam of favourite paffion, or any ray of amufement, booke through this gloom of penury, his infatiable defire of faving was now become uniform and fyftematic. He ufed ftill to ride about the country on one of thefe mares—but then he rode her very economically, on the foft turf, adjoining the road, without putting himfelf to the expence of fhoes, as he obferved, "The turf was fo pleafant to a horfe's foot!" And when any gentleman called to pay him a vifit, and the boy who attended in the ftables was profufe enough to put a little hay before his horfe, old Elwes would flily fteal back into the ftable, and take the hay very carefully away. That very ftrong appetite which Mr Elwes had in fome meafure reftrained during the long fitting of parliament, he now indulged moft voracioufly, and on every thing he could find. To fave, as he thought, the expence of going to a butcher, he would have a whole fheep killed, and fo eat mutton to the—*end of the chapter*. When he occafionally had his river drawn, though fometimes horfe loads of fmall fifh were taken, not one would he fuffer to be thrown in again; for he obferved, "He fhould never fee them again!" Game in the laft ftate of putrefaction, and meat that *walked about his plate*, would he continue to eat, rather than have new things killed before the old provifion was finifhed. With this diet—the *charnel houfe of fuftenance*—his drefs kept pace—equally in the laft ftage of *abfolute diffolution*. Sometimes he would walk about in a tattered browncoloured hat, and fometimes in a red and white woollen cap, like a prifoner confined for debt. His fhoes he never would fuffer to be cleaned, left they fhould be worn out the fooner. But ftill, with all this *felf-denial*—that penury of life to which the inhabitant of an *alms houfe* is not doomed—ftill did he think he was profufe, and frequently fay, "He muft be a little more careful of his property." His difquietude on the fubject of money was now continual. When he went to bed, he would put five or ten guineas into a bureau; and then, full of his money, after he had retired to reft, and fometimes in the middle of the night, he would come down to fee if it was there.

The fcene of mortification at which Mr Elwes was now arrived was all but a denial of the common neceffaries of life: and indeed it might have admitted a doubt, whether or not, if his manors, his fifh ponds, and fome grounds in his own hands, had not furnifhed a fubfiftence, where he had not any thing *actually to buy*, he would not, rather than have *bought any thing*, have ftarved. Strange as this may appear, it is not exaggerated.—He one day, during this period, dined upon the remaining part of a moor hen, which had been brought out of the river by a *rat!* and at another ate an undigefted part of a pike which a larger one had fwallowed, but had not finifhed, and which were taken in this ftate in a net. At the time this laft circumftance happened, he difcovered a ftrange kind of fatisfaction; for he faid to a friend, "Aye! this was killing two birds with one ftone!" In the room of all comment—of all moral—let it be remarked, that at this time Mr Elwes was perhaps worth nearly *eight hundred thoufand pounds!* and, at this period, he had not made his will, of courfe was not faving from any fentiment of affection for any perfon.

The fummer of 1788 Mr Elwes paffed at his houfe in Welbeck ftreet, London; and he paffed that fummer without any other fociety than that of two maid fervants; for he had now given up the expence of keeping any male domeftic. His chief employment ufed to be that of getting up early in a morning to vifit fome of his houfes in Mary-le-bone, which during the fummer were repairing. As he was there generally at four o'clock in a morning, he was of courfe on the fpot before the workmen; and he ufed contentedly to fit down on the fteps before the door, to fcold them

Mifer.

them when they did come. The neighbours who ufed to fee him appear thus regularly every morning, and who concluded, from his apparel, that he was one of the workmen, obferved, "there never was fo punctual a man as the old carpenter." During the whole morning he would continue to run up and down ftairs to fee the men were not idle for an inftant, with the fame anxiety as if his whole happinefs in life had been centered in the finifhing of this houfe, regardlefs of the greater property he had at a ftake in various places, and for ever employed in the *minutiæ* only of affairs. Indeed fuch was his anxiety about this houfe, the rent of which was not above 50l. a-year, that it brought on a fever which nearly coft him his life: but the fate which dragged him on thus ftrangely to bury him under the load of his own wealth, feemed as refiftlefs as it was unaccountable.

In the mufcular and unencumbered frame of Mr Elwes there was every thing that promifed extreme length of life; and he lived to above 70 years of age without any natural diforder attacking him: but, as Lord Bacon has well obferved, "the minds of fome men are a lamp that is continually burning;" and fuch was the mind of Mr Elwes. Removed from thofe occafional public avocations which had once engaged his attention, money was now his only thought. He rofe upon money—upon money he lay down to reft; and as his capacity funk away from him by degrees, he dwindled from the real cares of his property into the puerile concealment of a few guineas. This little ftore he would carefully wrap up in various papers, and depofiting them in different corners, would amufe himfelf with running from one to the other, to fee whether they were all fafe. Then forgetting, perhaps, where he had concealed fome of them, he would become as ferioufly afflicted as a man might be who had loft all his property. Nor was the day alone thus fpent—he would frequently rife in the middle of the night, and be heard walking about different parts of the houfe, looking after what he had thus hidden and forgotten.

During the winter of 1789, the laft winter Mr Elwes was fated to fee, his memory vifibly weakened every day; and from the unceafing wifh to fave money, he now began to fear he fhould die in want of it. Mr Gibfon had been appointed his builder in the room of Mr Adams; and one day, when this gentleman waited upon him, he faid with apparent concern, "Sir, pray confider in what a wretched ftate I am; you fee in what a good houfe I am living; and here are five guineas, which is all I have at prefent; and how I fhall go on with fuch a fum of money puzzles me to death. I dare fay you thought I was rich; now you fee how it is!"

Mr George Elwes having now fettled at his feat at Marcham in Berkfhire, he was naturally defirous that, in the affiduities of his wife, his father might at length find a comfortable home. In London he was certainly moft uncomfortable: but ftill, with thefe temptations before and behind him, a journey with any expence annexed to it was infurmountable. This, however, was luckily obviated by an offer from Mr Partis, a gentleman of the law, to take him to his ancient feat in Berkfhire with his purfe perfectly whole. But there was one circumftance ftill very diftreffing—the old gentleman had now nearly worn out his laft coat, and he would not buy a new one; his fon, therefore, with a pious fraud, contrived to get Mr Partis to buy him a coat and make him a prefent of it. Thus formerly having had a good coat, then a bad one, and at laft no coat at all, he was kind enough to accept one from a neighbour.

Mifer ‖ Misfeafance.

Mr Elwes carried with him into Berkfhire five guineas and a half, and half a crown. Left the mention of this fum may appear fingular, it fhould be faid, that previous to his journey he had carefully wrapped it up in various folds of paper, that no part of it might be loft. On the arrival of the old gentleman, Mr George Elwes and his wife did every thing they could to make the country a fcene of quiet to him. But "he had that within" which baffled every effort of this kind. Of his heart it might be faid, "there was no peace in Ifrael." His mind, caft away upon the vaft and troubled ocean of his property, extending beyond the bounds of his calculation, returned to amufe itfelf with fetching and carrying about a few guineas, which in that ocean was indeed a drop. But nature had now carried on life nearly as far as fhe was able, and the fand was almoft run out. The firft fymptom of more immediate decay was his inability to enjoy his reft at night. Frequently would he be heard at midnight as if ftruggling with fome one in his chamber, and crying out, "I will keep my money, I will; nobody fhall rob me of my property." On any one of the family going into his room, he would ftart from this fever of anxiety, and, as if waking from a troubled dream, again hurry into bed, and feem unconfcious of what had happened. At length, on the 26th November 1789, expired this miferably rich man, whofe property, nearly reaching to a million, extended itfelf almoft through every county in England.

MISERICORDIA, in *Law*, is an arbitrary fine impofed on any perfon for an offence: this is called *mifericordia*, becaufe the amercement ought to be but fmall, and lefs than that required by magna charta. If a perfon be outrageoufly amerced in a court that is not of record, the writ called *moderata mifericordia* lies for moderating the amercement according to the nature of the fault.

MISFORTUNE. An unlucky accident.

MISFORTUNE, or chance, in *Law*, a deficiency of the will; or committing of an unlawful act by misfortune or chance, and not by defign. In fuch cafe, the will obferves a total neutrality, and does not co-operate with the deed; which therefore wants one main ingredient of a crime. See CRIME.

Of this, when it affects the life of another, we have fpoken under the article HOMICIDE; and in this place have only occafion to obferve, that if any accidental mifchief happens to follow from the performance of a lawful act, the party ftands excufed from all guilt: but if a man be doing any thing unlawful, and a confequence enfues which he did not forefee or intend, as the death of a man or the like, his want of forefight fhall be no excufe; for, being guilty of one offence, in doing antecedently what is in itfelf unlawful, he is criminally guilty of whatever confequence may follow the firft mifbehaviour.

MISFEASANCE, in law books, fignifies a trefpafs.

MISLETOE,

MISLETOE. See VISCUM, BOTANY *Index*.

MISNOMER, in *Law*, a misnaming or mistaking a person's name. The Christian name of a person should always be perfect; but the law is not so strict in regard to surnames, a small mistake in which will be dispensed with to make good a contract, and support the act of the party. See PLEA *to Indictment*.

MISPRISIONS, (a term derived from the old French, *mespris*, a neglect or contempt), are, in the acceptation of our law, generally understood to be all such high offences as are under the degree of capital, but nearly bordering thereon: and it is said, that a misprision is contained in every treason and felony whatsoever; and that, if the king so please, the offender may be proceeded against for the misprision only. And upon the same principle, while the jurisdiction of the star-chamber subsisted, it was held that the king might remit a prosecution for treason, and cause the delinquent to be censured in that court, merely for a high misdemeanor: as happened in the case of Roger earl of Rutland, in 43 Eliz. who was concerned in the earl of Essex's rebellion. Misprisions are generally divided into two sorts; negative, which consist in the concealment of something which ought to be revealed; and positive, which consist in the commission of something which ought not to be done.

1. Of the first, or negative kind, is what is called *misprision of treason*; consisting in the bare knowledge and concealment of treason, without any degree of assent thereto; for any assent makes the party a principal traitor; as indeed the concealment, which was construed aiding and abetting, did at the common law; in like manner as the knowledge of a plot against the state, and not revealing it, was a capital crime at Florence, and other states of Italy. But it is now enacted by the statue 1 & 2 Ph. & Mar. c. 10. that a bare concealment of treason shall be only held a misprision. This concealment becomes criminal, if the party apprised of the treason does not, as soon as conveniently may be, reveal it to some judge of assize or justice of the peace. But if there be any probable circumstances of assent, as if one goes to a treasonable meeting, knowing beforehand that a conspiracy is intended against the king; or, being in such company once by accident, and having heard such treasonable conspiracy, meets the same company again, and hears more of it, but conceals it; this is an implied assent in law, and makes the concealer guilty of actual high treason.

Misprision of felony is also the concealment of a felony which a man knows, but never assented to; for, if he assented, this makes him either principal or accessory. And the punishment of this, in a public officer, by the statute Westm. 1. 3 Edw. I. c. 9. is imprisonment for a year and a day; in a common person, imprisonment for a less discretionary time; and, in both, fine and ransom at the king's pleasure: which pleasure of the king must be observed, once for all, not to signify any extrajudicial will of the sovereign, but such as is declared by his representatives, the judges in his courts of justice; *voluntas regis in curia, non in comera*.

2. Misprisions, which are merely positive, are generally denominated *contempt* or *high misdemeanours*; of which the principal is the *mal-administration* of such high officers as are in public trust and employment. This is usually punished by the method of parliamentary impeachment; wherein such penalties, short of death, are inflicted, as to the wisdom of the house of peers shall seem proper; consisting usually of banishment, imprisoment, fines, or perpetual disability. Hither also may be referred the offence of *embezzling the public money*, called among the Romans *peculatus*; which the Julian law punished with death in a magistrate, and with deportation, or banishment, in a private person. With us it is not a capital crime, but subjects the committer of it to a discretionary fine and imprisonment.—Other misprisions are, in general, such contempts of the executive magistrate as demonstrate themselves by some arrogant and undutiful behaviour towards the king and government: for a detail of which, *vide* Blackstone's Comment. iv. 22.

MISSAL, the Romish mass-book, containing the several masses to be said on particular days. It is derived from the Latin word *missa*, which, in the ancient Christian church, signified every part of divine service.

MISSEL-BIRD, a species of TURDUS. See TURDUS, ORNITHOLOGY *Index*.

MISSIO, among the Romans, was a full discharge given to a soldier after 20 years service, and differed from the *exauctoratio*, which was a discharge from duty after 17 years service. Every soldier had a right to claim his *missio* at the end of 20 years.

MISSION, in *Theology*, denotes a power or commission to preach the gospel. Jesus Christ gave his disciples their mission in these words, *Go and teach all nations*, &c.

The Romanists reproach the Protestants, that their ministers have no mission, as not being authorized in the exercise of their ministry, either by an uninterrupted succession from the apostles, or by miracles, or by any extraordinary proof of a vocation.

Many among us deny any other mission necessary for the ministry than the talents necessary to discharge it.

MISSION is also used for an establishment of people zealous for the glory of God and the salvation of souls; who go and preach the gospel in remote countries and among infidels.

There are missions in the East as well as in the West Indies. Among the Romanists, the religious orders of St Dominic, St Francis, St Augustine, and the Jesuits, have missions in the Levant, America, &c. The Jesuits have also missions in China, and all other parts of the globe where they have been able to penetrate. There have been also several Protestant missions for diffusing the light of Christianity through the benighted regions of Asia and America. Of this kind has been the Danish mission planned by Frederic IV. in 1706. And the liberality of private benefactors in our own country has been also extended to the support of missionaries among the Indians in America, &c.

MISSIONARY, an ecclesiastic who devotes himself and his labours to some mission, either for the instruction of the orthodox, the conviction of heretics, or the conversion of infidels. See JESUITS.

MISSISSIPPI, a noble river in America, which waters about five-eighths of the United States, forming their

their weftern boundary, and feparating them from the province of Louifiana and the Indian country. Its length has not been accurately afcertained, but it is conjectured to be upwards of 3000 miles. There are numerous tributary ftreams which fall into it from the W. and E.; and the country on both fides of the river, is faid to be equal in goodnefs and fertility to any in North America. It is navigable as far as to what are denominated the *falls of St Anthony*, and fome fay farther. There are falt fprings on each fide of this river, which produce falt of an excellent quality, and large quantities of coal are found on its upper branches. Its mouths alfo form an ifland of confiderable extent. Thefe are fituated between 29° and 30° N. Lat. and between 89° and 90° W. Long.

MISSOURI, a river in Louifiana, which falls into the Miffiffippi from the weft, 195 miles above the mouth of the Ohio, and about 1160 miles from the Balize in the gulf of Mexico. The extent of its navigation is not fufficiently known; but by the map of Captain Hutchins it appears to be navigable 1300 miles. The progrefs of fettlement by the Spaniards on the fouth and weft, and by the Englifh on the north and eaft, is reported by late travellers to be aftonifhing; and according to the map of Mr M'Kenzie, it appears that there is a communication by water, attended with little difficulty, from the upper lakes to Nootka found, or its vicinity.

In a voyage of difcovery undertaken by Captains Lewis and Clarke in 1805, under the aufpices of the American government, it appears that the Miffouri at the diftance of 3848 miles by the courfe of the river from its junction with the Miffiffippi, divides into three branches, to which they gave the names of Jefferfon's, Madifon's, and Gallatin's rivers; and the firft of thefe, Jefferfon's river, and the only one explored, is navigable for 248 miles. Phil. Mag. xxvii. 13.

MISSUS, in the Circenfian games, were the matches in horfe or chariot races. The ufual number of *miffus* or matches in one day was 24; though the emperor Domitian prefented the people with 100. The laft match was generally made at the expence of the people, who made a collection for the purpofe; hence it was called *miffus ærarius*, a fubfcription plate.

MIST, or Fog. See Fog.

MISTAKE, any wrong action committed, not through an evil defign, but through an error of judgement.

Mistake, in *Law*. See Ignorance.

MISUSER, in *Law*, is an abufe of any liberty or benefit; as "He fhall make fine for his misuser." Old. Nat. Br. 149. By mifufer a charter of a corporation may be forfeited; fo alfo an office, &c.

MITCHELSTOWN, a poft town of Ireland, in the county of Cork and province of Munfter in Ireland, where there is a college founded by the Earl of Kingfton for the fupport of 12 decayed gentlemen and 12 decayed gentlewomen, who have 40l. yearly, and handfome apartments.

MITE, a fmall piece of money mentioned Luke xii. 59. and xxi. 2. In the Greek it is χοδραντης, i. e. *quadrans*, or a quarter of the Roman *denarius*; fo that the mite was worth about feven farthings, or two pence of our money.

Mite. See Acarus, Entomology *Index*.

MITELLA, bastard American sanicle: A genus of plants belonging to the decandria clafs, and in the natural method ranking under the 13th order, *Succulentæ*. See Botany *Index*.

MITHRA, feafts of, in antiquity, were feafts celebrated among the Romans in honour of Mithras or the fun. The moft ancient inftance of this Mithras among the Romans occurs in an infcription dated in the third confulate of Trajan, or about the year of Chrift 101. This is the dedication of an altar to the fun under the above name, thus infcribed, *Deo Soli Mithræ*. But the worfhip of Mithras was not known in Egypt and Syria in the time of Origen, who died about the year of Chrift 263; though it was common at Rome for more than a century before this time. The worfhip of Mithras was profcribed at Rome in the year 378, by order of Gracchus, prefect of the prætorium. According to M. Freret, the feafts of Mithras were derived from Chaldea, where they had been inftituted for celebrating the entrance of the fun into the fign Taurus.

MITHRAS, or Mithra, a god of Perfia and Chaldea, fuppofed to be the fun. His worfhip was introduced at Rome. He is generally reprefented as a young man, whofe head is covered with a turban after the manner of the Perfians. He fupports his knee upon a bull that lies on the ground, and one of whofe horns he holds in one hand, while with the other he plunges a dagger in his neck.

MITHRIDATE, an old term, in *Pharmacy*; an antidote, or compofition, in form of an electuary, fuppofed to ferve either as a remedy or a prefervative againft poifons. It takes its name from the inventor, Mithridates king of Pontus, who is faid to have fo fortified his body againft poifons with antidotes and prefervatives, that when he had a mind to defpatch himfelf, he could not find any poifon that would take effect.

MITHRIDATES, the name of feveral kings of Pontus. See Pontus.

Mithridates VII. furnamed *Eupator* and *the Great*, fucceeded to the throne at the age of 11 years, about 123 years before the Chriftian era. The beginning of his reign was marked by ambition, cruelty, and artifice. He murdered his own mother, who had been left by his father co-heirefs of the kingdom; and he fortified his conftitution by drinking antidotes againft the poifon with which his enemies at court attempted to deftroy him. He early inured his body to hardfhip, and employed himfelf in the moft manly exercifes, often remaining whole months in the country, and making frozen fnow and the earth the place of his repofe. Naturally ambitious and cruel, he fpared no pains to acquire himfelf power and dominion. He murdered the two fons whom his fifter Laodice had had by Ariarathes king of Cappadocia, and placed one of his own children, only eight years old, on the vacant throne. Thefe violent proceedings alarmed Nicomedes king of Bithynia, who had married Laodice the widow of Ariarathes. He fuborned a youth to be king of Cappadocia, as the third fon of Ariarathes; and Laodice was fent to Rome to impofe upon the fenate, and affure them that her third fon was now alive, and that his pretenfions to the kingdom of Cappadocia were juft and well grounded. Mithridates, on his part, fent to Rome Gordius the governor of his fon; who folemnly declared before the Roman people, that the youth who fat

Mithridates. on the throne of Cappadocia was the third ſon and lawful heir of Ariarathes, and that he was ſupported as ſuch by Mithridates. This intricate affair diſpleaſed the Roman ſenate; and finally to ſettle the diſpute they took away the kingdom of Cappadocia from Mithridates, and Paphlagonia from Nicomedes. Theſe two kingdoms being thus ſeparated from their original poſſeſſors, were preſented with their freedom and independence; but the Cappadocians refuſed it, and received Ariobarzanes for king. Such were the firſt ſeeds of enmity between Rome and the king of Pontus. Mithridates never loſt an opportunity by which he might leſſen the influence of his adverſaries; and the more effectually to deſtroy their power in Aſia, he ordered all the Romans that were in his dominions to be maſſacred. This was done in one night, and no leſs than 150,000, according to Plutarch, or 80,000 Romans, as Appian mentions, were made the victims of his cruelty. This called aloud for vengeance. Aquilius, and ſoon after Sylla, marched againſt Mithridates with a large army. The former was made priſoner; but Sylla obtained a victory over the king's generals; and another deciſive engagement rendered him maſter of all Greece, Macedonia, Ionia, and Aſia Minor. This ill fortune was aggravated by the loſs of about 200,000 men, who were killed in the ſeveral engagements that had been fought; and Mithridates, weakened by repeated ill ſucceſs by ſea and land, ſued for peace from the conqueror, which he obtained on condition of defraying the expences which the Romans had incurred by the war, and of remaining ſatisfied with the poſſeſſions which he had received from his anceſtors. While theſe negotiations of peace were carried on, Mithridates was not unmindful of his real intereſt. His poverty, and not his inclinations, obliged him to wiſh for peace. He immediately took the field with an army of 140,000 infantry, and 16,000 horſe, which conſiſted of his own forces and thoſe of his ſon-in-law Tigranes king of Armenia. With ſuch a numerous army he ſoon made himſelf maſter of the Roman provinces in Aſia; none dared to oppoſe his conqueſts; and the Romans, relying on his fidelity, had withdrawn the greateſt part of their armies from the country. The news of his warlike preparations were no ſooner heard, than Lucullus the conſul marched into Aſia; and without delay he blocked up the camp of Mithridates who was then beſieging Cyzicus. The Aſiatic monarch eſcaped from him, and fled into the heart of his kingdom. Lucullus purſued him with the utmoſt celerity; and would have taken him priſoner after a battle, had not the avidity of his ſoldiers preferred the plundering of a mule loaded with gold to the taking of a monarch who had exerciſed ſuch cruelties againſt their countrymen, and ſhown himſelf ſo faithleſs to the moſt ſolemn engagements. After this eſcape Mithridates was more careful about the ſafety of his perſon; and he even ordered his wives and ſiſters to deſtroy themſelves, fearful of their falling into the enemy's hands. The appointment of Glabrio to the command of the Roman forces, inſtead of Lucullus, was favourable to Mithridates, who recovered the greateſt part of his dominions. The ſudden arrival of Pompey, however, ſoon put an end to his victories. A battle in the night was fought near the Euphrates, in which the troops of Pontus laboured under every diſadvantage. The engagement was by moon-light, and as the moon then ſhown in the face of the enemy, the lengthened ſhadows of the arms of the Romans having induced Mithridates to believe that the two armies were cloſe together, the arrows of his ſoldiers were darted from a great diſtance, and their efforts rendered ineffectual. An univerſal overthrow enſued, and Mithridates, bold in his misfortunes, ruſhed through the thick ranks of the enemy at the head of 800 horſemen, 500 of whom periſhed in the attempt to follow him. He fled to Tigranes; but that monarch refuſed an aſylum to his father-in-law, whom he had before ſupported with all the collected forces of his kingdom. Mithridates found a ſafe retreat among the Scythians; and though deſtitute of power, friends, and reſources, yet he meditated the overthrow of the Roman empire, by penetrating into the heart of Italy by land. Theſe wild projects were rejected by his followers, and he ſued for peace. It was denied to his ambaſſadors; and the victorious Pompey declared, that, to obtain it, Mithridates muſt aſk it in perſon. He ſcorned to truſt himſelf in the hands of his enemy, and reſolved to conquer or to die. His ſubjects refuſed to follow him any longer; and revolting from him, made his ſon Pharnaces king. The ſon ſhowed himſelf ungrateful to his father; and even, according to ſome writers, he ordered him to be put to death. This unnatural treatment broke the heart of Mithridates; he obliged his wife to poiſon herſelf, and attempted to do the ſame himſelf. It was in vain: the frequent antidotes he had taken in the early part of his life, ſtrengthened his conſtitution againſt the poiſon; and when this was unavailing, he attempted to ſtab himſelf. The blow was not mortal; and a Gaul who was then preſent, at his own requeſt, gave him the fatal ſtroke, about 64 years before the Chriſtian era. Such were the misfortunes, abilities, and miſerable end, of a man, who ſupported himſelf ſo long againſt the power of Rome, and who, according to the declarations of the Roman authors, proved a more powerful and indefatigable adverſary to the capital of Italy than the great Hannibal, Pyrrhus, Perſeus, or Antiochus. Mithridates has been commended for his eminent virtues, and cenſured for his vices. As a commander he deſerves the moſt unbounded applauſe; and it may create admiration to ſee him waging war with ſuch ſucceſs, during ſo many years, againſt the moſt powerful people on earth, led to the field by a Sylla, a Lucullus, and a Pompey. He was the greateſt monarch that ever ſat on a throne, according to the opinion of Cicero; and indeed no greater proof of his military character can be brought, than the mention of the great rejoicings which happened in the Roman armies and in the capital at the news of his death. No leſs than 12 weeks were appointed for public thankſgivings to the immortal gods; and Pompey, who had ſent the firſt intelligence of his death to Rome, and who had partly haſtened his fall, was rewarded with the moſt uncommon honours. It is ſaid that Mithidrates conquered 24 nations, whoſe different languages he knew, and ſpoke with the ſame eaſe and fluency as his own. As a man of letters he alſo deſerves attention. He was acquainted with the Greek language, and even wrote in that dialect a treatiſe on botany. His ſkill in phyſic is well known; and even now there is a celebrated antidote which bears his name, and is called *mithridate*. Superſtition as well as

 nature

nature had united to render him great; and, if we rely upon the authority of Juſtin, his birth was accompanied by the appearance of two large comets, which were ſeen for 70 days ſucceſſively, and whoſe ſplendour eclipſed the mid-day ſun, and covered the fourth part of the heavens.

MITHRIDATICUM BELLUM, the *Mithridatic War*, one of the longeſt and moſt celebrated wars ever carried on by the Romans againſt a foreign power. See PONTUS.

MITRA, was a cap or covering for the head, worn by the Roman ladies, and ſometimes by the men; but it was looked upon as a mark of effeminacy in the laſt, eſpecially when it was tied upon their heads.

MITRE, a ſacerdotal ornament worn on the head, by biſhops and certain abbots on ſolemn occaſions; being a ſort of cap, pointed and cleft at top. The high prieſt among the Jews wore a mitre or bonnet on his head. The inferior prieſts of the ſame nation had likewiſe their mitres; but in what reſpect they differed from that of the high prieſt, is uncertain. Some contend that the ancient biſhops wore mitres; but this is by no means certain.

MITRE, in *Architecture*, is the workmen's term for an angle that is juſt 45 degrees, or half a right one. If the angle be a quarter of a right angle, they call it a *half mitre*.

To deſcribe ſuch angles, they have an inſtrument called the *mitre ſquare;* with this they ſtrike mitre lines on their quarters or battens; and for deſpatch, they have a *mitre box*, as they call it, which is made of two pieces of wood, each about an inch thick, one nailed upright on the edge of the other; the upper piece hath the mitre lines ſtruck upon it on both ſides, and a kerf to direct the ſaw in cutting the mitre joints readily, by only applying the piece into this box.

MITRE is uſed by the writers of the Iriſh hiſtory for a ſort of baſe money, which was very common there about the year 1270, and for 30 years before and as many after.

There were beſides the mitre ſeveral other pieces, called, according to the figures impreſſed upon them, roſaries, lionades, eagles, and by the like names. They were imported from France and other countries, and were ſo much below the proper currency of the kingdom, that they were not worth ſo much as a halfpenny each. They were at length decryed in the year 1300, and good coins ſtruck in their place. Theſe were the firſt Iriſh coins in which the ſceptre was left out. They were ſtruck in the reign of Edward, the ſon of our Henry III. and are ſtill found among the other antiquities of that country. They have the king's head in a triangle full faced. The penny, when well preſerved, weighs 22 grains; the halfpenny $10\frac{1}{2}$ grains.

MITTAU, the capital of the duchy of Courland. It is ſtrongly fortified; but was taken by the Swedes in 1701, and by the Muſcovites in 1706. E. Long. 23. 51. N. Lat. 56. 44.

MITTIMUS, as generally uſed, hath two ſignifications. 1. It ſignifies a writ for removing or tranſferring of records from one court to another. 2. It ſignifies a precept, or command in writing, under the hand and ſeal of a juſtice of the peace, directed to the gaoler or keeper of ſome priſon, for the receiving and ſafe keeping of an offender, charged with any crime, until he be delivered by due courſe of law.

MITYLENE, or MYTELENE, in *Ancient Geography*, a celebrated, powerful, and affluent city, capital of the iſland of Leſbos. It received its name from *Mitylene*, the daughter of Macareus, a king of the country. It is greatly commended by the ancients for the ſtatelineſs of its buildings and the fruitfulneſs of its ſoil, but more particularly for the great men it produced: Pittacus, Alcæus, Sappho, Terpander, Theophanes, Hellanicus, &c. were all natives of Mitylene. It was long a ſeat of learning; and, with Rhodes and Athens, it had the honour of having educated many of the great men of Rome and Greece. In the Peloponneſian war, the Mitylenians ſuffered greatly for their revolt from the power of Athens; and in the Mithridatic wars, they had the boldneſs to reſiſt the Romans, and diſdain the treaties which had been made between Mithridates and Sylla. See METELIN.

MIXT, or MIXT BODY, in *Chemiſtry*, that which is compounded of different elements or principles.

MIXTURE, a compound or aſſemblage of ſeveral different bodies in the ſame maſs. Chemical mixture is attended with many phenomena which are never obſerved in ſimple mixtures; ſuch as heat, effervеſcence, &c. To chemical mixture belong the union of acids and alkalies, the amalgamation of metals, ſolution of gums, &c. and upon it depend many of the principal operations of CHEMISTRY. See that article, *paſſim.*

MIXTURE, in *Pharmacy*, a medicine which differs from a julep in this reſpect, that it receives into its compoſition not only ſalts, extracts, and other ſubſtances diſſoluble in water; but alſo earths, powders, and ſuch ſubſtances as cannot be diſſolved.

MIZEN, in the ſea language, is a particular maſt or ſail. The mizen maſt ſtands in the ſternmoſt part of the ſhip. In ſome great ſhips there are two of theſe; when that next the main-maſt is called the *main-mizen*, and that next the poop the *bonaventure mizen*.

MIZRAIM, or MISRAIM, the dual name of Egypt, uſed in Scripture to denote the Higher and Lower Egypt, which ſee. It ſometimes occurs ſingular, *Mazor:* 2 Kings xix. Iſaiah xix. Micah vii.

MNEMOSYNE, in fabulous hiſtory, a daughter of Cœlus and Terra. She married Jupiter, by whom ſhe had the nine Muſes. The word *mnemoſyne* ſignifies "memory;" and therefore the poets have rightly called Memory the mother of the Muſes, becauſe it is to that mental endowment that mankind are indebted for their progreſs in ſcience.

MNIUM, MARSHMOSS; a genus of the natural order of muſci, belonging to the cryptogamia claſs of plants. See BOTANY *Index*.

MOAB, in *Ancient Geography*, a country of Arabia Petræa; ſo called from Moab the ſon of Lot, to whoſe poſterity this country was allotted by divine appointment, Deut. xi. 9. It was originally occupied by the Emim, a race of giants extirpated by the Moabites, *ibid.* Moab anciently lay to the ſouth of Ammon, before Sihon the Amorite ſtripped both nations of a part of their territory, afterwards occupied by the Iſraelites, Numb. xxi.; and then Moab was bounded by the river Arnon to the north, the Lacus Aſphaltites to the weſt, the

the brook Zared to the south, and the mountains Abarim to the east.

MOAT, or Ditch, in fortification, a deep trench dug round the rampart of a fortified place, to prevent surprises.

The brink of the moat, next the rampart, is called the *scarpe*; and the opposite one, the *counterscarpe*.

A dry moat round a large place, with a strong garrison, is preferable to one full of water; because the passage may be disputed inch by inch, and the besiegers, when lodged in it, are continually exposed to the bombs, grenades, and other fire works, which are thrown incessantly from the rampart into their works. In the middle of dry moats, there is sometimes another small one, called *cunette;* which is generally dug so deep till they find water to fill it.

The deepest and broadest moats are accounted the best; but a deep one is preferable to a broad one: the ordinary breadth is about 20 fathoms, and the depth about 16.

To drain a moat that is full of water, they dig a trench deeper than the level of the water, to let it run off; and then throw hurdles upon the mud and slime, covering them with earth or bundles of rushes, to make a sure and firm passage.

MOATAZALITES, or Separatists, a religious sect among the Turks, who deny all forms and qualities in the Divine Being; or who divest God of his attributes.

There are two opinions among the Turkish divines concerning God. The first admits metaphysical forms or attributes; as, that God has wisdom, by which he is wise; power, by which he is powerful; eternity, by which he is eternal, &c. The second allows God to be wise, powerful, eternal; but will not allow any form or quality in God, for fear of admitting a multiplicity. Those who follow this latter opinion are called *Moatazalites;* they who follow the former, *Sephalites*.

The Moatazalites also believed that the word of God was created *in subjecto*, as the schoolmen term it, and to consist of letters and sound; copies thereof being written in books to express or imitate the original: they denied absolute predestination, and affirmed that man is a free agent. This sect is said to have first invented the scholastic divinity, and is subdivided into no less than 20 inferior sects, which mutually brand one another with infidelity.

MOBILE, moveable, any thing susceptible of motion, or that is disposed to be moved either by itself or by some other prior *mobile* or mover.

Primum Mobile, in the ancient astronomy, was a ninth heaven or sphere, imagined above those of the planets and fixed stars. This was supposed to be the first mover, and to carry all the lower spheres round along with it; by its rapidity communicating to them a motion whereby they revolved in 24 hours. But the diurnal revolution of the planets is now accounted for without the assistance of any such *primum mobile*.

Perpetuum Mobile. See *Perpetual Motion*.

MOCHO, Moco, or *Mokha;* by some supposed to be the Musa or Muza of Ptolemy, is a port and town on the Red sea, of considerable trade; contains about 10,000 inhabitants, Jews, Armenians, and Mohammedans; and it gives name to a kingdom extending along the most southern coast of Arabia; of which that part which lies next the sea is a dry barren desert, in some places 10 or 12 leagues over; but bounded by mountains, which being well watered, enjoy an almost perpetual spring; and besides coffee, the peculiar produce of this country, yields corn, grapes, myrrh, frankincense, cassia, balm, gums of several sorts, mangos, dates, pomegranates, &c. The weather here is so hot and sultry in summer, especially when the south wind blows, that it would be insupportable, if it was not mitigated by the cool breezes that generally blow from the mountains on the north, or the Red and Arabic seas on the west and east. The heat in winter is equal to that of our warmest summers; and it is very seldom that either clouds or rain are seen. The city of Mocho is now the emporium for the trade of all India to the Red sea. The trade was removed hither from Aden, in consequence of the prophecy of a sheik, much revered by the people, who foretold that it would soon become a place of extensive commerce notwithstanding its disadvantageous situation. The buildings here are lofty, and tolerably regular, having a pleasant aspect from Mecca. The steeples of several mosques are very high, presenting themselves to view at a great distance. Their markets are well stored with beef, mutton, lamb, kid, camels, and antelopes flesh, common fowls, Guinea hens, partridges, and pigeons. The sea affords plenty of fish, but not savoury; which some think proceeds from the extreme saltness of the water and the nature of their aliment. The markets are also stocked with fruit, such as grapes, peaches, apricots, quinces, and nectarines; although neither shrub nor tree is to be seen near the town, except a few date trees. Frequently no rain falls here in two or three years, and seldom more than a shower or two in a year; but in the mountains, at the distance of about 20 miles from Mocha, the earth is watered with a gentle shower every morning, which makes the valleys fertile in corn and the fruits natural to the climate. The Arab inhabitants, though remarkably grave and superstitious, are said to be extremely covetous and hypocritical; robbing, thieving, and committing piracy, without the least scruple or remorse. The English and Dutch companies have handsome houses here, and carry on a great trade in coffee, olibanum, myrrh, aloes, liquid storax, white and yellow arsenic, gum arabic, mummy, balm of Gilead, and other drugs. One inconvenience, however, they sustain from the violence and exactions of the Arabian princes; but the king's customs are easy, being fixed at three per cent. to Europeans. Of the coins at Mocha, the most current is the camassie, which rises and falls in value at the banker's discretion: they are from 50 to 80 for a current dollar, which is but an imaginary species, being always reckoned one and a half per cent. lower than Spanish dollars.

MOCKING Bird. See Turdus, Ornithology *Index*.

MOCOCO. See Lemur, Mammalia *Index*.

MODE, which is a word of the same general import with manner, is used as a technical term in grammar, metaphysics, and music. For its import in Grammar, see that article, N° 80.

Mode, in *Metaphysics*, seems properly to denote the manner of a thing's existence: but Locke, whose

language

language in that ſcience is generally adopted, uſes the word in a ſenſe ſomewhat different from its ordinary and proper ſignification. "Such complex ideas, which, however compounded, contain not in them the ſuppoſition of ſubſiſting by themſelves, but are conſidered as dependencies on, or affections of, ſubſtances," he calls *modes*. Of theſe *modes*, there are, according to him, two ſorts, which deſerve diſtinct conſideration. Firſt, There are ſome "which are only variations, or different combinations of the ſame ſimple idea, without the mixture of any other, as *a dozen* or *a ſcore*; which are nothing but the ideas of ſo many diſtinct units added together:" and theſe he calls *ſimple modes*. Secondly, "There are others compounded of ſimple ideas of ſeveral kinds put together to make one complex one; v. g. *beauty*, conſiſting of a certain compoſition of colour and figure, cauſing delight in the beholder; *theft*, which being the concealed change of the poſſeſſion of any thing without the conſent of the proprietor, contains, as is viſible, a combination of ſeveral ideas of ſeveral kinds;" and theſe he calls *mixed modes*. For the juſt diſtinction between *ideas* and *notions*, as well as between *ideas* and the *qualities* of external objects, which in this account of modes are all confounded together, ſee METAPHYSICS.

MODE, in *Muſic*, a regular diſpoſition of the air and accompaniments, relative to certain principal ſounds upon which a piece of muſic is formed, and which are called the *eſſential ſounds of the mode*.

Our *modes* are not, like thoſe of the ancients, characterized by any ſentiment which they tend to excite, but reſult from our ſyſtem of harmony alone. The ſounds eſſential to the mode are in number three, and form together one perfect chord. 1. The tonic or key, which is the fundamental note both of the tone and of the mode. 2. The dominant, which is a fifth from the tonic. 3. The mediant, which properly conſtitutes the *mode*, and which is a third from the ſame tonic. As this third may be of two kinds, there are of conſequence two different modes. When the mediant forms a greater third with the tonic, the mode is major; when the third is leſſer, it is minor. See MUSIC.

MODEL, in a general ſenſe, an original pattern, propoſed for any one to copy or imitate.

1 Different kinds of models.

This word is particularly uſed, in building, for an artificial pattern made in wood, ſtone, plaſter, or other matter, with all its parts and proportions, in order for the better conducting and executing ſome great work, and to give an idea of the effect it will have in large. In all great buildings, it is much the ſureſt way to make a model in relievo, and not to truſt to a bare deſign or draught. There are alſo models for the building of ſhips, &c. and for extraordinary ſtaircaſes, &c.

They alſo uſe modes in painting and ſculpture; whence, in the academies, they give the term *model* to a naked man or women, diſpoſed in ſeveral poſtures, to afford an opportunity to the ſcholars to deſign them in various views and attitudes.

2 General method of making models.

Models in imitation of any natural or artificial ſubſtance, are moſt uſually made by means of moulds compoſed of plaſter of Paris. For the purpoſe of making theſe moulds, this kind of plaſter is much more fit than any other ſubſtance, on account of the power it has of abſorbing water, and ſoon condenſing into a hard ſubſtance, even after it has been rendered ſo thin as to be of the conſiſtence of cream. This happens in a ſhorter or longer time as the plaſter is of a better or worſe quality; and its good or bad properties depend very much upon its age, to which, therefore, particular regard ought to be had. It is ſold in the ſhops at very different prices; the fineſt being made uſe of for caſts, and the middling ſort for moulds. It may be very eaſily coloured by means of almoſt any kind of powder excepting what contains an alkaline ſalt; for this would chemically decompoſe the ſubſtance of it, and render it unfit for uſe. A very conſiderable quantity of chalk would alſo render it ſoft and uſeleſs, but lime hardens it to a great degree. The addition of common ſize will likewiſe render it much harder than if mere water is made uſe of. In making either moulds or models, however, we muſt be careful not to make the mixture too thick at firſt; for if this is done, and more water added to thin it, the compoſition muſt always prove brittle and of a bad quality.

The particular manner of making models (or *caſts*, as they are alſo called) depends on the form of the ſubject to be taken. The proceſs is eaſy, where the parts are elevated only in a ſlight degree, or where they form only a right or obtuſe angle with the principal ſurface from which they project; but where the parts project in ſmaller angles, or form curves inclined towards the principal ſurface, the work is more difficult. This obſervation, however, holds good only with regard to hard and inflexible bodies; for ſuch as are ſoft may often be freed from the mould, even though they have the ſhape laſt mentioned. But though this be the caſe with the ſoft original ſubſtance, it is not ſo with the inflexible model when once it is caſt.

The moulds are to be made of various degrees of thickneſs, according to the ſize of the model to be caſt; and may be from half an inch to an inch, or, if very large, an inch and a half. Where a number of models are to be taken from one mould, it will likewiſe be neceſſary to have it of a ſtronger contexture than where only a few are required, for very obvious reaſons.

3 Anatomical models.

It is much more eaſy to make a mould for any ſoft ſubſtance than a rigid one, as in any of the viſcera of the animal body; for the fluidity of the mixture makes it eaſily accommodate itſelf to the projecting parts of the ſubſtance; and as it is neceſſary to inflate theſe ſubſtances, they may be very readily extracted again by letting out the air which diſtended them.

When a model is to be taken, the ſurface of the original is firſt to be greaſed, in order to prevent the plaſter from ſticking to it; but if the ſubſtance itſelf is ſlippery, as is the caſe with the internal parts of the human body, this need not be done: when neceſſary, it may be laid over with linſeed oil by means of a painter's bruſh. The original is then to be laid on a ſmooth table, previouſly greaſed or covered with a cloth, to prevent the plaſter ſticking to it; then ſurround the original with a frame or ridge of glaziers putty, at ſuch a diſtance from it as will admit the plaſter to reſt upon the table on all ſides of the ſubject for about an inch, or as much as is ſufficient to give the proper degree of ſtrength to the mould. A ſuffi- *Pole's Anatomical Instructor.*

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Model. cient quantity of plafter is then to be poured as uniformly as poffible over the whole fubftance, until it be everywhere covered to fuch a thicknefs as to give a proper fubftance to the mould, which may vary in proportion to the fize. The whole muft then be fuffered to remain in this condition till the plafter has attained its hardnefs; when the frame is taken away, the mould may be inverted, and the fubject removed from it; and when the plafter is thoroughly dry let it be well feafoned.

Having formed and feafoned the moulds, they muft next be prepared for the cafts by greafing the infide of them with a mixture of olive oil and lard in equal parts, and then filled with fine fluid plafter, and the plane of the mould formed by its refting on the furface of the table covered to a fufficient thicknefs with coarfe plafter, to form a ftrong bafis or fupport for the caft where this fupport is requifite, as is particularly the cafe where the thin and membranous parts of the body are to be reprefented. After the plafter is poured into the mould, it muft be fuffered to ftand until it has acquired the greateft degree of hardnefs it will receive; after which the mould muft be removed: but this will be attended with fome difficulty when the fhape of the fubject is unfavourable; and in fome cafes the mould muft be feparated by means of a fmall mallet and chiffel. If by thefe inftrnments any parts of the model fhould be broken off, they may be cemented by making the two furfaces to be applied to each other quite wet; then interpofing betwixt them a little liquid plafter; and laftly, the joint fmoothed after being thoroughly dry. Any fmall holes that may be made in the mould can be filled up with liquid plafter, after the fides of them have been thoroughly wetted, and fmoothed over with the edge of a knife.

In many cafes it is altogether impracticable to prepare a mould of one piece for a whole fubject; and therefore it muft be confidered how this can be done in fuch a manner as to divide the mould into the feweft pieces. This may be effected by making every piece cover as much of the pattern as poffible, without furrounding fuch projecting parts, or running into fuch hollows as would not admit a feparation of the mould. It is impoffible, however, to give any particular directions in this matter which can hold good in every inftance, the number of pieces of which the mould is to confift being always determined from the fhape of the pattern. Thus the mould of the human calculus will require no more than three pieces, but that of an *os femoris* could fcarce have fewer than ten or twelve.—Where any internal pieces are required, they are firft to be made, and then the outer pieces after the former have become hard.

To make a mould upon a hard and dry fubftance, we muft, in the firft place, rub the furface of it fmoothly over with the mixture of oil and lard above mentioned. Such hollows as require internal pieces are then to be filled up with fluid plafter; and while it continues in this ftate, a wire loop muft be introduced into it, by which, when hardened, it can be pulled off. The plafter fhould be fomewhat raifed in a pyramidal form around this wire, and afterwards cut fmooth with a knife while yet in its foft ftate; preferving two or three angular ridges from the loop to the outer edge, that it may fix the more fteadily in the outer piece of the mould to be afterwards made upon it. Let the outer piece then be well greafed, to prevent the fecond piece from adhering; the loop being enclofed with fome glaziers putty, both to prevent the fecond piece from adhering and to preferve a hollow place for the cord.

To form the fecond or outfide piece, mix a quantity of plafter proportioned to the extent of furface it is to cover and the intended thicknefs of the mould: when it is juft beginning to thicken, or affumes fuch a confiftence as not to run off very eafily, fpread it over the internal piece or pieces as well as the pattern, taking care at the fame time not to go too far left it fhould not deliver fafely; and as the plafter becomes more tenacious, add more upon the pattern until it has become fufficiently thick, keeping the edges fquare and fmooth like the edge of a board. The plafter fhould be fpread equally upon all parts, which is beft done by a painter's pallet knife or apothecary's bolus knife: but for this the inftrument fhould be fomewhat lefs pliable than it is commonly made.

When the outfide piece is hardened, the edges are to be pared fmooth, and nearly made fquare with a fmall pointed knife. Little holes of a conical fhape are to be made with the point of a knife about an inch diftant from one another, according to the fize of the piece. Thefe are defigned to receive the fluid plafter in forming the adjacent parts of the mould, and occafion points correfponding to the hollows; and are intended to preferve the edges of the different pieces fteadily in their proper relative fituations. The third piece is then to be formed in a manner fimilar to the fecond; greafing the edges of the former plentifully with hog's lard and oil, to prevent the pieces from adhering to each other. Thus the pattern is to be wholly enclofed, only leaving a proper orifice for pouring in the plafter to form the model; fmall holes being alfo bored in the mould oppofite to the wire-loops fixed in the infide pieces, through which a cord is to be conveyed from the loop to confine fuch pieces during the time of cafting. In fome cafes, however, it is not neceffary that the mould fhould totally enclofe the pattern; for inftance, where a model is to be made of a pedeftal, or a buft of any part of the human body. The bottom of fuch moulds being left open, there is accordingly ample room for pouring in the plafter.

After the mould is completely formed, it is next to be dried either naturally or by a gentle artificial heat, and then feafoned in the following manner:—Having been made thoroughly dry, which, if the mould is large, will require two or three weeks, it is to be brufhed over plentifully with linfeed oil boiled with fugar of lead, finely levigated litharge, or oil of vitriol. The infide and joints of the mould fhould be particularly well fupplied with it. If the mould be large, it is needlefs to attend to the outfide; but when the moulds are fmall, it will not be improper to boil them in the oil; by which means their pores are more exactly filled than could otherwife be done. After the moulds have undergone this operation, they are again fet by to dry, when, being greafed with olive oil and hog's lard, they are fit for ufe. If linfeed oil be ufed for greafing the moulds, it will in a fhort time impart a difagreeable yellow colour to the cafts.

The

Model.

The mould being properly prepared and feafoned, nothing more is requifite to form the model than to pour the fineft liquid plafter of Paris into it. After a layer of this, about half an inch in thicknefs, has been formed all round the mould, we may ufe the coarfer kind to fill it up entirely, or to give to the model what thicknefs we pleafe.

4 Models from living fubjects.

Befides the models which are taken from inanimate bodies, it has been frequently attempted to take the exact refemblance of people while living, by ufing their face as the original of a model, from whence to take a mould; and the operation, however difagreeable, has been fubmitted to by perfons of the higheft ranks in life. A confiderable difficulty occurs in this, however, by reafon of the perfon's being apt to fhrink and diftort his features when the liquid is poured upon him; neither is he altogether without danger of fuffocation, unlefs the operator well underftands his bufinefs.

To avoid the former inconvenience, it will be proper to mix the plafter with warm inftead of cold water, by which means the perfon will be under no temptation to fhrink; and to prevent any danger of a fatal accident, the following method is to be practifed: Having laid the perfon horizontally on his back, the head muft firft be raifed by means of a pillow to the exact pofition in which it is naturally carried when the body is erect; then the parts to be reprefented muft be very thinly covered over with fine oil of almonds by means of a painter's brufh; the face is then to be firft covered with fine fluid plafter, beginning at the upper part of the forehead, and fpreading it over the eyes, which are to be kept clofe, that the plafter may not come in contact with the globe; yet not clofed fo ftrongly as to caufe any unnatural wrinkles. Cover then the nofe and ears, plugging firft up the *meatus auditorij* with cotton, and the noftrils with a fmall quantity of tow rolled up, of a proper fize, to exclude the plafter. During the time that the noife is thus ftopped, the perfon is to breathe through the mouth: in this ftate the fluid plafter is to be brought down low enough to cover the upper lip, obferving to leave the rolls of tow projecting out of the plafter. When the operation is thus far carried on, the plafter muft be fuffered to harden; after which the tow may be withdrawn, and the noftrils left free and open for breathing. The mouth is then to be clofed in its natural pofition, and the plafter brought down to the extremity of the chin. Begin then to cover that part of the breaft which is to be reprefented, and fpread the plafter to the outfides of the arms and upwards, in fuch a manner as to meet and join that which is previoufly laid on the face: when the whole of the mafs has acquired its due hardnefs, it is to be cautioufly lifted, without breaking, or giving pain to the perfon. After the mould is conftructed, it muft be feafoned in the manner already directed; and when the mould is caft, it is to be feparated from the mould by means of a fmall mallet and chiffel. The eyes, which are neceffarily fhown clofed, are to be carved, fo that the eyelids may be reprefented in an elevated pofture; the noftrils hollowed out, and the back part of the head, from which, on account of the hair, no mould can be taken, muft be finifhed according to the fkill of the artift. The edges of the model are then to be neatly fmoothed off, and the buft fixed on its pedeftal.

Model.

5 Topographical models, &c.

The method of making models in the plafter of Paris is undoubtedly the moft eafy way of obtaining them. When models, however, are made of fuch large objects that the model itfelf muft be of confiderable fize, it is vain to attempt making it in the way above defcribed. Such models muft be conftructed by the hand with fome foft fubftance, as wax, clay, putty, &c. and it being neceffary to keep all the proportions with mathematical exactnefs, the conftruction of a fingle model of this kind muft be a work of great labour and expence as well as of time. Of all thofe which have been undertaken by human induftry, however, perhaps the moft remarkable is that conftructed by General Pfiffer, to reprefent the mountainous parts of Switzerland. It is compofed of 142 compartments, of different fizes and forms, refpectively numbered, and fo artfully put together, that they can be feparated and replaced with the greateft eafe. The model itfelf is $20\frac{1}{2}$ feet long and 12 broad, and formed on a fcale which reprefents two Englifh miles and a quarter by an Englifh foot: comprehending part of the cantons of Zug, Zurich, Schweitz, Underwalden, Lucerne, Berne, and a fmall part of the mountains of Glarus; in all, an extent of country of $18\frac{1}{2}$ leagues in length and 12 in breadth. The higheft point of the model, from the level of the centre (which is the lake of Lucerne), is about ten inches; and as the moft elevated mountain reprefented therein rifes 1475 toifes or 9440 feet above the lake of Lucerne, at a grofs calculation, the height of an inch in the model is about 900 feet. The whole is painted of different colours, in fuch a manner as to reprefent objects as they exift in nature; and fo exactly is this done, that not only the woods of oak, beech, pine, and other trees, are diftinguifhed, but even the ftrata of the feveral rocks are marked, each being fhaped upon the fpot, and formed of granite, gravel, or fuch other fubftances as compofe the natural mountain. So minute alfo is the accuracy of the plan, that it comprifes not only all the mountains, lakes, rivers, towns, villages, and forefts, but every cottage, bridge, torrent, road, and even every path is diftinctly marked.

The principal material employed in the conftruction of this extraordinary model, is a mixture of charcoal, lime, clay, a little pitch, with a thin coat of wax; and is fo hard that it may be trod upon without any damage. It was begun in the year 1766, at which time the general was about 50 years of age, and it employed him till the month of Auguft 1785; during all which long fpace of time he was employed in the moft laborious and even dangerous tafks.—He raifed the plans with his own hands on the fpot, took the elevation of mountains, and laid them down in their feveral proportions. In the profecution of this laborious employment, he was twice arrefted for a fpy; and in the popular cantons was frequently forced to work by moon light, in order to avoid the jealoufy of the peafants, who imagined that their liberty would be endangered fhould a plan of their country be taken with fuch minute exactnefs. Being obliged frequently to remain on the tops of fome of the Alps, where no provifions could be procured, he he took along with him a few milk goats, who supplied him with nourishment. When any part was finished, he sent for the people residing near the spot, and desired them to examine each mountain with accuracy, whether it corresponded, as far as the smallness of the scale would admit, with its natural appearance; and then, by frequently retouching, corrected the deficiencies. Even after the model was finished, he continued his Alpine expeditions with the same ardour as ever, and with a degree of vigour that would fatigue a much younger person. All his elevations were taken from the level of the lake Lucerne; which, according M. Saussure, is 1408 feet above the level of the Mediterranean.

MODENA, a duchy of Italy, bounded on the south by Tuscany and the republic of Lucca, on the north by the duchy of Mantua, on the east by the Bolognese and the territories of the Church, and on the west by the duchy of Parma; extending in length from south to north about 56 English miles, and in breadth between 24 and 36, and yielding plenty of corn, wine, and fruits, with mineral waters. In some places also petroleum is skimmed off the surface of the water of deep wells made on purpose; and in others is found a kind of earth or tophus, which, when pulverized, is said to be an excellent remedy against poison, fevers, dysenteries, and hypochondriac disorders. The country of La Salsa affords several kinds of petrifactions. The principal rivers are the Crostolo, Secchia, and Panaro. The family of Esté, dukes of Modena, is very ancient. They had their name from Esté, a small city in the district of Padua. In 1753, the duke was appointed imperial vicar general, field marshal, and governor of the Milanese, during the minority of the archduke Peter Leopold, who was declared governor general of the Austrian Lombardy. The duke, though a vassal of the empire, hath an unlimited power within his own dominions.

MODENA, an ancient city, in Latin *Mutina*, which gives name to a duchy of Italy, and is its capital. It stands 28 miles east of Parma, 44 almost south of Mantua, and 20 west of Bologna; and is a pretty large and populous, but not a handsome city. The population is said to amount to about 40,000. It is much celebrated by Roman authors for its grandeur and opulence; but was a great sufferer by the siege it underwent during the troubles of the triumvirate. It hath long been the usual residence of the dukes; and is also the see of a bishop, who is suffragan to the archbishop of Bologna. Mr Keysler says, that when Decius Brutus was besieged here by Mark Antony, Hirtius the consul made use of carrier pigeons; and that, even at this day, pigeons are trained up at Modena to carry letters and bring back answers. This city hath given birth to several celebrated persons, particularly Tasso the poet, Corregio the great painter, Sigonius the civilian and historian, Da Vignola the architect, and Montecuculi the imperial general. The tutelary saint of it is named *Geminianus*. The ducal palace is a very noble edifice, in which, among the other fine pictures, the birth of Christ by Corregio, called *la Notte Felice*, is much celebrated. The only manufacture for which this city is noted, is that of masks, of which great numbers are exported. The churches of the Jesuits, of the Theatines, and of St Dominic, are well worth viewing. In the college of St Carlo Boromeo between 70 and 80 young noblemen are continually maintained, and instructed both in the sciences and genteel exercises. St Beatrix, who was of the family of Esté, is said to knock always at the gate of the palace three days before any of the family dies. Before most of the houses are covered walks or porticoes, as at Bologna. The city is fortified, and on its south side stands the citadel. E. Long. 11. 0. N. Lat. 44. 34.

MODERATION, in *Ethics*, is a virtue consisting in the proper government of our appetites, passions, and pursuits, with respect to honours, riches, and pleasures; and in this sense it is synonymous with *temperance*: it is also often used to denote *candour*.

MODERATOR, in the schools, the person who presides at a dispute, or in a public assembly: thus the president of the annual assembly of the church of Scotland is styled *moderator*.

MODERN, something new, or of our time; in opposition to what is antique or *ancient*.

Modern Authors, according to Naude, are all those who have wrote since Boethius. The modern philosophy commences with Galileo; the modern astronomy with Copernicus.

MODESTY, in *Ethics*, is sometimes used to denote humility; and sometimes to express chastity, or purity of sentiments and manners.—Modesty, in this last sense, and as particularly applied to women, is defined by the authors of the *Encyclopédie Methodique*, as a natural, chary, and honest shame; a secret fear; a feeling on account of what may be accompanied with disgrace. Women who possess only the remains of a suspicious modesty, make but feeble efforts to resist: those who have obliterated every trace of modesty from their countenance, soon extinguish it completely in their soul, and throw aside for ever the veil of decency. She, on the contrary, who truly possesses modesty, passes over in silence attempts against her honour, and forbears speaking of those from whom she has received an outrage, when in doing so she must reveal actions and expressions that might give alarm to virtue.

The idea of modesty is not a chimera, a popular prejudice, or an illusion arising from laws and education. Nature, which speaks the same language to all men, has, with the unanimous consent of nations, annexed contempt to female incontinence. To resist and to attack are laws of her appointment: and while she bestows desires on both parties, they are in the one accompanied with boldness, in the other with shame. To individuals she has allotted long spaces of time for the purposes of self-preservation, and but moments for the propagation of their species. What arms more gentle than *Modesty* could she have put into the hands of that sex which she designed to make resistance.

If it were the custom for both sexes to make and receive advances indiscriminately, vain importunity would not be prevented: the fire of passion would never be stirred up, but languish in tedious liberty; the most amiable of all feelings would scarcely warm the human breast; its object would with difficulty be attained. That obstacle which seems to remove this object to a diſtance, in fact brings it nearer. The veil of ſhame only makes the deſires more attractive. Modeſty kindles that flame which it endeavours to ſuppreſs: its fears, its evaſions, its caution, its timid avowals, its pleaſing and affecting fineſſes, ſpeak more plainly what it wiſhes to conceal, than paſſion can do without it: it is MODESTY, in ſhort, which enhances the value of a favour, and mitigates the pain of a refuſal.

Since modeſty is the ſecret fear of ignominy; and ſince all nations, ancient or modern, have confeſſed the obligation of its laws; it muſt be abſurd to violate them in the puniſhment of crimes, which ſhould always have for its object the re-eſtabliſhment of order. Was it the intention of thoſe oriental nations, who expoſed women to elephants, trained for an abominable ſpecies of puniſhment, to violate one law by the obſervance of another? By an ancient practice among the Romans, a girl could not be put to death before ſhe was marriageable. Tiberius found means to evade this law, by ordering them to be violated by the executioner previous to the infliction of puniſhment; the refinement of a cruel tyrant, who ſacrificed the morals to the cuſtoms of his people! When the legiſlature of Japan cauſed women to be expoſed naked in the market places, and obliged them to walk on all fours like brutes, modeſty was ſhocked: but when it wanted to force a mother—when it wanted to compel a ſon—nature received an outrage.

Such is the influence of climate in other countries, that the phyſical part of love poſſeſſes an almoſt irreſiſtible force. The reſiſtance is feeble; the attack is accompanied with a certainty of ſucceſs. This is the caſe at Patana, at Bantam, and in the ſmall kingdoms on the coaſt of Guinea. When the women in theſe countries (ſays Mr Smith) meet with a man, they lay hold of him and threaten to inform their huſbands if he deſpiſes their favours. But here the ſexes ſeem to have aboliſhed the laws peculiar to each. It is fortunate to live in a temperate climate like ours, where that ſex which poſſeſſes the moſt powerful charms exerts them to embelliſh ſociety; and where modeſt women, while they reſerve themſelves for the pleaſures of one, contribute to the amuſement of all.

MODIFICATION, in *Philoſophy*, that which modifies a thing, or gives it this or that manner of being. Quantity and quality are accidents which modify all bodies.

Decree of MODIFICATION, in *Scots Law*, a decree aſcertaining the extent of a miniſter's ſtipend, without proportioning it among the perſons liable in payment.

MODILLIONS, in *Architecture*, ornaments in the corniche of the Ionic, Corinthian, and Compoſite columns.

MODIUS, a Roman dry meaſure for all ſorts of grain, containing 32 heminæ, or 16 ſextarii, or one third of the amphora; amounting to an Engliſh peck. See MEASURE.

MODULATION, the art of forming any thing to certain proportion.

MODULATION, in reading or ſpeaking. See READING.

MODULATION, in *Muſic*, derived from the Latin *modulari*. This word in our language is ſuſceptible of ſeveral different ſignifications. It frequently means no more than an air, or a number of muſical ſounds properly connected and arranged. Thus it anſwers to what Mr Malcolm underſtands by the word *tune*, when he does not expreſsly treat concerning the tuning of inſtruments. Thus likewiſe it expreſſes the French word *chant*; for which reaſon, in the article MUSIC, we have frequently expreſſed the one word by the other. But the preciſe and technical acceptation to which it ought to be confined, is the art of compoſing melody or harmony agreeably to the laws preſcribed by any particular key, that of changing the key, or of regularly and legitimately paſſing from one key to another. See MUSIC.

MODULE, in *Architecture*, a certain meaſure, or bigneſs, taken at pleaſure, for regulating the proportions of columns, and the ſymmetry or diſpoſition of the whole building. Architects generally chooſe the ſemidiameter of the bottom of the column for their module, and this they ſubdivide into parts or minutes.

MŒONIA, or MÆONIA. See MÆONIA and LYDIA.

MŒSIA, or MYSIA, in *Ancient Geography*, a country of Europe, extending from the confluence of the Savus and the Danube to the ſhores of the Euxine. It was divided into Upper and Lower Mœſia. Lower Mœſia was on the borders of the Euxine, and comprehended that tract of country which received the name of *Pontus* from its vicinity to the ſea. Upper Mœſia lay beyond the other, in the inland country.

MOFFAT, a village of Scotland, in Annandale, in the county of Dumfries, 50 miles ſouth-weſt of Edinburgh; famous for its ſulphureous well, which has been in juſt eſtimation for near 150 years as a remedy in all cutaneous and ſcrofulous complaints; and for its chalybeate ſpring, called Hartfell ſpaw, which was diſcovered above 50 years ago, and is of a very bracing quality.—The place is chiefly ſupported by the company who reſort thither for the benefit of its waters and air; but it has alſo a manufacture of coarſe woollen ſtuffs. It is a well-built clean village; and contains many good and even elegant lodgings, a tolerable aſſembly room, a bowling green and walks, and one of the beſt inns between London and Edinburgh.

MOFFETTA. See AMPSANCTI.

MOGODORE, or MOGADORE, a large, uniform, and well built town in the kingdom of Morocco, ſituated about 350 miles from Tangier on the Atlantic ocean, and ſurrounded on the land ſide by deep and heavy ſands. The European factory here conſiſts of about a dozen mercantile houſes of different nations, whoſe owners, from the protection granted them by the emperor, live in full ſecurity from the Moors, whom indeed they keep at a rigid diſtance. They export, to America, mules; to Europe, Morocco leather, hides, gum arabic, gum ſandaric, oſtrich feathers, copper, wax, wool, elephants teeth, fine mats, beautiful carpeting, dates, figs, raiſins, olives, almonds, oil, &c. In return, they import timber, artillery of all kinds, gunpowder, woollen cloths, linens, lead, iron in bars, all kinds of hardware and trinkets, ſuch as looking glaſſes, ſnuff boxes, watches, ſmall knives, &c. tea, ſugar, ſpices, and moſt of the uſeful articles which are not otherwiſe to be procured in this empire. The town is regularly fortified on the

Moguls. sea side; and on the land, batteries are so placed as to prevent any incursion from the southern Arabs, who are of a turbulent disposition, and who, from the great wealth which is known to be always in Mogodore, would gladly avail themselves of any opportunity that offered to pillage the town. The entrance, both by sea and land, consists of elegant stone arch-ways, with double gates. The market-place is handsomely built, with piazzas of the same materials; and at the water port there is a customhouse and powder magazine, both of which are neat stone buildings. Besides these public edifices, the emperor has a small but handsome palace for his occasional residence. The streets of the town, though very narrow, are all in straight lines; and the houses, contrary to what we meet with in the other towns of the empire, are lofty and regular. The bay, which is little better than a road, and is very much exposed when the wind is at north-west, is formed by a curve in the land, and a small island about a quarter of a mile from the shore. —Its entrance is defended by a fort well furnished with guns.

MOGULS, a celebrated nation of Asia, whose conquests formerly were the most rapid and extensive of any people recorded in history. They themselves deduce their origin from Japhet, or, as they call him, *Japhis*, the son of Noah. His son Turk, they say, was the first king, or khan, of those nations who are now known by the separate names of *Turks*, *Tartars*, and *Moguls*; and the Tartars especially assert, that their proper designation is *Turks*. To this prince is attributed many of those inventions which barbarous nations commonly ascribe to their first sovereigns. He was succeeded by Taunak; in whose reign the whole posterity of Turk were divided into four large tribes, denominated the *orda's* of Erlat, Gialair, Kaugin, Berlas or Perlas; of which last came the famous Timur Beg, or Tamerlane.—From this time to that of Alanza Khan, we meet with nothing remarkable. In his reign the Turks being immersed in all kinds of luxury, universally apostatized into idolatry. Having two sons, Tartar and Mogul, he divided his dominions among them, and thus gave rise to the two empires of the Tartars and Moguls.

1 Moguls descended from Japhet.

The two nations had not long existed before they began to make war upon each other: and after long contention, the event at last was, that Il Khan, emperor of the Moguls, was totally overthrown by Siuntz Khan, emperor of the Tartars; and so great was the defeat, that the Mogul nation seems to have been almost exterminated. Only two of Il Khan's family survived this disaster. These were Kajan his youngest son, and Nagos his nephew, who were both of an age, and had both been married the same year. These two princes, with their wives, had been taken prisoners by Siuntz Khan, but found means to make their escape to their own country. Here they seized upon all the cattle which had not been carried off by the Tartars: which was easily done, as having none to dispute the property with them; then stripping some of the slain, they took their clothes, and retired into the mountains. They passed several mountains without much difficulty; but at last advanced to the foot of one exceedingly high, which had no way over it but a very small path made by certain animals, called in the Tartar language *archara*. This path they found themselves obliged to make use of, though it was so strait, that only one could pass at a time, and he was in the most imminent danger of breaking his neck at the least false step. Having ascended the mountain on one side by this path, they descended by the same on the other side; and were agreeably surprised to find themselves in a most delightful tract, interspersed with rivulets and charming meadows, abounding with a vast variety of delicious fruits, and enclosed on all sides by inaccessible mountains, in such a manner as to shelter them from all future pursuits of the Tartars. Here they lived some time, and gave this beautiful country the name of *Irgana-kon*, in illusion to its situation; *Irgana* signifying, in the old language of the Moguls, a "valley," and *Kon* a "steep height."

2 Almost exterminated.

3 They arrive in a delightful valley.

In process of time these two families very much increased. Kajan, whose posterity was the most numerous, called his descendants *Kajath*; but the people springing from Nagos were divided into two tribes; one of which received the appellation of *Nagoster*, and the other that of *Durlagan*.

These two Mogul princes and their descendants lived in this place for more than 400 years; but the latter then finding it too narrow for them, meditated a return to the country from which their forefathers had been driven. For some time, however, they found this impracticable, as the path that conducted their ancestors had been long since destroyed. At last they discovered, that one part of the high mountain above-mentioned was not very thick in a certain place; and also, that it consisted entirely of iron ore. To this, having before set fire to a layer of wood, and another of charcoal, laid along the foot of the mountain, they applied 70 large bellows, and at last melted the mountain in such a manner, that an opening was made large enough for a loaded camel to pass; and through this passage they all marched out with great joy.

The Moguls having thus issued as it were from a new world, overthrew the Tartars in their turn; and continued to be a very considerable nation till the time of their great hero Temujin, afterwards called *Jenghiz Khan*, whom they extol in the most extravagant manner. It is difficult, however, to say, at the time Temujin made his appearance, how far the dominions of the Moguls extended, or in what estimation they were held by their neighbours. It seems to be pretty certain that great part of the vast region, now known by the name of *Tartary*, was then in a state of considerable civilization, and likewise extremely populous, as we find mention made of many cities which the Moguls destroyed; and the incredible multitudes whom they slaughtered, abundantly show the populousness of the country. On the east, the country of the Moguls and Tartars had the great desert which divides Tartary from China; on the west, it had the empire of Karazm, founded by Mahmud Gazni; and on the south were the countries now known by the name of *Indostan* *Siam*, *Pegu*, *Tonquin*, and *Cochin China*. Thus it comprehended the eastern part of modern Tartary, and all Siberia. This whole region was divided among a great number of *Aymacks*, or *tribes*; who had each one or more khans, according as it was more or less numerous, or divided into branches. Among these that of the *Kara-its* was the most powerful: their prince

4 From whence they at last issue and defeat the Tartars.

5 State of Asia at the time of Jenghiz Khan.

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prince assumed the title of *Grand Khan*, and among the rest the Moguls were tributary to him; but, according to the Chinese historians, both the one and the other were tributary to the emperor of Kitay or Katay. China was divided into two parts: the nine southern provinces were in the hands of the Chinese emperors of the Song dynasty, who kept their court at Hang-chew, the capital of the province of Chekyang; the five northern provinces, excepting part of Shensi, were possessed by the Kin, a people of Eastern Tartary, from whom are descended the Manchew Tartart, at present masters of China. This vast dominion was named *Kitay* or *Katay*, and was divided into two parts: that which belonged to China, was properly called *Kitay;* and the part which belonged to Tartary was called *Karakitay*, in which some even include the territories of the Moguls, Karaits, and other tribes which are the subject of the present history. The western part of the empire of Kitay was possessed by a Turkish prince, who had lately founded a new kingdom there called *Hya;* whose capital city was Hyachew, now Ninghya in Shensi, from whence the kingdom took its name. To the west of Hya lay Tangut; a country of great extent, and formerly very powerful; but at that time reduced to a low state, and divided among many princes; some of whom were subject to the emperor of Hya, and others to the emperor of China. All Tartary to the westward as far as the Caspian sea, with the greater part of Little Buckharia, which then passed under the general name of *Turkestan*, was subject to Ghurkhan, Khurkhan, or Kaver Khan; to whom even the Gazni monarchs are said to have been tribnary. This Ghurkhan had been prince of the Western Kitan or Lyau; who, driven out of Kitay by the king, settled in Little Buckharia, and the country to the north, where they founded a powerful state about the year 1124.

6
Descent and birth of Temujin.

Thus the Moguls, properly so called, had but a very small extent of empire which could be called their own, if indeed they had any, when Temujin made his appearancy. This hero is said by the Tartars to have been of divine origin, since his family could be traced no farther back than ten generations, the mother of whom was got with child by a spirit. The names and transactions of his predecessors are equally uncertain and unimportant: he himself, however, was born in the year 1163, and is said to have come into the world with congealed blood in his hands; from whence it was prognosticated that he would be a great warrior, and obtain the victory over all his enemies.

This prediction, if any such there was, Temujin most literally fulfilled. At the time of his father's decease, his subjects amounted to between 30,000 and 40,000 families; but of these two-thirds quickly deserted, and Temujin was left almost without subjects. When only 13 years of age, he fought a bloody battle against these revolters; but either was defeated, or gained an indecisive victory; so that he remained in obscurity for 27 years longer. His good fortune at last he owed to the friendship of Vang Khan, who ruled over a great number of Tartar tribes to the north of Kitay, and has been heard of under the name of *Prester John* among the Europeans. This prince took Temujin under his protection; and a rebellion being afterwards raised against himself, Temujin was made his general, and the khan was kept in possession of his throne: soon after which Temujin subdued the tribes which had revolted from himself, treating them at the same time with the utmost barbarity.

7
Subdues his revolted subjects by means of Vang Khan.

8
Who becomes jealous, and contrives his destruction.

This happened in the year 1201; but Vang Khan, instead of continuing the friend of Temujin, now became jealous, and resolved to destroy him by treachery. With this view he proposed a marriage between Temujin's son Juji and his own daughter, and another between Temujin's daughter and his own son. Temujin was invited to the camp of Vang Khan, in order to celebrate this double marriage; but receiving intelligence of some evil intention against him, he excused himself to Vang Khan's messengers, and desired that the ceremony might be put off to some other time.

A few days after the departure of these messengers, Badu and Kishik, two brothers, who kept the horses of one of Vang Khan's chief domestics, came and informed Temujin, that the grand Khan finding he had missed his aim, was resolved to set out instantly, and surprise him next morning, before he could suspect any danger. Temujin, alarmed at this intelligence, quitted his camp, in the night time, and retired with all his people to some distance. He was scarce gone when Vang Khan's troops arrived, and discharged an incredible number of arrows among the empty tents; but finding nobody there, they pursued Temujin in such haste that they fell into great disorder. In this condition they were suddenly attacked and routed by Temujin; after which an open war with Vang Khan took place.

9
Temujin overcomes all his enemies.

By this quarrel almost all the princes of Tartary were put in motion, some siding with Temujin, and others with Vang Khan. But at last fortune declared in favour of the former: Vang Khan was overthrown in a battle, where he lost 40,000 men; and obliged to fly for refuge to a prince named *Tayyan Khan*, who was Temujin's father-in-law, and his own enemy, and by whom he was ungenerously put to death. Temujin immediately began to seize on his dominions, great part of which voluntarily submitted: but a confederacy was formed against him by a number of Vang Khan's tributaries, at the head of whom was Jamuka, a prince who had already distinguished himself by his enmity to Temujin; and even Tayyan Khan himself was drawn into the plot, through jealousy of his son-in-law's good fortune. But Temujin was well prepared; and in the year 1204 attacked Tayyan Khan, entirely routed his army, killed himself, and took Jemuka prisoner, whose head he caused instantly to be struck off; after which he marched against the other tribes who had conspired against him. Them he quickly reduced; took a city called *Kashin*, where he put all to the sword who had borne arms against him; and reduced all the Mogul tribes in 1205.

Temujin now, having none to oppose him, called a general diet, which he appointed to be held on the first day of the spring 1206; that is, on the day in which the sun entered Aries. To this diet were summoned all the great lords both Moguls and Tartars; and in the mean time, to establish good order in the army, he divided his soldiers into bodies of 10,000, 1000, 100, and 10 men, with their respective officers, all subordinate to the generals, or those who commanded the bodies of 10,000; and these were to act under his own

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own ſons. On the day of holding the diet, the princes of the blood and great lords appeared dreſſed in white. Temujin dreſſed in the ſame manner, with his crown on his head, ſat down on his throne, and was complimented by the whole aſſembly, who wiſhed him the continuance of his health and proſperity. After this they confirmed the Mogul empire to him and his ſucceſſors, adding all thoſe kingdoms which he had ſubdued, the deſcendants of whoſe vanquiſhed khans were deprived of all right or title to them; and after this he was proclaimed emperor with much ceremony. During this inauguration, a pretended prophet declared that he came from God to tell the aſſembly, that from thenceforth Temujin ſhould aſſume the name of *Jenghiz Khan*, or *the moſt Great Khan of khans;* prophecying alſo, that all his poſterity ſhould be khans from generation to generation. This prophecy, which was no doubt owing to Temujin himſelf, had a ſurpriſing effect on his ſubjects, who from that time concluded that all the world belonged of right to them, and even thought it a crime againſt heaven for any body to pretend to reſiſt them.

10 Aſſumes the title of Jenghiz Khan.

Jenghiz Khan having now reduced under his ſubjection all the wandering tribes of Moguls and Tartars, began to think of reducing thoſe countries to the ſouth and ſouth-weſt of his own, where the inhabitants were much more civilized than his own ſubjects: and the countries being full of fortified cities, he muſt of courſe expect to meet with more reſiſtance. He began with the emperor of Hya, whoſe dominions he invaded in 1209, who at laſt ſubmitted to become his tributary. But in the mean time Jenghiz Khan himſelf was ſuppoſed to be tributary to the emperor of Kitay: who, in 1210, ſent him an officer, demanding the cuſtomary tribute. This was refuſed with the utmoſt indignation, and a war commenced, which ended not but with the diſſolution of the empire of Kitay, as mentioned under the article CHINA.

11 Invades Hya, China, &c.

In the year 1216, Jenghiz Khan reſolved to carry his arms weſtward, and therefore left his general Muchuli to purſue his conqueſts in Kitay. In his journey weſtward he overthrew an army of 300,000 Tartars who had revolted againſt him; and, in 1218, ſent ambaſſadors deſiring an alliance with Mohammed Karazm Shah, emperor of Gazna. His ambaſſador was haughtily treated: however, the alliance was concluded; but ſoon after broken, through the treachery as it is ſaid, of the Karazmian monarch's ſubjects. This brought on a war attended with the moſt dreadful devaſtations, and which ended with the entire deſtruction of the empire of Karazm or Gazna, as related under the the article GAZNA.

After the reduction of Karazm, part of the Moguls broke into Iran or Perſia, where alſo they made large conqueſts, while others of their armies invaded Georgia and the countries to the weſt; all this time committing ſuch enormities, that the Chineſe hiſtorians ſay both men and ſpirits burſt with indignation. In 1225, Jenghiz Khan returned to Hya, where he made war on the emperor for having ſheltered ſome of his enemies. The event was, that the emperor was ſlain, and his kingdom conquered, or rather deſtroyed; which, however, was the laſt exploit of this moſt cruel conqueror, who died in 1227, as he marched to complete the deſtruction of the Chineſe.

The Mogul empire, at the death of Jenghiz Khan, extended over a prodigious tract of country; being more than 1800 leagues in length from eaſt to weſt, and upwards of 1000 in breadth from north to ſouth. Its princes, however, were ſtill inſatiable, and puſhed on their conqueſts on all ſides. Oktay was acknowledged emperor after Jenghiz Khan; and had under his immediate goverment Moguleſtan (the country of the Moguls properly ſo called), Kitay, and the countries eaſt ward to the Tartarian ſea. Jagaty his brother governed under him a great part of the weſtern conqueſts. The country of the Kipjacks, and others to the eaſt, and north-eaſt, north, and north-weſt, were governed by Batu or Patu the ſon of Juji, who had been killed in the wars; while Tuli or Toley, another ſon of Jenghiz Khan, had Khoraſſan, Perſia, and what part of India was conquered. On the eaſt ſide the Mogul arms were ſtill attended with ſucceſs; not only the empire of Kitay, but the ſouthern part of CHINA, was conquered, as already related under that article, N° 24—42. On the weſt ſide matters continued much in the ſame way till the year 1254, when Magu, or Menkho, the fourth khan of the Moguls, (the ſame who was afterwards killed at a ſiege in China *), raiſed a great army, which he gave to his brother Hulaku or Hulagu, to extend his dominions weſtward. In 1255 he entered Iran, where he ſuppreſſed the Iſmaelians or Aſſaſſins, of whom an account is given under the article ASSASSINS, and two years afterwards he advanced to Bagdad, which he took, and cruelly put the caliph to death, treating the city with no more lenity than the Moguls uſually treated thoſe which fell into their hands. Every thing was put to fire and ſword; and in the city and its neighbourhood the number of ſlain, it is ſaid, amounted to 1,600,000. The next year he invaded Syria; the city of Damaſcus was delivered up, and, as it made no reſiſtance, the inhabitants were ſpared; but Aleppo being taken by ſtorm, a greater ſlaughter enſued there than had taken place at Bagdad, not even the children in their cradles being ſpared. Some cities of this country revolted the next year, or the year after; but falling again into the hands of the Moguls, they were plundered, and the inhabitants butchered without mercy, or carried into ſlavery.

12 Vaſt extent of his empire.

* See *China*, N° 38.

13 Bagdad reduced.

Hulaku died in 1264, and at his death we may fix the greateſt extent of the Mogul empire. It now comprehended the whole of the continent of Aſia, excepting part of Indoſtan, Siam, Pegu, Cochin China, and a few of the countries of Leſſer Aſia, which had not been attacked by them; and during all theſe vaſt conqueſts no Mogul army had ever been conquered, except one by Jaloloddin, as mentioned under the article GAZNA.—From this period, however, the empire began to decline. The ambition of the khans having prompted them to invade the kingdoms of Japan and Cochin China, they were miſerably diſappointed in their attempts, and loſt a great number of men. The ſame bad ſucceſs attended them in Indoſtan; and in a ſhort time this mighty empire broke into ſeveral ſmaller ones. The governors of Perſia being of the family of Jenghiz Khan, owned no allegiance to any ſuperior; thoſe of Tartary did the ſame. The Chineſe threw off the yoke; and thus the continent of Aſia wore much the ſame face that it had done before Jenghiz Khan began his conqueſts.

14 It begins to decline.

The

Moguls.

The fucceffors of Hulaku reigned in Perfia till the year 1335; but that year Abufaid Khan, the eighth from Hulaku, dying, the affairs of that country fell into confufion for want of a prince of the race of Jenghiz Khan to fucceed to the throne. The empire, therefore, was divided among a great number of petty princes who fought againft each other almoft without intermiffion, till in the year 1369 Timur Bek, or Tamerlane, one of thefe princes, having conquered a number of others, was crowned at Balkh, with the pompous title of *Saheb Karan;* that is, "the emperor of the age, and the conqueror of the world." As he had juft before taken that city, and deftroyed one of his moft formidable rivals who had fhut himfelf up in it, the new emperor began his reign with beheading fome of the inhabitants, imprifoning others, burning their houfes, and felling the women and children for flaves. In 1370 he croffed the Sihun, made war on the Getes, and attacked Karazm. Next year he granted a peace to his enemies; but two years after, he again invaded the country of the Getes, and by the year 1379 had fully conquered that country as well as Korazan; and from that time he continued to extend his conquefts in much the fame manner as Jenghiz Khan had done, though with lefs cruelty.—In 1387 he had reduced Armenia, Georgia, and all Perfia; the conqueft of which laft was completed by the reduction of Ifpahan, 70,000 of the inhabitants of which were flaughtered on account of a fedition raifed by fome rafh or evil difpofed perfons.

15 Tamerlane crowned emperor of Balkh.

16 Becomes a great conqueror.

After the reduction of Perfia, Timur turned his arms northward and weftward, fubduing all the countries to the Euphrates. He took the city of Bagdad; fubdued Syria; and having ravaged great part of Ruffia, returned to Perfia in 1396, where he fplendidly feafted his whole army. In 1398 he invaded Indoftan, croffed the Indus on the 17th of September, reduced feveral fortreffes, and made a vaft number of captives. However, as he was afraid that, in cafe of any emergency, thefe prifoners might take part with the enemy, he gave orders to his foldiers to put all their Indian flaves to death; and in confequence of this inhuman order, more than 100,000 of thefe poor wretches were flaughtered in lefs than an hour.

17 Invades and conquers Indoftan.

In the beginning of the year 1399 Timur was met by the Indian army; whom after a defperate battle, he defeated with great flaughter, and foon after took the city of Delhi the capital of the country. Here he feated himfelf on the throne of the Indian emperors, and here the fharifs, kadis, and principal inhabitants of the city, came to make their fubmiffion, and begged for mercy. The tame elephants and rhinocerofes likewife were brought to kneel before him as they had been accuftomed to do to the Indian emperors, and made a great cry as if they implored his clemency. Thefe war elephants, 120 in number, were, at his return, fent to Samarcand, and to the province where his fons refided. After this, at the requeft of the lords of the court, Timur made a great feaft; at which he diftributed prefents to the princes and principal officers.

18 The city of Delhi deftroyed, and the inhabitants flaughtered.

Delhi at this time confifted of three cities, called *Seyri*, *Old Delhi*, and *Jehan Penah*. Seyri was furrounded with a wall in form of a circle. Old Delhi was the fame, but much larger, lying fouth-weft of the other. Thefe two parts were joined on each fide by a wall; and the third, lying between them, was called *Jehan Penah*, which was larger than Old Delhi. Penah had ten gates; Seyri had feven, three of which looked towards Jehan Penah; this laft had 13 gates, fix to the north-weft, and feven to the fouth-eaft. Every thing feemed to be in a quiet pofture; when, on the 12th of January 1399, the foldiers of Timur being affembled at one of the gates of Delhi, infulted the inhabitants of the fuburbs. The great emirs were ordered to put a ftop to thefe diforders; but their endeavours were not effectual. The foltanas having a curiofity to fee the rarities of Delhi, and particularly a famous palace adorned with 1000 pillars, built by an ancient king of India, went in with all the court; and the gate being on that occafion left open for every body, above 15,000 foldiers got in unperceived. But there was a far greater number of troops in a large place between Delhi, Seyri, and Jehan Penah, who committed great diforders in the two laft cities. This made the inhabitants in defpair fall on them; and many, fetting fire to their houfes, burnt their wives and children. The foldiers feeing this confufion, did nothing but pillage the houfes; while the diforder was increafed by the admiffion of more troops, who feized the inhabitants of the neighbouring places who had fled thither for fhelter. The emirs, to put a ftop to this mifchief, caufed the gates to be fhut: but they were quickly opened by the foldiers within, who rofe in arms againft their officers; fo that by the morning of the 13th the whole army was entered, and this great city was totally deftroyed. Some foldiers carried out 150 flaves, men, women, and children; nay, fome of their boys had 20 flaves a piece to their fhare. The other fpoils, in jewels, plate, and manufactures, were immenfe; for the Indian women and girls were adorned with precious ftones, and had bracelets and rings on their hands, feet, and even toes, fo that the foldiers were loaded with them. On the 15th, in Old Delhi, the Indians retired into the great mofque to defend themfelves; but being attacked by the Tartars, they were all flaughtered, and towers erected with their heads. A dreadful carnage now enfued throughout the whole city, and feveral days were employed before the inhabitants could be made to quit it entirely; and as they went, the emirs took a number of them for their fervice. The artifans were alfo diftributed among the princes and commanders; all but the mafons, who were referved for the emperor, in order to build him a fpacious ftone mofque at Samarcand.

After this terrible devaftation, Timur marched into the different provinces of Indoftan, everywhere defeating the Indians who oppofed him, and flaughtering the Ghebrs or worfhippers of fire. On the 25th of March he fet out on his return, and on the 9th of May arrived at Samarcand. In a few months after his arrival, he was obliged to undertake an expedition into Perfia, where affairs were in the utmoft diforder on account of the mifconduct of his fon, whom he had appointed fovereign of that empire. Here Timur foon fettled matters; after which he again fet out on an expedition weftward, reduced many places in Georgia which had not fubmitted before, and invaded and conquered Syria. At the fame time he quarrelled with Bajazet the Turkifh fultan, then bufied in an enterprife againft Conftantinople, in which he would probably have fucceeded had not Timur interpofed. The caufe of this quarrel

19 Timur quarrels with Bajazet the Turkifh fultan.

Moguls. quarrel at firſt was, that Bajazet had demanded tribute from a prince who was under Timur's protection, and is ſaid to have returned an inſulting anſwer to the Tartar ambaſſadors who were ſent to him on that account. Timur, however, who was an enthuſiaſt in the cauſe of Mahometaniſm, and conſidered Bajazet as engaged in the cauſe of heaven when beſieging a Chriſtian city, was very unwilling to diſturb him in ſo pious a work; and therefore undertook ſeveral expeditions againſt the princes of Syria and Georgia, in order to give the Turkiſh monarch time to cool and return to reaſon. Among other places, he again inveſted the city of Bagdad, which had caſt off its allegiance to him; and having taken it by ſtorm, made ſuch a dreadful maſſacre of the inhabitants, that 120 towers were erected with the heads of the ſlain. In the mean time Bajazet continued to give freſh provocation, by protecting one Kara Yuſef a robber, who had even inſulted the caravan of Mecca; ſo that Timur at length reſolved to make war upon him. The ſultan, however, foreſeeing the danger of bringing ſuch a formidable enemy againſt himſelf, thought proper to aſk pardon, by a letter, for what was paſt, and promiſe obedience to Timur's will for the future. This embaſſy was graciouſly received; and Timur returned for anſwer, that he would forbear hoſtilities, provided Bajazet would either put Kara Yuſef to death, ſend him to the Tartar camp, or expel him out of his dominions. Along with the Turkiſh ambaſſadors he ſent one of his own; telling Bajazet that he would march into the confines of Anatolia, and there wait his final anſwer.

Though Bajazet had ſeemed at firſt willing to come to an agreement with Timur, and to dread his ſuperior power; yet he now behaved in ſuch an unſatisfactory manner, that the Tartar monarch deſired him to prepare for war; upon which he raiſed the ſiege of Conſtantinople, and having met Timur with an army greatly inferior to the Tartars, was utterly defeated and taken priſoner. According to ſome accounts, he was treated with great humanity and honour; while others inform us, that he was ſhut up in an iron cage, againſt which he daſhed out his brains the following year. At any rate, it is certain that he was not reſtored to liberty, but died in confinement.

20 Bajazet defeated and taken priſoner.

This victory was followed by the ſubmiſſion of many places of the Leſſer Aſia to Timur; the Greek emperor owned himſelf his tributary, as did alſo the ſultan of Egypt. After this Timur once more returned to Georgia, which he cruelly ravaged; after which he marched to Samarcand, where he arrived in the year 1405. Here, being now an old man, this mighty conqueror began to look forward to that ſtate which at one time or other is the dread of all living creatures; and Timur, in order to quiet the remorſes of his own conſcience, came to the following curious reſolution, which he communicated to his intimate friends; namely, that "as the vaſt conqueſts he had made were not obtained without *ſome violence*, which had occaſioned the deſtruction of a great number of God's creatures, he was reſolved, by way of atonement for his paſt crimes, to perform ſome good action; namely, to make war on the infidels, and exterminate the idolaters of China." This atonement, however, he did not live to accompliſh; for he died the ſame year of a burning fever, in the 71ſt year of his age and 36th of his reign.

21 Death of Tamerlane, and diſſolution of his empire.

On the death of Timur, his empire fell immediately into great diſorder, and the civil wars continued for five or ſix years; but at laſt peace was reſtored, by the ſettlement of Shah Rukh, Timur's ſon, on the throne. He did not, however, enjoy the empire in its full extent, or indeed much above one half of it; having only Karazm, Khoraſſan, Kandahar, Perſia, and part of Hindoſtan. Neither was he able, though a brave and warlike prince, to extend his dominions, though he tranſmitted them to his ſon Ulug Beg. He proved a wiſe and learned monarch; and is famous for the aſtronomical tables which he cauſed to be compoſed, and which are well known at this day. He was killed in 1448 by his ſon Abdollatif, who ſix months after was put to death by his own ſoldiers. After the death of Abdollatif, Abdollah, a grandſon of Shah Rukh, ſeized the throne; but, after reigning one year, was expelled by Abuſaid Mirza, the grandſon of Miran Shah the ſon of Timur. His reign was one continued ſcene of wars and tumults; till at laſt he was defeated and taken priſoner by one Haſſan Beg, who put him to death in 1468. From this time we may look upon the empire of Timur as entirely diſſolved, though his deſcendants ſtill reigned in Perſia and Indoſtan, the latter of which is ſtill known by the name of the *Mogul's empire*.

Moguls ‖ Mohilof.

22 Hiſtory of Hindoſtan.

On the death of the above mentioned monarch, his ſon Babr or Babor ſucceeded him, but was ſoon driven out by the Uſbeck Tartars; after which he reſided ſome time in Gazna, whence he made incurſions into Hindoſtan, and at length became maſter of the whole empire, excepting the kingdoms of Dekan, Guzerat, and Bengal.—For the tranſactions ſubſequent to this period, ſee HINDOSTAN and INDIA.

MOHAIR, in commerce, the hair of a kind of goat frequent about Angora in Turkey; the inhabitants of which city are all employed in the manufacture of camblets made of this hair.

Some give the name *mohair* to the camblets or ſtuffs made of this hair: of theſe there are two kinds; the one ſmooth and plain, the other watered like tabbies: the difference between the two only conſiſts in this, that the latter is callendered, the other not. There are alſo mohairs both plain and watered, whoſe woof is of wool, cotton, or thread.

MOHAIR Shell, in *Conchology*, a name given to a ſpecies of voluta, which ſeems of a cloſely and finely reticulated texture, and reſembles on the ſurface a piece of mohair or a very cloſe ſilkworm's web.

MOHAWKS. See MUCK.

MOHAWK Country, a part of North America, inhabited by one of the five nations of the Iroquois, ſituated between the province of New York, and the lake Ontario or Frontignac.

MOHILA, or MOELIA, one of the Comora iſlands in the Indian ſea, between the north end of Madagaſcar and the continent of Africa. The inland parts are mountainous and woody; but the lands adjoining to the ſea are watered by ſeveral fine ſtreams. The iſland abounds with proviſions of all kinds; and the Eaſt India ſhips of different nations ſometimes touch here for refreſhment.

MOHILOF, a large and ſtrong city of Poland, in the province of Lithuania, and palatinate of Mſciſlau. It is well built, populous, and has a conſiderable trade.

Near

Near this place the Swedes obtained a great victory over the Ruſſians in 1707.

MOIDORE, a Portugueſe gold coin, value 1l. 7s. ſterling.

MOIETY (*Medietas*), the half of any thing.

MOIRA, a town of Ireland, in the county of Down and province of Ulſter, 69 miles from Dublin; noted for its linen manufacture. It gives title of earl to the family of Rawdon.

MOISTURE. See HUMIDITY.

The moiſture of the air has conſiderable effects on the human body. For the quantity and quality of the food, and the proportion of the meat to the drink, being given, the weight of a human body is leſs, and conſequently its diſcharges greater in dry weather than in wet weather; which may be thus accounted for: the moiſture of the air moiſtens the fibres of the ſkin and leſſens perſpiration by leſſening their vibratory motion. When perſpiration is thus leſſened by the moiſture of the air, urine indeed is by degrees increaſed, but not equally. Hence, according to Dr Bryan Robinſon, we learn, that to keep a body of the ſame weight in wet weather as in dry, either the quantity of food muſt be leſſened, or the proportion of the meat to the drink increaſed: and both theſe may be done by leſſening the drink without making any change in the meat.

The inſtrument uſed for determining the degree of moiſture in the air, is called an *hygrometer*. See HYGROMETER.

MOIVRE, ABRAHAM, a learned mathematician, was born at Vitri in Champagne, in France, 1667, where his father was a ſurgeon. At the revocation of the edict of Nantes, he came to England. Before he left France, he had begun the ſtudy of mathematics; and having perfected himſelf in that ſcience in London, he was obliged, by neceſſity, to teach it. Newton's *Principia*, which accidentally fell into his hands, ſhowed him how little progreſs he had made in a ſcience of which he thought himſelf maſter. From this work he acquired a knowledge of the geometry of infinites with as great facility as he had learned the elementary geometry; and in a ſhort time he was fit to be ranked with the moſt celebrated mathematicians. His ſucceſs in theſe ſtudies procured him a ſeat in the Royal Society of London and in the Academy of Sciences at Paris. His merit was ſo well underſtood in the former, that he was thought capable of deciding in the famous diſpute between Leibnitz and Newton concerning the differential calculus.—He publiſhed a Treatiſe on Chances in 1738, and another on Annuities in 1752; both extremely accurate. The Philoſophical Tranſactions contain many intereſting memoirs of his compoſition.—Some of them treat of the method of fluxions; others are on the lunula of Hippocrates; others on phyſical aſtronomy, in which he reſolved many important problems; and others, in ſhort, on the analyſis of the games of chance, in which he followed a different courſe from that of Montmort. Towards the cloſe of his life he loſt his ſight and hearing; and the demand for ſleep became ſo great that he required 20 hours of it in a day. He died at London, 1754, aged 87. His knowledge was not confined to mathematics; but he retained to the laſt a taſte for polite literature. He was intimately acquainted with the beſt authors of antiquity; and he was frequently conſulted about difficult paſſages in their works. Rabelais and Moliere were his favourite French authors: he had them by heart; and he one day obſerved to one of his acquaintance, "that he would rather have been Moliere than Newton." He recited whole ſcenes of the *Miſanthrope* with that delicacy and force with which he remembered to have heard them recited at Paris 70 years before, by Moliere's own company. The character indeed was ſomewhat ſimilar to his own. He judged ſeverely of mankind; and could never conceal his diſguſt at the converſation of a fool, or his averſion to cunning and diſſimulation. He was free from the affectation of ſcience, and no one could know him to be a mathematician but from the accuracy of his thoughts. His converſation was general and inſtructive. Whatever he ſaid was well digeſted and clearly expreſſed. His ſtyle poſſeſſed more ſtrength and ſolicity than ornament and animation; but he was always correct, and he beſtowed as much pains on his ſentences as on his calculations. He could never endure any bold aſſertions or indecent witticiſms againſt religion.

MOLA, an ancient town of Italy, in the kingdom of Naples, and in the Terra di Lavoro, where they pretend to ſhow the ruins of Cicero's houſe. It is ſeated on the gulf of Venice, in E. Long. 17. 50. N. Lat. 41. 5.

MOLA Salſa (Salt Cake), in antiquity, was barley parched, and afterwards ground to meal or flour, then mixed with ſalt and frankincenſe, with the addition of a little water. Thus prepared, it was ſprinkled between the horns of the victim before it was killed in ſacrifice. This act was called *immolatio*, and was common to the Greeks as well as Romans; with this difference, that the *mola* of the Romans was of wheat. The Greeks called it ουλη or ουλοχυτη.

MOLARES, or DENTES MOLARES, in *Anatomy*, the large teeth, called in Engliſh the *grinders*. See ANATOMY *Index*.

MOLASSES, or MOLOSSES. See MOLOSSES.

MOLDAVIA, a province of Turkey in Europe, bounded on the north-eaſt by the river Nieſter, which divides it from Poland; on the eaſt, by Beſſarabia; on the ſouth by the Danube, which parts it from Bulgaria; and on the weſt, by Walachia and Tranſylvania. It is 240 miles in length and 150 in breadth. It lies in a good air and fruitful ſoil, producing corn, wine, rich paſtures, a good breed of horſes, oxen, ſheep, plenty of game, fiſh, fowl, honey, wax, and all European fruits. Its principal rivers are the Danube, Nieſter, Pruth, Bardalach, and Ceret. The inhabitants are Chriſtians of the Greek church, and Jaſſy is the principal town. It has been tributary to the Turks ſince the year 1574; who appoint a prince who is a native of the country, but have no regard to his being of the principal families. The province pays a large yearly tribute to the Turkiſh government; beſides raiſing a great body of horſe at its own expence.

MOLE, a river in Surry, which has taken its name from running under ground. It firſt diſappears at Boxhill, near Darking, in the county of Surry, and emerges again near Leatherhead.

MOLE. See TALPA, MAMMALIA *Index*; and for methods of deſtroying, ſee VERMIN, *Deſtruction of*.

MOLE, in *Midwifery*, a maſs of fleſhy matter, of a ſpherical

spherical figure, generated in the uterus, and sometimes mistaken for a child. See MIDWIFERY.

MOLE, or *Mark*. See NÆVUS.

MOLE, in *Architecture*, a massive work formed of large stones laid in the sea by means of coffer dams, extended either in a right line or an arch of a circle, before a port, which it serves to close; to defend the vessels in it from the impetuosity of the waves, and to prevent the passage of ships without leave. Thus we say the mole of the harbour of Messina, &c.

MOLE is sometimes also used to signify the harbour itself.

MOLE, (*moles*), among the Romans, was also used for a kind of mausoleum, built in manner of a round tower on a square base, insulate, encompassed with columns, and covered with a dome.—The mole of the emperor Adrian, now the castle of St Angelo, was the greatest and most stately of all the moles. It was crowned with a brazen pine apple, wherein was a golden urn containing the ashes of the emperor.

MOLE Cricket. See GRYLLOTALPA, ENTOMOLOGY *Index*.

MOLE Hills. These little hillocks of earth are a very great prejudice to the pasture lands, not only in wasting so much of the land as they cover, but in obstructing the scythe in mowing. In the west of England they use a peculiar instrument for the breaking up of these; it is a flat board, very thick, and of about eight inches in diameter, into which there is fastened a perpendicular handle of three or four feet long. It has four broad and sharp iron teeth at the front, which readily cut through the hill, and spread the earth it consists of; and behind there is a large knob proper for breaking the clods with, if there are any. Some use a spade, or other common instrument, in the place of this, but not so well. There is, however, a much better instrument even than this, for destroying these hills, where they are in very great numbers. This is a kind of horse machine; it has a sharp iron about three feet over, and with a strong back.—It is about four or five inches broad, and has two long handles for a horse to be harnessed to, and a cross bar of iron to strengthen it at the bottom of the handles, reaching from the one handle to the other. The middle of this cross bar is furnished with one, two, or more sharp pieces of iron like small ploughshares, to cut the mole hills into two, three, or more parts. The iron behind is of a semicircular figure. A single horse is harnessed to this machine, and a boy must be employed to drive it, and a man to hold and guide it; the sharp irons or shares are the first things that meet the hill, they run through it, break its texture, and cut it into several parts; and the circular iron following immediately behind them, cuts up the whole by the roots, and leaves the land level. This instrument will destroy as many mole hills in one day as a common labourer can do in eight, and would be of very great advantage to the kingdom if brought into general use.

MOLIERE, JOHN BAPTIST, a celebrated French comedian and dramatic writer, whose true name was *Pocquelin*, which for some reason he changed to that of Moliere. He was the son of a valet de chambre, and was born at Paris about the year 1620. He went through the study of the classics under the Jesuits in the college of Clermont, and was designed for the bar; but at his quitting the law schools, he made choice of the actor's profession. From a strong attachment to the drama, his whole study and application were directed to the stage, and he continued till his death to exhibit plays, which were greatly applauded. It is said the first motive of his going upon the stage was to enjoy the company of an actress for whom he had contracted a violent fondness. His comedies are highly esteemed. And it is no wonder he so justly represented domestic feuds, and the torments of jealous husbands, or of those who have reason to be so; for it is asserted that no man ever experienced this more than Moliere. His last comedy was *Le Malade Imaginaire*, which was brought on the stage in 1673; and Moliere died on the fourth night of its representation; some say in acting the very part of the pretended dead man, which gave some exercise for the wits of the time; but according to others he died in his bed that night, from the bursting of a vein in his lungs by coughing. The king, as a last mark of his favour, prevailed with the archbishop of Paris to suffer him to be buried in consecrated ground; though he had irritated the clergy by his *Tartuff*. The most esteemed editions of his works are that of Amsterdam, 5 vols. 12mo, 1699; and that of Paris, 6 vols. 4to, 1734.

MOLINISTS, in ecclesiastical history, a sect in the Romish church, who follow the doctrine and sentiments of the Jesuit Molina, relating to sufficient and efficacious grace. He taught that the operations of divine grace were entirely consistent with the freedom of human will; and he introduced a new kind of hypothesis to remove the difficulties attending the doctrines of predestination and liberty, and to reconcile the jarring opinions of Augustines, Thomists, Semi-Pelagians, and other contentious divines. He affirmed, that the decree of predestination to eternal glory was founded upon a previous knowledge and consideration of the merits of the elect; that the grace, from whose operation these merits are derived, is not efficacious by its own intrinsic power only, but also by the consent of our own will, and because it is administered in those circumstances, in which the Deity, by that branch of his knowledge which is called *scientia media*, foresees that it will be efficacious. The kind of prescience, denominated in the schools *scientia media*, is that foreknowledge of future contingents that arises from an acquaintance with the nature and faculties of rational beings, of the circumstances in which they shall be placed, of the objects that shall be presented to them, and of the influence which their circumstances and objects must have on their actions.

MOLINOSISTS, a sect among the Romanists, who adhere to the doctrine of Molinos. These are the same with what are otherwise called *Quietists*, whose chief principle was, that men ought to annihilate themselves in order to be united to God, and afterwards remain in quietness of mind, without being troubled for what shall happen to the body. Molinos, the author of those opinions, was a Spanish priest, and was born in 1627. His 68 propositions were examined in 1687 by the pope and inquisitors, who decreed that his doctrine was false and pernicious, and that his books should be burned. He was forced to recant his errors publicly in the Dominican church, and was condemned to perpetual imprisonment. He was then 60 years old, and had been spreading his doctrine 22 years before. He died in prison in 1692.

MOLLUGO, AFRICAN CHICKWEED; a genus of plants

plants belonging to the triandria clafs, and in the natural method rankind under the 22d order, *Caryophyllei*. See Botany *Index*.

MOLLUSCA, in the Linnæan fyftem, one of the orders of vermes or worms. Thefe are fimple naked animals, not included in a fhell, but furnifhed with limbs. See Helminthology *Index*.

MOLOCH, a falfe god of the Ammonites, who dedicated their children to him, by making them "pafs through the fire," as the Scriptures exprefs it. There are various opinions concerning this method of confecration. Some think, the children leaped over a fire facred to Moloch; others, that they paffed between two fires; and others, that they were really burnt in the fire, by way of facrifice to this god. There is foundation for each of thefe opinions. For, firft, it was ufual among the pagans to luftrate or purify with fire; and, in the next place, it is exprefsly faid, that the inhabitants of Sepharvaim burnt their children in the fire to Anamelech and Adramelech; much fuch deities as Moloch of the Ammonites.

Mofes, in feveral places, forbids the Ifraelites to dedicate their children to this god as the Ammonites did, and threatens death and utter extirpation to fuch perfons as were guilty of this abominable idolatry. And there is great probability that the Hebrews were much addicted to the worfhip of this deity: fince Amos, and after him St Stephen, reproaches them with having carried along with them into the wildernefs the tabernacle of their god Moloch.

Solomon built a temple to Moloch upon the mount of Olives; and Manaffeh, a long time after, imitated his impiety, by making his fon pafs through the fire in honour of Moloch. It was chiefly in the valley of Tophet and Hinnom, to the eaft of Jerufalem, that the Ifraelites paid their idolatrous worfhip to this falfe god of the Ammonites.

There are various fentiments concerning the relation which Moloch had to the other pagan divinities. Some believe he was the fame with Saturn, to whom it is well known that human facrifices were offered. Others fuppofe him to be Mercury; others, Mars; others, Mithras; and others, Venus. Laftly, Others take Moloch to be the fun, or the king of heaven. Moloch was likewife called *Milcom;* as appears from what is faid of Solomon, that he went after Afhtaroth the abomination of the Zidonians, and Milcom the abomination of the Ammonites.

MOLOSSES, Molasses, or *Melaffes*, that grofs fluid matter remaining of fugar after refining, and which no boiling will bring to a confiftence more folid than that of fyrup; hence alfo called *fyrup of fugar*.

Properly, moloffes are only the fediment of one kind of fugar called *chypre*, or brown fugar, which is the refufe of other fugars not to be whitened or reduced into loaves.

Moloffes are much ufed in Holland for the preparation of tobacco, and alfo among poor people inftead of fugar. There is a kind of brandy or fpirit made of moloffes; but by fome held exceedingly unwholefome. See below.

Artificial Molosses. There has been found a method of making moloffes from apples without the addition of fugar. The apple that fucceeds beft in this operation is a fummer fweeting of a middle fize, pleafant to the tafte, and fo full of juice that feven bufhels will yield a barrel of cyder.

The manner of making it is this: the apples are to be ground and preffed, then the juice is to be boiled in a large copper, till three quarters of it be evaporated: this will be done with a moderate fire in about fix hours, with the quantity of juice above mentioned; by this time it will be of the confiftence and tafte as well as of the colour of moloffes.

This new molaffes ferves all the purpofes of the common kind, and is of great ufe in preferving cyder. Two quarts of it, put into a barrel of racked cyder, will preferve it, and give it an agreeable colour.

The invention of this kind of moloffes was owing to Mr Chandler of Woodftock in New England, who living at a diftance from the fea, and where the common molaffes was very dear and fcarce, provided this for the fupply of his own family, and introduced the practice among people of the neighbourhood. It is to be obferved, that this fort of apple, the fweeting, is of great ufe in making cyder; one of the very beft kinds we know being made of it. The people in New England alfo feed their hogs with the fallings of their orchards of thefe apples; and the confequence of this is, that their pork is the fineft in the world.

Molosses Spirit; a very clean and pure fpirit, much ufed in England, and made from moloffes or common treacle diffolved in water, and fermented in the fame manner as malt or the common malt fpirit. See Distillation.

MOLOSSI, a people of Epirus, who inhabited that part of the country which was called *Moloffia*, or *Moloffus*, from King Moloffus, a fon of Pyrrhus and Andromache. This country had the bay of Ambracia on the fouth, and the country of the Perrhæbeans on the eaft. The dogs of the place were famous, and received the name of *Moloffi* among the Romans. Dodona was the capital of the country, according to fome writers. Others, however, reckon it as the chief city of Thefprotia.

MOLOSSUS, in the Greek and Latin poetry, a foot confifting of three long fyllables. As *audiri*, *cantabant*, *virtutem*.

It takes its name either from a dance in ufe among the people called *Moloffi* or *Epirotæ;* or from the temple of Jupiter Moloffus, where odes were fung, in which this foot had a great fhare; or elfe becaufe the march of the Moloffi, when they went to the combat, was compofed of thefe feet, or had the cadence thereof. The fame foot was alfo called among the ancients, *Vertumnus*, *extenfipes*, *hippius*, *et cannius*.

MOLUCILLA, a genus of plants belonging to the didynamia clafs, and in the natural method ranking under the 42d order, *Verticillatæ*. See Botany *Index*.

MOLTEN-grease. See Farriery, N° 499.

MOLUCCA islands, lie in the Eaft Indian fea under the line; of which there are five principal, namely, Ternate, Tydor, Machian, Motyr, and Bachian. The largeft of them is hardly 30 miles in circumference. They produce neither corn, rice, nor cattle, except goats: but they have oranges, lemons, and other fruits; and are moft remarkable for fpices, efpecially cloves. They have large fnakes, which are not venomous, and very dangerous land crocodiles. At prefent they have three kings; and the Dutch, who are

are very ſtrong here, keep out all other European nations, being jealous of their ſpice trade. The religion is idolatry; but there are many Mahometans. They were diſcovered by the Portugueſe in 1511, who ſettled upon the coaſt; but the Dutch drove them away, and are now maſters of all theſe iſlands.

MOLWITZ, a town of Sileſia, in the province of Grotſka, remarkable for a battle gained by the Pruſſians over the Auſtrians in 1741. E. Long. 16. 45. N. Lat. 50. 26.

MOLY. The name of this plant is rendered famous by Homer: and hence has been much inquired into, as to its true ſenſe, by the botaniſts of almoſt all times. The old interpreters of Homer explain this word by the "wild rue;" and the only reaſon for this is, that at ſome time, probably long after the days of Homer, the people of Cappadocia called the wild rue *moly*. But this plant is wholly different from the moly of Homer, which Theophraſtus affirms grew in his time in Arcadia in great plenty, and had a round bulbous root like an onion, and long and graſſy leaves like the ſquill. On the whole, the moly of Homer ſeems to have been a ſpecies of allium or garlic.

MOLYBDENA, a metal. See CHEMISTRY and MINERALOGY *Index*.

MOMBAZA, or MONBAZA, a town of Africa, in an iſland of the ſame name, with a caſtle and a fort; ſeated on the eaſtern coaſt, oppoſite to the country of Mombaza in Zanguebar, 75 miles ſouth of Melinda, and ſubject to Portugal. E. Long. 39. 30. S. Lat. 3. 15.

MOMBAZA, a country of Africa in Zanguebar, ſubject to the Portugueſe, from whence they export ſlaves, gold, ivory, rice, fleſh, and other proviſions, with which they ſupply the ſettlements in Braſil. The king of this country being a Chriſtian, had a quarrel with the Portugueſe governor, took the caſtle by aſſault in 1631, turned Mahometan, and murdered all the Chriſtians; but in 1729 they became maſters of the territory again.

MOMENT, in the doctrine of time, an inſtant, or the moſt minute and indiviſible part of duration.

MOMENTUM, in *Mechanics*, ſignifies the ſame with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter multiplied into the velocity; or, which is the ſame thing, it may be conſidered as a rectangle under the quantity of matter and velocity. See MECHANICS.

MOMORDICA, MALE BALSAM APPLE; a genus of plants belonging to the monœcia claſs; and in the natural method ranking under the 34th order, *Cucurbitaceæ*. See BOTANY *Index*.

MOMUS, in fabulous hiſtory, the god of raillery, or the jeſter of the celeſtial aſſembly, and who ridiculed both gods and men. Being choſen by Vulcan, Neptune, and Minerva, to give his judgement concerning their works, he blamed them all: Neptune for not making his bull with horns before his eyes, in order that he might give a ſurer blow; Minerva for building a houſe that could not be removed in caſe of bad neighbours; and Vulcan, for making a man without a window in his breaſt, that his treacheries might be ſeen. For his free reflections upon the gods, Momus was driven from heaven. He is generally repreſented raiſing a maſk from his face, and holding a ſmall figure in his hand.

MONA, in *Ancient Geography*, two iſlands of this name in the ſea lying between Britain and Ireland. The one deſcribed by Cæſar, as ſituated in the middle paſſage between both iſlands, and ſtretching out in length from ſouth to north. Called *Monaæda* (Ptolemy); *Monapia*, or *Monabia* (Pliny). Suppoſed to be the iſle of Man.—Another Mona, (Tacitus); an iſland more to the ſouth, and of greater breadth; ſituated on the coaſt of the Ordovices, from which it is ſeparated by a narrow ſtrait. The ancient ſeat of the Druids. Now called *Angleſey*, the iſland of the Angles or Engliſh.

MONA, an iſland of the Baltic ſea, ſouth-weſt of the iſland of Zealand, ſubject to Denmark. E. Long. 12. 30. N. Lat. 55. 20.

MONA. See INCHCOLM.

MONACO, a ſmall but handſome and ſtrong town of Italy, in the territory of Genoa, with a caſtle, citadel, and a good harbour. It is ſeated on a craggy rock, and has its own prince, under the protection of France. E. Long. 7. 33. N. Lat. 43. 48.

MONAD. See LEIBNITZIAN *Philoſophy*.

MONADELPHIA, (from μονος *alone*, and αδελφια a *brotherhood*;) a "ſingle brotherhood:" The name of the 16th claſs in Linnæus's ſexual ſyſtem, conſiſting of plants with hermaphrodite flowers; in which all the ſtamina are united below into one body or cylinder, through which paſſes the piſtillum. See BOTANY *Index*.

MONAGHAN, a county of Ireland, ſituated in the province of Ulſter, is bounded by Tyrone on the north, Armagh on the eaſt, Cavan and Louth on the ſouth, and Fermanagh on the weſt. It is a mountainous tract, but in ſome places is well improved. It contains 170,090 Iriſh plantation acres, and is about 30 miles long and 22 broad. The linen trade of this county is averaged at 104,000l. yearly.

MONAGHAN, the capital town of the county of that name, is diſtant 62 miles from Dublin, and gives title of baron to the family of Blayney. It was anciently called *Muinechan*. An abbey was founded here in a very early age, of which Moelodius the ſon of Aodh was abbot. In 1462, a monaſtery for conventual Franciſcans was erected on the ſite of this abbey, which was granted on the general ſuppreſſion of monaſteries to Edward Withe, and a caſtle has been ſince erected on the ſite by Edward Lord Blayney.

MONANDRIA, (from μονος *alone*, and ανηρ a *man* or *huſband*), the name of the firſt claſs in Linnæus's ſexual ſyſtem; conſiſting of plants with hermaphrodite flowers, which have only one ſtamen.

MONARCHY, a large ſtate governed by one; or a ſtate where the ſupreme power is lodged in the hands of a ſingle perſon. The word comes from the Greek μοναρχης, "one who governs alone;" formed of μονος, *ſolus*, and αρχη *imperium*, "government." Of the three forms of government, viz. democracy, ariſtocracy, and monarchy, the laſt is the moſt powerful, all the ſinews of government being knit together, and united in the hand of the prince; but then there is imminent danger of his employing that ſtrength to improvident or oppreſſive purpoſes. As a democracy is the beſt calculated to direct the end of a law, and an ariſtocracy to invent the means by which that end ſhall be obtained, a monarchy is moſt fit for carrying thoſe means into execution.

The moſt ancient monarchy was that of the Aſſyrians, which was founded ſoon after the deluge. We uſually reckon four grand or univerſal monarchies; the Aſſyrian, Perſian, Grecian, and Roman; though St Auguſtine makes them but two; viz. thoſe of Babylon and Rome. Belus is placed at the head of the ſeries of Aſſyrian kings who reigned at Babylon, and is by profane authors eſteemed the founder of it, and by ſome the ſame whom the Scriptures call Nimrod. The principal Aſſyrian kings after Belus were Ninus, who built Nineveh, and removed the ſeat of empire to it; Semiramis, who, diſguiſing her ſex, took poſſeſſion of the kingdom inſtead of her ſon, and was killed and ſucceeded by her ſon Ninyas; and Sardanapalus, the laſt of the Aſſyrian monarchs, and more effeminate than a woman. After his death the Aſſyrian empire was ſplit into three ſeparate kingdoms, viz. the Median, Aſſyrian, and Babylonian. The firſt king of the Median kingdom was Arbaces; and this kingdom laſted till the time of Aſtyages, who was ſubdued and diveſted of his kingdom by Cyrus.

In the time of Cyrus there aroſe a new and ſecond monarchy called the Perſian, which ſtood upwards of 200 years from Cyrus, whoſe reign began A. M. 3468, to Darius Codomannus, who was conquered by Alexander, and the empire tranſlated to the Greeks A. M. 3674.—The firſt monarch was Cyrus, founder of the empire. 2. Cambyſes, the ſon of Cyrus. 3. Smerdis. 4. Darius, the ſon of Hyſtaſpis, who reigned 521 years before Chriſt. 5. Xerxes, who reigned 485 years before Chriſt. 6. Artaxerxes Longimanus, who reigned 464 years before Chriſt. 7. Xerxes the ſecond. 8. Ochus, or Darius, called Nothus, 424 years before Chriſt. 9. Artaxerxes Mnemon, 405 years before Chriſt. 10. Artaxerxes Ochus, 359 years before Chriſt. 11. Arſes, 338 years before Chriſt. 12. Darius Codomannus, 336 years before Chriſt, who was defeated by Alexander the Great, and deprived of his kingdom and life about 331 years before Chriſt: the dominion of Perſia after his death was tranſlated to the Greeks.

The third monarchy was the Grecian. As Alexander, when he died, did not declare who ſhould ſucceed him, there ſtarted up as many kings as there were commanders. At firſt they governed the provinces that were divided among them under the title of viceroys; but when the family of Alexander the Great was extinct, they took upon them the name of kings. Hence, in proceſs of time, the whole empire of Alexander produced four diſtinct kingdoms, viz. 1. The Macedonian; the kings of which, after Alexander, were Antipater, Caſſander, Demetrius Poliorcetes, Seleucus Nicanor, Meleager, Antigonus Doſon, Philip, and Perſeus, under whom the Macedonian kingdom was reduced to the form of a Roman province. 2. The Aſiatic kingdom, which upon the death of Alexander fell to Antigonus, comprehending that country now called Natolia, together with ſome other regions beyond Mount Taurus. From this kingdom proceeded two leſſer ones, viz. that of Pergamus, whoſe laſt king, Attalus, appointed the Roman people to be his heir; and Pontus, reduced by the Romans into the form of a province, when they had ſubdued the laſt king, Mithridates. 3. The Syrian, of whoſe twenty-two kings the moſt celebrated were, Seleucus Nicanor, founder of the kingdom; Antiochus Deus; Antiochus the Great; Antiochus Epiphanes; and Tigranes, who was conquered by the Romans under Pompey, and Syria reduced into the form of a Roman province. 4. The Egyptian, which was formed by the Greeks in Egypt, and flouriſhed near 240 years under 12 kings, the principal of whom were, Ptolemy Lagus, its founder; Ptolemy Philadelphus, founder of the Alexandrian library; and Queen Cleopatra, who was overcome by Auguſtus, in conſequence of which Egypt was added to the dominion of the Romans.

The fourth monarchy was the Roman, which laſted 244 years, from the building of the city until the time when the royal power was abrogated. The kings of Rome were Romulus, its founder; Numa Pompilius; Tullus Hoſtilius; Ancus Martius; Tarquinius Priſcus; Servius Tullius; and Tarquin the Proud, who was baniſhed, and with whom terminated the regal power.

There ſeems in reality no neceſſity to make the Medes, Perſians, and Greeks, ſucceed to the whole power of the Aſſyrians, to multiply the number of the monarchies. It was the ſame empire ſtill; and the ſeveral changes that happened in it did not conſtitute different monarchies. Thus the Roman empire was ſucceſſively governed by princes of different nations, yet without any new monarchy being formed thereby. Rome, therefore, may be ſaid to have immediately ſucceeded Babylon in the empire of the world. See Empire.

Of monarchies ſome are abſolute and deſpotic, where the will of the monarch is uncontroulable; others are limited, where the prince's authority is reſtrained by laws, and part of the ſupreme power lodged in other hands, as in Britain. See Government.

Some monarchies again are hereditary, where the ſucceſſion devolves immediately from father to ſon; and others are elective, where, on the death of the monarch, his ſucceſſor is appointed by election, as in Poland.

Fifth-Monarchy Men, in the eccleſiaſtical hiſtory of England, were a ſet of wrong-headed and turbulent enthuſiaſts who aroſe in the time of Cromwell, and who expected Chriſt's ſudden appearance upon earth to eſtabliſh a new kingdom; and, acting in conſequence of this illuſion, aimed at the ſubverſion of all human government.

MONARDA, Indian horehound, a genus of plants belonging to the diandria claſs; and in the natural method ranking under the 42d order *Verticillatæ*. See Botany *Index*.

MONASTEREVAN, a poſt town of Ireland, in the county of Kildare and province of Leinſter, 36 miles from Dublin, ſo called from a magnificent abbey which was founded here, in which St Evan in the beginning of the 7th century placed a number of monks from South Munſter, and which had the privilege of being a ſanctuary. The conſecrated bell, which belonged to this ſaint, was on ſolemn trials ſworn upon by the whole tribe of the Eoganachts, and was always committed to the care of the Mac Evans, hereditary chief juſtices of Munſter; the abbot of this houſe ſat as a baron in parliament.—At the general ſuppreſſion of monaſteries, this abbey was granted to Lord Audley, who aſſigned it to Viſcount Ely. It afterwards came into

into the family of Moor, earls of Drogheda, and has been beautifully repaired by the present Lord Drogheda, still wearing the venerable appearance of an abbey. There is a nursery at Monasterevan for the charter schools of the province of Leinster; and the grand canal has been carried up to this town from Dublin, since which it has been much improved and enlarged with several new buildings.

MONASTERY, a convent or house built for the reception of religious; whether it be abbey, priory, nunnery, or the like.

MONASTERY is only properly applied to the houses of monks, mendicant friars, and nuns. The rest are more properly called *religious houses*. For the origin of monasteries, see MONASTIC and MONK.

The houses belonging to the several religious orders which obtained in England and Wales were, cathedrals, colleges, abbeys, priories, preceptories, commandries, hospitals, friaries, hermitages, chantries, and free chapels. These were under the direction and management of various officers. The dissolution of houses of this kind began so early as the 1312, when the Templars were suppressed; and in 1323 their lands, churches, advowsons, and liberties, here in England, were given by 17 Ed. II. st. 3. to the prior and brethren of the hospital of St John at Jerusalem. In the years 1390, 1437, 1441, 1459, 1497, 1505, 1508, and 1515, several other houses were dissolved, and their revenues settled on different colleges in Oxford and Cambridge. Soon after the last period, Cardinal Wolsey, by license of the king and pope, obtained a dissolution of above 30 religious houses for the founding and endowing his colleges at Oxford and Ipswich. About the same time a bull was granted by the same pope to Cardinal Wolsey to suppress monasteries, where there were not above six monks, to the value of 8000 ducats a-year, for endowing Windsor and King's College in Cambridge; and two other bulls were granted to Cardinals Wolsey and Campeius, where there were less than twelve monks, and to annex them to the greater monasteries; and another bull to the same cardinals to inquire about abbeys to be suppressed in order to be made cathedrals. Although nothing appears to have been done in consequence of these bulls, the motive which induced Wolsey and many others to suppress these houses was the desire of promoting learning; and Archbishop Crammer engaged in it with a view of carrying on the Reformation. There were other causes that concurred to bring on their ruin: many of the religious were loose and vicious; the monks were generally thought to be in their hearts attached to the pope's supremacy; their revenues were not employed according to the intent of the donors; many cheats in images, feigned miracles, and counterfeit relicks, had been discovered, which brought the monks into disgrace; the Observant friars had opposed the king's divorce from Queen Catharine; and these circumstances operated, in concurrence with the king's want of a supply and the people's desire to save their money, to forward a motion in parliament, that in order to support the king's state and supply his wants, all the religious houses might be conferred upon the crown which were not able to spend above 200l. a-year; and an act was passed for that purpose 27 Hen. VIII. c. 28. By this act about 380 houses were dissolved, and a revenue of 30,000l. or 32,000l. a-year came to the crown; besides about 100,000l. in plate and jewels. The suppression of these houses occasioned discontent, and at length an open rebellion: when this was appeased, the king resolved to suppress the rest of the monasteries, and appointed a new visitation: which caused the greater abbeys to be surrendered apace; and it was enacted by 31 Hen. VIII. c. 13. that all monasteries, &c. which have been surrendered since the 4th of February, in the 27th year of his majesty's reign, and which hereafter shall be surrendered, shall be vested in the king. The knights of St John of Jerusalem were also suppressed by the 32 Hen. VIII. c. 24. The suppression of these greater houses by these two acts produced a revenue to the king of above 100,000l. a-year, besides a large sum in plate and jewels. The last act of dissolution in this king's reign was the act of 37 Hen. VIII. c. 4. for dissolving colleges, free chapels, chantries, &c. which act was farther enforced by 1 Edw. VI. c. 14. By this act were suppressed 90 colleges, 110 hospitals, and 2374 chantries and free chapels. The number of houses and places suppressed from first to last, so far as any calculations appear to have been made, seems to be as follow:

Of lesser monasteries, of which we have the valuation,	374
Of greater monasteries,	186
Belonging to the hospitallers,	48
Colleges,	90
Hospitals,	110
Chantries and free chapels,	2374
Total	3182

Besides the friars houses and those suppressed by Wolsey, and many small houses of which we have no particular account.

The sum total of the clear yearly revenue of the several houses at the time of their dissolution, of which we have any account, seems to be as follow:

Of the greater monasteries,	L. 104,919	13	$3\frac{1}{2}$
Of all those of the lesser monasteries of which we have the valuation,	29,702	1	$10\frac{1}{2}$
Knights hospitallers head house in London	2385	12	8
We have the valuation of only 28 of their houses in the country	3026	9	5
Friars houses of which we have the valuation	751	2	$0\frac{3}{4}$
Total	L. 140,786	19	$3\frac{3}{4}$

If proper allowances are made for the lesser monasteries and houses not included in this estimate, and for the plate, &c. which came into the hands of the king by the dissolution, and for the value of money at that time, which was at least six times as much as at present, and also consider that the estimate of the lands was generally supposed to be much under the real worth, we must conclude their whole revenues to have been immense.

It does not appear that any computation hath been made of the number of persons contained in the religious houses.

Those

Those of the lesser monasteries dissolved by 27 Hen. VIII. were reckoned at about 10,000
If we suppose the colleges and hospitals to have contained a proportionable number, these will make about - - 5347
If we reckon the number in the greater monasteries, according to the proportion of their revenues, they will be about 35,000; but as probably they had larger allowances in proportion to their number than those of the lesser monasteries, if we abate upon that account 5000, they will then be 30,000
One for each chantry and free chapel, 2374

Total 47,721

But as there were probably more than one person to officiate in several of the free chapels, and there were other houses which are not included within this calculation, perhaps they may be computed in one general estimate at about 50,000. As there were pensions paid to almost all those of the greater monasteries, the king did not immediately come into the full enjoyment of their whole revenues: however, by means of what he did receive, he founded six new bishoprics, viz. those of Westminster (which was changed by Queen Elizabeth into a deanery, with twelve prebends and a school), Peterborough, Chester, Gloucester, Bristol, and Oxford. And in eight other sees he fonnded deaneries and chapters, by converting the priors and monks into deans and prebendaries, viz. Canterbury, Winchester, Durham, Worcester, Rochester, Norwich, Ely, and Carlisle. He founded also the colleges of Christ-church in Oxford and Trinity in Cambridge, and finished King's college there. He likewise founded professorships of divinity, law, physic, and of the Hebrew and Greek tongues, in both the said universities. He gave the house of Greyfriars and St Bartholomew's hospital to the city of London, and a perpetual pension to the poor knights of Windsor, and laid out great sums in building and fortifying many ports in the channel. It is observable, upon the whole, that the dissolution of these houses was an act, not of the church, but of the state; in the period preceding the Reformation, by a king and parliament of the Roman catholic communion in all points except the king's supremacy; to which the pope himself, by his bulls and licenses, had led the way.

MONASTIC, something belonging to monks, or the monkish life. The monastic profession is a kind of civil death, which in all worldly matters has the same effect with the natural death. The council of Trent, &c. fix sixteen years for the age at which a person may be admitted into the monastical state.

St Anthony is the person who, in the fourth century, first instituted the monastic life; as St Pachomius, in the same century, is said to have first set on foot the cœnobitic life, *i. e.* regular communities of religious. In a short time the deserts of Egypt became inhabited with a set of solitaries, who took upon them the monastic profession. St Basil carried the monkish humour into the east, where he composed a rule which afterwards obtained through a great part of the west.

In the 11th century the monastic discipline was grown very remiss. St Odo first began to retrieve it in the monastery of Cluny; that monastery, by the conditions of its erection, was put under the immediate protection of the holy see; with a prohibition to all powers, both secular and ecclesiastical, to disturb the monks in the possession of their effects or the election of their abbot. In virtue hereof they pleaded an exemption from the jurisdiction of the bishop, and extended this privilege to all the houses dependent on Cluny. This made the first congregation of several houses, under one chief immediately subject to the pope, so as to constitute one body, or, as they now call it, one *religious order*. Till then, each monastery was independent and subject to the bishop. See MONK.

MONDA, or MUNDA, in *Ancient Geography*, a river of Lusitania, running mid-way from east to west into the Atlantic, between the Durius and Tagus, and washing Conimbrica. Now the *Mondego*, a river of Portugal, which running by Coimbra, falls into the Atlantic, 30 miles below it.

MONDAY, the second day of the week, so called as being anciently sacred to the moon; *q. d.* moon-day.

MONDOVI, a considerable town of Italy, in Piedmont; with a citadel, university, and bishop's see. It is the largest and most populous town of Piedmont, and is seated in E. Long. 8. 6. N. Lat. 44. 33.

MONEMUGI, an empire in the south of Africa, has Zanguebar on the east, Monomotapa on the south, Motamba and Makoko on the west, and Abyssinia on the north and partly to the east, though its boundaries that way cannot be ascertained. It is divided into the kingdoms of Mujaco, Makoko or Ansiko, Gingiro, Cambate, Alaba, and Monemugi Proper. This last lies in the middle of the torrid zone, and about the equinoctial line, south of Makoko, west of Zanguebar, north of Monomotapa, and east of Congo and of the northern parts of Monomotapa. To ascertain its extent, is too difficult a task, being a country so little frequented. The country known, abounds with gold, silver, copper mines, and elephants. The natives clothe themselves in silks and cottons, which they buy of strangers, and wear collars of transparent amber beads, brought them from Cambaya: which beads serve also instead of money; gold and silver being too common, and of little value among them.

Their monarch always endeavours to be at peace with the princes round about him, and to keep an open trade with Quitoa, Melinda, and Mombaza, on the east, and with Congo on the west; from all which places the black merchants resort thither for gold. The Portuguese merchants report, that on the east side of Monemugi there is a great lake full of small islands, abounding with all sorts of fowl and cattle, and inhabited by negroes. They relate also, that on the main land eastward they heard sometimes the ringing of bells, and that one could observe buildings very much like churches; and that from these parts came men of a brown and tawny complexion, who traded with those islanders, and with the people of Monemugi. This country abounds in palm wine, oil, and honey.

MONETARIUS, or MONEYER, a name which antiquaries and medalists give to those who struck the ancient coins or monies.

Many of the old Roman, &c. coins have the name of

Money. of the *monetarius*, either written at length, or at least the initial letters of it. See MEDAL.

MONEY, a piece of matter, commonly metal, to which public authority has affixed a certain value and weight to serve as a medium in commerce. See COIN, COMMERCE, and MEDALS; also the article BANK.

Money is usually divided into *real* or *effective*, and *imaginary* or *money of account*,

I. *REAL Money*.

1. *History of real money*. Real money includes all coins, or species of gold, silver, copper, and the like; which have course in common, and do really exist. Such are guineas, pistoles, pieces of eight, ducats, &c.

Real money, civilians observe, has three essential qualities, viz. matter, form, and weight or value,

For the matter, copper is that thought to have been first coined; afterwards silver; and lastly gold, as being the most beautiful, scarce, cleanly, divisible, and pure of all metals.

The degrees of goodness are expressed in gold by carats; and in silver by pennyweights, &c. For there are several reasons for not coining them pure and without alloy, viz. the great loss and expence in refining them, the necessity of hardening them to make them more durable, and the scarcity of gold and silver in most countries. See ALLOY.

Among the ancient Britons, iron rings, or, as some say, iron plates, were used for money; among the Lacedemonians, iron bars quenched with vinegar, that they might not serve for any other use. Seneca observes, that there was anciently stamped money of leather, *corium forma publica impressum*. And the same thing was put in practice by Frederic II. at the siege of Milan; to say nothing of an old tradition among ourselves, that in the confused times of the barons wars the like was done in England: but the Hollanders, we know, coined great quantities of pasteboard in the year 1574.

As to the form of money, it has been more various than the matter. Under this are comprehended the weight, figure, impression, and value.

For the impression, the Jews, though they detested images, yet stamped on the one side of their shekel the golden pot which held the manna, and on the other Aaron's rod. The Dardans stamped two cocks fighting. The Athenians stamped their coins with an owl, or an ox; whence the proverb on bribed lawyers, *Bos in lingua*. They of Ægina, with a tortoise; whence that other saying, *Virtutem et sapientiam vincunt testudines*. Among the Romans, the monetarii sometimes impressed the images of men that had been eminent in their families on the coins: but no living man's head was ever stamped on a Roman coin till after the fall of the commonwealth. From that time they bore the emperor's head on one side. From this time the practice of stamping the prince's image on coins has obtained among all civilized nations; the Turks and other Mahometans alone excepted, who, in detestation of images, inscribe only the prince's name, with the year of the transmigration of their prophet.

As to the figure, it is either round, as in Britain; multangular or irregular, as in Spain; square, as in some parts of the Indies; or nearly globular, as in most of the rest.

After the arrival of the Romans in this island, the Britons imitated them, coining both gold and silver with the images of their kings stamped on them. When the Romans had subdued the kings of the Britons, they also suppressed their coins, and brought in their own; which were current here from the time of Claudius to that of Valentinian the younger, about the space of 500 years.

Mr Camden observes, that the most ancient English coin he had known was that of Ethelbert king of Kent, the first Christian king in the island; in whose time all money accounts begin to pass by the names of *pounds*, *shillings*, *pence*, and *mancuses*. Pence seems borrowed from the Latin *pecunia*, or rather from *pendo*, on account of its just weight, which was about threepence of our money. These were coarsely stamped with the king's image on the one side, and either the mint-master's, or the city's where it was coined, on the other. Five of these pence made their schilling, probably so called from *scilingus*, which the Romans used for the fourth part of an ounce. Forty of these schillings made their pound; and 400 of these pounds were a legacy, or a portion for a king's daughter, as appears by the last will of King Alfred. By these names they translated all sums of money in their old English testament; talents by *pundes*; Judas's thirty pieces of silver by *thirtig scillinga*; tribute money, by *penining*; the mite by *feorthling*.

But it must be observed, they had no other real money, but pence only; the rest being imaginary moneys, i. e. names of numbers or weights. Thirty of these pence made a mancus, which some take to be the same with a mark; manca, as appears by an old MS. was *quinta pars unciæ*. These mancas or mancuses were reckoned both in gold and silver. For in the year 680 we read that Ina king of the West Saxons obliged the Kentishmen to buy their peace at the price of 30,000 mancas of gold. In the notes on King Canute's laws, we find this distinction, that *mancusa* was as much as a mark of silver, and *manca*, a square piece of gold, valued at 30 pence.

The Danes introduced a way of reckoning money by ores, *per oras*, mentioned in Domesday book; but whether they were a several coin, or a certain sum, does not plainly appear. This, however, may be gathered from the Abbey book of Burton, that 20 ores were equivalent to two marks. They had also a gold coin called *byzantine*, or *bezant*, as being coined at Constantinople, then called *Byzantium*. The value of which coin is not only now lost, but was so entirely forgot even in the time of King Edward III. that whereas the bishop of Norwich was fined a byzantine of gold to be paid the abbot of St Edmund's Bury for infringing his liberties (as it had been enacted by parliament in the time of the Conqueror), no man then living could tell how much it was; so it was referred to the king to rate how much he should pay. Which is the more unaccountable, because but 100 years before, 200,000 bezants were exacted by the soldan for the ransom of St Louis of France: which were then valued at 100,000 livres.

Though the coining of money be a special prerogative of the king, yet the ancient Saxon princes communicated it to their subjects; insomuch that in every good town there was at least one mint; but at London

don eight; at Canterbury four for the king, two for the archbishop, one for the abbot at Winchester, six at Rochester, at Hastings two, &c.

The Norman kings continued the same custom of coining only pence, with the prince's image on one side, and on the other the name of the city where it was coined, with a cross so deeply impressed, that it might be easily parted and broke into two halves, which, so broken, they called *halfpence;* or into four parts, which they called *fourthings* or *farthings*.

In the time of King Richard I. money coined in the east parts of Germany came in special request in England on account of its purity, and was called *easterling money*, as all the inhabitants of those parts were called *Easterlings*. And shortly after, some of those people skilled in coining were sent for hither, to bring the coin to perfection; which since has been called *sterling* for *Easterling*. See STERLING.

King Edward I. who first adjusted the measure of an ell by the length of his arm, herein imitating Charles the Great, was the first also who established a certain standard for the coin, which is expressed to this effect by Greg. Rockley, mayor of London, and mint-master.—" A pound of money containeth twelve ounces: in a pound there ought to be eleven ounces, two easterlings, and one farthing; the rest alloy. The said pound ought to weigh twenty shillings and three pence in account and weight. The ounce ought to weigh twenty pence, and a penny twenty-four grains and a half. Note, That eleven ounces two pence sterling ought to be of pure silver, called *leaf silver;* and the minter must add of other weight seventeen pence halfpenny farthing, if the silver be so pure."

About the year 1320, the states of Europe first began to coin gold; and among the rest, our King Edward III. The first pieces he coined were called *florences*, as being coined by Florentines: afterwards he coined nobles; then rose-nobles, current at 6s. 8d. half nobles called *half pennies*, at 3s. 4d. of gold; and quarters at 20d. called *farthings of gold*. The succeeding kings coined rose-nobles, and double rose-nobles, great sovereigns, and half Henry nobles, angels, and shillings.

King James I. coined units, double crowns, Britain crowns: then crowns, half-crowns, &c.

2. *Comparative value of Money and Commodities at different periods*. The English money, though the same names do by no means correspond with the same quantity of precious metal as formerly, has not changed so much as the money of most other countries. From the time of William the Conqueror, the proportion between the pound, the shilling, and the penny, seems to have been uniformly the same as at present.

Edward III. as already mentioned, was the first of our kings that coined any gold; and no copper was coined by authority before James I. These pieces were not called farthings, but *farthing tokens*, and all people were at liberty to take or refuse them. Before the time of Edward III. gold was exchanged, like any other commodity, by its weight; and before the time of James I. copper was stamped by any one person who chose to do it.

In the year 712 and 727, an ewe and lamb were rated at 1s. Saxon money till a fortnight after Easter. Between the years 900 and 1000, two hydes of land, each containing about 120 acres, were sold for 100 shillings. In 1000, by King Ethelred's laws, a horse was rated at 30s. a mare or a colt of a year old, at 20s. a mule or young ass, at 12s. an ox at 30s. a cow at 24s. a swine at 8d. a sheep at 1s In 1043, a quarter of wheat was sold for 60d. Hence it is computed, that in the Saxon times there was ten times less money, in proportion to commodities, than at present. Their nominal specie, therefore, being about three times higher than ours, the price of every thing, according to our present language, must be reckoned thirty times cheaper than it is now.

In the reign of William the Conqueror, commodities were ten times cheaper than they are at present; from which we cannot help forming a very high idea of the wealth and power of that king: for his revenue was 400,000l. per annum, every pound being equal to that weight of silver, consequently the whole may be estimated at 1,200,000l. of the present computation; a sum which, considering the different value of money between that period and the present, was equivalent to 12,000,000l. of modern estimation.

The most necessary commodities do not seem to have advanced their price from William the Conqueror to Richard I.

The price of corn in the reign of Henry III. was near half the mean price in our times. Bishop Fleetwood has shown, that in the year 1240, which was in this reign, 4l. 13s. 9d. was worth about 50l. of our present money. About the latter end of this reign, Robert de Hay, rector of Souldern, agreed to receive 100s. to purchase to himself and successor the annual rents of 5s. in full compensation of an acre of corn.

Butchers meat, in the time of the great scarcity in the reign of Edward II. was, by a parliamentary ordinance, sold three times cheaper than our mean price at present; poultry somewhat lower, because being now considered as a delicacy, it has risen beyond its proportion. The mean price of corn at this period was half the present value, and the mean price of cattle one eighth.

In the next reign, which was that of Edward III. the most necessary commodities were in general about three or four times cheaper than they are at present.

In these times, knights, who served on horseback in the army, had 2s. a day, and a foot archer 6d. which last would now be equal to a crown a-day. This pay has continued nearly the same nominally (only that in the time of the commonwealth the pay of the horse was advanced to 2s. 6d. and that of the foot 1s. though it was reduced again at the Restoration), but soldiers were proportionably of a better rank formerly.

In the time of Henry VI. corn was about half its present value, other commodities much cheaper. Bishop Fleetwood has determined, from a most accurate consideration of every circumstance, that 3l. in this reign was equivalent to 28l. or 30l. now.

In the time of Henry VII. many commodities were three times as cheap here, and in all Europe, as they are at present, there having been a great increase of gold and silver in Europe since his time occasioned by the discovery of America.

The commodities whose price has risen the most since before the time of Henry VII. are butchers meat, fowls,

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fowls, and fish, especially the latter. And the reason why corn was always much dearer in proportion to other eatables, according to their prices at present, is, that in early times agriculture was little understood. It required more labour and expence, and was more precarious than it is at present. Indeed, notwithstanding the high price of corn in the times we are speaking of, the raising of it so little answered the expence, that agriculture was almost universally quitted for grazing; which was more profitable, notwithstanding the low price of butchers meat. So that there was constant occasion for statutes to restrain grazing, and to promote agriculture; and no effectual remedy was found till the bounty upon the exportation of corn; since which, above ten times more corn has been raised in this country than before.

The price of corn in the time of James I. and consequently that of other necessaries of life, was not lower, but rather higher, than at present: wool is not two thirds of the value it was then; the finer manufactures having sunk in price by the progress of art and industry, notwithstanding the increase of money. Butchers meat was higher than at present. Prince Henry made an allowance of near 4d. per pound for all the beef and mutton used in his family. This may be true with respect to London; but the price of butchers meat in the country, which does not even now much exceed this price at a medium, has certainly greatly increased of late years, and particularly in the northern counties.

The prices of commodities are higher in England than in France; besides that the poor people of France live upon much less than the poor in England, and their armies are maintained at less expence. It is computed by Mr Hume, that a British army of 20,000 men is maintained at near as great an expence as 60,000 in France, and that the English fleet, in the war of 1741, required as much money to support it as all the Roman legions in the time of the emperors. However, all that we can conclude from this is, that money is much more plentiful in Europe at present than it was in the Roman empire.

In the 13th century, the common interest which the Jews had for their money, Voltaire says, was 20 per cent. But with regard to this, we must consider the great contempt that nation was always held in, the large contributions they were frequently obliged to pay, the risk they ran of never receiving the principal, the frequent confiscations of all their effects, and the violent persecutions to which they were exposed; in which circumstances it was impossible for them to lend money at all, unless for most extravagant interest, and much disproportioned to its real value. Before the discovery of America, and the plantation of our colonies, the interest of money was generally 12 per cent. all over Europe; and it has been growing gradually less since that time, till it is now generally about four or five.

When sums of money are said to be raised by a whole people, in order to form a just estimate of it, we must take into consideration not only the quantity of the precious metal according to the standard of the coin, and the proportion of the quantity of coin to the commodities, but also the number and riches of the people who raise it; for populous and rich countries will much more easily raise any certain sum of money than one that is thinly inhabited, and chiefly by poor people. This circumstance greatly adds to our surprise at the vast sums of money raised by William the Conqueror, who had a revenue nearly in value equal to 12,000,000l. of our money (allowance being made for the standard of coin and the proportion it bore to the commodities), from a country not near so populous or rich as England is at present. Indeed, the accounts historians give us of the revenues of this prince, and the treasure he left behind him, are barely credible.

II. *Imaginary Money*, or *Money of Account*, is that which has never existed, or at least which does not exist in real specie, but is a denomination invented or retained to facilitate the stating of accounts, by keeping them still on a fixed footing, not to be changed, like current coins, which the authority of the sovereign raises or lowers according to the exigencies of the state. Of which kind are pounds, livres, marks, maravedies, &c. See the annexed Table, where the fictitious money is distinguished by a dagger (†).

Moneys of Account among the Ancients.—1. The Grecians reckoned their sums of money by *drachma*, *minæ*, and *talenta*. The drachma was equal to $7\frac{3}{4}$d. sterling; 100 drachmæ made the mina, equal to 3l. 4s. 7d. sterling; 60 minæ made the talent, equal to 193l. 15s. sterling; hence 100 talents amounted to 19,375l. sterling. The mina and talentum, indeed, were different in different provinces: their proportions in Attic drachms are as follow: The Syrian mina contained 25 Attic drachms; the Ptolemaic $33\frac{1}{3}$; the Antiochic and Eubœan 100; the Babylonic 116; the greater Attic and Tyrian $133\frac{1}{3}$; the Æginean and Rhodian $166\frac{2}{3}$. The Syrian talent contained 15 Attic minæ; the Ptolemaic 20; the Antiochic 60; the Eubœan 60; the Babylonic 70; the greater Attic and Tyrian 80; the Æginean and Rhodian 100.

2. Roman moneys of account were the *sestertius* and *sestertium*. The sestertius was equal to 1d. $3\frac{1}{2}$q. sterling. One thousand of these made the sestertium, equal to 8l. 1s. 5d. 2q. sterling. One thousand of these sestertia made the decies sestertium (the adverb *centies* being always understood) equal to 8072l. 18s. 4d. sterling. The decies sestertium they also called *decies centena millia nummum*. Centies sestertium, or centies HS, were equal to 80,729l. 3s. 4d. Millies HS to 807,291l. 13s. 4d. Millies centies HS to 888,020l. 16s. 8d.

Theory of Money.

1. *Of Artificial or Material Money.*

I. As far back as our accounts of the transactions of mankind reach, we find they had adopted the precious metals, that is, silver and gold, as the common measure of value, and as the adequate equivalent for every thing alienable.

The metals are admirably adapted for this purpose: they are perfectly homogeneous: when pure, their masses, or bulks, are exactly in proportion to their weights; no physical difference can be found between two pounds of gold, or silver, let them be the production of the mines of Europe, Asia, Africa, or America: they are perfectly malleable, fusible, and suffer the

the moſt exact diviſion which human art is capable to give them: they are capable of being mixed with one another, as well as with metals of a baſer, that is, of a leſs homogeneous nature, ſuch as copper: by this mixture they ſpread themſelves uniformly through the whole maſs of the compoſed lump, ſo that every atom of it becomes proportionally poſſeſſed of a ſhare of this noble mixture; by which means the ſubdiviſion of the precious metals is rendered very extenſive.

Their phyſical qualities are invariable: they loſe nothing by keeping; they are ſolid and durable; and though their parts are ſeparated by friction, like every other thing, yet ſtill they are of the number of thoſe which ſuffer leaſt by it.

If money, therefore, can be made of any thing, that is, if the proportional value of things vendible can be meaſured by any thing material, it may be meaſured by the metals.

II. The two metals being pitched upon as the moſt proper ſubſtances for realizing the ideal ſcale of money, thoſe who undertake the operation of adjuſting a ſtandard, muſt conſtantly keep in their eye the nature and qualities of a ſcale, as well as the principles upon which it is formed.

The unit of the ſcale muſt conſtantly be the ſame, although realized in the metals, or the whole operation fails in the moſt eſſential part. This realizing the unit is like adjuſting a pair of compaſſes to a geometrical ſcale, where the ſmalleſt deviation from the exact opening once given muſt occaſion an incorrect meaſure. The metals, therefore, are to money what a pair of compaſſes is to a geometrical ſcale.

This operation of adjuſting the metals to the money of account implies an exact and determinate proportion of both metals to the money unit, realized in all the ſpecies and denominations of coin, adjuſted to that ſtandard.

The ſmalleſt particle of either metal added to, or taken away from, any coins, which repreſent certain determinate parts of the ſcale, overturns the whole ſyſtem of material money. And if, notwithſtanding ſuch variation, theſe coins continue to bear the ſame denominations as before, this will as effectually deſtroy their uſefulneſs in meaſuring the value of things, as it would overturn the uſefulneſs of a pair of compaſſes, to ſuffer the opening to vary, after it is adjuſted to the ſcale repreſenting feet, toiſes, miles, or leagues, by which the diſtances upon the plan are to be meaſured.

III. Debaſing the ſtandard is a good term, becauſe it conveys a clear and diſtinct idea. It is diminiſhing the weight of the pure metal contained in that denomination by which a nation reckons, and which we have called the *money unit.* Raiſing the ſtandard requires no farther definition, being the direct contrary.

IV. Altering the ſtandard (that is, raiſing or debaſing the value of the money unit) is like altering the national meaſures or weights. This is beſt diſcovered by comparing the thing altered with things of the ſame nature which have ſuffered no alteration. Thus, if the foot of meaſure was altered at once over all England, by adding to it, or taking from it, any proportional part of its ſtandard length, the alteration would be beſt diſcovered by comparing the new foot with that of Paris, or of any other country, which had ſuffered no alteration. Juſt ſo, if the pound ſterling, which is the Engliſh unit, ſhall be found anyhow changed, and if the variation it has met with be difficult to aſcertain becauſe of a complication of circumſtances, the beſt way to diſcover it, will be to compare the former and the preſent value of it with the money of other nations which has ſuffered no variation. This the courſe of exchange will perform with the greateſt exactneſs.

V. Artiſts pretend, that the precious metals, when abſolutely pure from any mixture, are not of ſufficient hardneſs to conſtitute a ſolid and laſting coin. They are found alſo in the mines mixed with other metals of a baſer nature; and the bringing them to a ſtate of perfect purity occaſions an unneceſſary expence. To avoid, therefore, the inconvenience of employing them in all their purity, people have adopted the expedient of mixing them with a determinate proportion of other metals, which hurts neither their fuſibility, malleability, beauty, nor luſtre. This metal is called *alloy:* and, being conſidered only as a ſupport to the principal metal, is accounted of no value in itſelf. So that eleven ounces of gold, when mixed with one ounce of ſilver, acquires by that addition no augmentation of value whatever.

This being the caſe, we ſhall, as much as poſſible, overlook the exiſtence of alloy, in ſpeaking of money, in order to render language leſs ſubject to ambiguity.

2. *Incapacities of the Metals to perform the Office of an invariable Meaſure of Value.*

I. Were there but one ſpecies of ſuch a ſubſtance as we have repreſented gold and ſilver to be; were there but one metal poſſeſſing the qualities of purity, diviſibility, and durability; the inconveniences in the uſe of it for money would be fewer by far than they are found to be as matters ſtand.

Such a metal might then, by an unlimited diviſion into parts exactly equal, be made to ſerve as a tolerably ſteady and univerſal meaſure. But the rivalſhip between the metals, and the perfect equality which is found between all their phyſical qualities, ſo far as regards purity and diviſibility, render them ſo equally well adapted to ſerve as the common meaſure of value, that they are univerſally admitted to paſs current as money.

What is the conſequence of this? that the one meaſures the value of the other, as well as that of every other thing. Now the moment any meaſure begins to be meaſured by another, whoſe proportion to it is not phyſically, perpetually, and invariably the ſame, all the uſefulneſs of ſuch a meaſure is loſt. An example will make this plain.

A foot of meaſure is a determinate length. An Engliſh foot may be compared with the Paris foot, or with that of the Rhine; that is to ſay, it may be meaſured by them: and the proportion between their lengths may be expreſſed in numbers, which proportion will be the ſame perpetually. The meaſuring the one by the other will occaſion no uncertainty; and we may ſpeak of length by Paris feet, and be be perfectly well underſtood by others who are uſed to meaſure by the Engliſh foot, or by the foot of the Rhine.

But ſuppoſe that a youth of 12 years old takes it into his head to meaſure from time to time, as he advances in age, by the length of his own foot, and that he divides this growing foot into inches and decimals: what can be learned from his account of meaſures? As he increaſes in years, his foot, inches, and ſubdiviſions, will be gradually lengthening; and were every man to follow his example, and meaſure by his own foot, then the foot of a meaſure now eſtabliſhed would totally ceaſe to be of any utility.

This is juſt the caſe with the two metals. There is no determinate invariable proportion between their value; and the conſequence of this is, that when they are both taken for meaſuring the value of other things, the things to be meaſured, like lengths to be meaſured by the young man's foot, without changing their relative proportion between themſelves, change, however, with reſpect to the denominations of both their meaſures. An example will make this plain.

Let us ſuppoſe an ox to be worth 3000 pounds weight of wheat, and the one and the other to be worth an ounce of gold, and an ounce of gold to be worth exactly 15 ounces of ſilver: if the caſe ſhould happen, that the proportional value between gold and ſilver ſhould come to be as 14 is to 1, would not the ox, and conſequently the wheat, be eſtimated at leſs in ſilver, and more in gold, than formerly? Farther, Would it be in the power of any ſtate to prevent this variation in the meaſure of the value of oxen and wheat, without putting into the unit of their money leſs ſilver and more gold than formerly?

If therefore any particular ſtate ſhould fix the ſtandard of the unit of their money to one ſpecies of the metals, while in fact both the one and the other are actually employed in meaſuring value; does not ſuch a ſtate reſemble the young man who meaſures all by his growing foot? For if ſilver, for example, be retained as the ſtandard, while it is gaining upon gold one fifteenth additional value; and if gold continue all the while to determine the value of things as well as ſilver; it is plain, that, to all intents and purpoſes, this ſilver meaſure is lengthening daily like the young man's foot, ſince the ſame weight of it muſt become every day equivalent to more and more of the ſame commodity; notwithſtanding that we ſuppoſe the ſame proportion to ſubſiſt, without the leaſt variation, between that commodity and every other ſpecies of things alienable.

Buying and ſelling are purely conventional, and no man is obliged to give his merchandiſe at what may be ſuppoſed to be the proportion of its worth. The uſe, therefore, of an univerſal meaſure, is to mark, not only the relative value of the things to which it is applied as a meaſure, but to diſcover in an inſtant the proportion between the value of thoſe, and of every other commodity valued by a determinate meaſure in all the countries of the world.

Were pounds ſterling, livres, florins, piaſtres, &c. which are all money of account, invariable in their values, what a facility would it produce in all converſions! what an aſſiſtance to trade! But as they are all limited or fixed to coins, and conſequently vary from time to time, this example ſhows the utility of the invariable meaſure which we have deſcribed.

There is another circumſtance which incapacitates the metals from performing the office of money; the ſubſtance of which the coin is made, is a commodity which riſes and ſinks in its value with reſpect to other commodities, according to the wants, competition, and caprices of mankind. The advantage, therefore, found in putting an intrinſic value into that ſubſtance which performs the function of money of account, is compenſated by the inſtability of that intrinſic value; and the advantage obtained by the ſtability of paper, or ſymbolical money, is compenſated by the defect it commonly has of not being at all times ſuſceptible of realization into ſolid property or intrinſic value.

In order, therefore, to render material money more perfect, this quality of metal, that is, of a commodity, ſhould be taken from it; and in order to render paper money more perfect, it ought to be made to circulate upon metallic or land ſecurity.

II. There are ſeveral ſmaller inconveniences accompanying the uſe of the metals, which we ſhall here ſhortly enumerate.

1mo, No money made of gold or ſilver can circulate long, without loſing its weight, although it all along preſerves the ſame denomination. This repreſents the contracting a pair of compaſſes which had been rightly adjuſted to the ſcale.

2do, Another inconvenience proceeds from the fabrication of money. Suppoſing the faith of princes who coin money to be inviolable, and the probity as well as capacity of thoſe to whom they commit the inſpection of the buſineſs of the metals to be ſufficient, it is hardly poſſible for workmen to render every piece exactly of a proper weight, or to preſerve the due proportion between pieces of different denominations; that is to ſay, to make every ten ſixpences exactly of the ſame weight with every crown piece and every five ſhillings ſtruck in a coinage. In proportion to ſuch inaccuracies, the parts of the ſcale become unequal.

3tio, Another inconvenience, and far from being inconſiderable, flows from the expence requiſite for the coining of money. This expence adds to its value as a manufacture, without adding any thing to its weight.

4to, The laſt inconvenience is, that by fixing the money of account entirely to the coin, without having any independent common meaſure, (to mark and controul theſe deviations from mathematical exactneſs, which are either inſeparable from the metals themſelves, or from the fabrication of them), the whole meaſure of value, and all the relative intereſts of debtors and creditors, become at the diſpoſal not only of workmen in the mint, of Jews who deal in money, of clippers and waſhers in coin; but they are alſo entirely at the mercy of princes who have the right of coinage, and who have frequently alſo the right of raiſing or debaſing the ſtandard of the coin, according as they find it moſt for their preſent and temporary intereſt.

3. *Methods which may be propoſed for leſſening the ſeveral Inconveniences to which Material Money is liable.*

The inconveniences from the variation in the relative

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value of the metals to one another, may in ſome meaſure be obviated by the following expedients.

1mo, By conſidering one only as the ſtandard, and leaving the other to ſeek its own value like any other commodity.

2do, By conſidering one only as the ſtandard, and fixing the value of the other from time to time by authority, according as the market price of the metals ſhall vary.

3tio, By fixing the ſtandard of the unit according to the mean proportion of the metals, attaching it to neither; regulating the coin accordingly; and upon every conſiderable variation in the proportion between them, either to make a new coinage, or to raiſe the denomination of one of the ſpecies, and lower it in the other, in order to preſerve the unit exactly in the mean proportion between the gold and ſilver.

4to, To have two units and two ſtandards, one of gold and one of ſilver, and to allow every body to ſtipulate in either.

5to, Or laſt of all, To oblige all debtors to pay one half in gold, and one half in the ſilver ſtandard.

4. *Variations to which the Value of the Money unit is expoſed from every Diſorder in the Coin.*

Let us ſuppoſe, at preſent, the only diſorder to conſiſt in a want of the due proportion between the gold and ſilver in the coin.

This proportion can only be eſtabliſhed by the market price of the metals; becauſe an augmentation and riſe in the demand for gold or ſilver has the effect of augmenting the value of the metal demanded. Let us ſuppoſe, that to-day one pound of gold may buy fifteen pounds of ſilver: If to-morrow there be a high demand for ſilver, a competition among merchants to have ſilver for gold will enſue: they will contend who ſhall get the ſilver at the rate of 15 pounds for one of gold: this will raiſe the price of it; and in proportion to their views of profit, ſome will accept of leſs than the 15 pounds. This is plainly a riſe in the ſilver, more properly than a fall in the gold; becauſe it is the competition for the ſilver which has occaſioned the variation in the former proportion between the metals.

Let us now ſuppoſe, that a ſtate, having with great exactneſs examined the proportion of the metals in the market, and having determined the preciſe quantity of each for realizing or repreſenting the money unit, ſhall execute a moſt exact coinage of gold and ſilver coin. As long as that proportion continues unvaried in the market, no inconvenience can reſult from that quarter in making uſe of metals for money of account.

But let us ſuppoſe the proportion to change: that the ſilver, for example, ſhall riſe in its value with regard to gold: will it not follow, from that moment, that the unit realized in the ſilver, will become of more value than the unit realized in the gold coin?

But as the law has ordered them to paſs as equivalents for one another, and as debtors have always the option of paying in what legal coin they think fit, will they not all chooſe to pay in gold; and will not then the ſilver coin be melted down or exported, in order to be ſold as bullion, above the value it bears when it circulates in coin? Will not this paying in gold alſo really diminiſh the value of the money unit, ſince upon this variation every thing muſt ſell for more gold than before, as we have already obſerved.

Conſequently, merchandiſes, which have not varied in their relative value to any other thing but to gold and ſilver, muſt be meaſured by the mean proportion of the metals: and the application of any other meaſure to them is altering the ſtandard. If they are meaſured by the gold, the ſtandard is debaſed; if by ſilver, it is raiſed.

If, to prevent the inconvenience of melting down the ſilver, the ſtate ſhall give up affixing the value of their unit to both ſpecies at once, and ſhall fix it to one, leaving the other to ſeek its price as any other commodity; in that caſe, no doubt, the melting down of the coin will be prevented; but will this ever reſtore the value of the money unit to its former ſtandard? Would it, for example, in the foregoing ſuppoſition, raiſe the debaſed value of the money unit in the gold coin, if that ſpecies were declared to be the ſtandard? It would indeed render ſilver coin purely a merchandiſe, and, by allowing it to ſeek its value, would certainly prevent it from being melted down as before; becauſe the pieces would riſe conventionally in their denomination; or an *agio*, as it is called, would be taken in payments made in ſilver; but the gold would not, on that account, riſe in its value, or begin to purchaſe any more merchandiſe than before. Were therefore the ſtandard fixed to the gold, would not this be an arbitrary and a violent revolution in the value of the money unit, and a debaſement of the ſtandard?

If, on the other hand, the ſtate ſhould fix the ſtandard to the ſilver, which we ſuppoſe to have riſen in its value, would that ever ſink the advanced value which the ſilver coin had gained above the worth of the former ſtandard unit? and would not this be a violent and an arbitrary revolution in the value of the money unit, and a raiſing of the ſtandard?

The only expedient, therefore, is, in ſuch a caſe, to fix the numerary unit to neither of the metals, but to contrive a way to make it fluctuate in a mean proportion between them; which is in effect the introduction of a pure ideal money of account.

The regulation of fixing the unit by the mean proportion, ought to take place at the inſtant the ſtandard unit is fixed with exactneſs both to the gold and ſilver. If it be introduced long after the market proportion between the metal has deviated from the proportion eſtabliſhed in the coin; and if the new regulation is made to have a retroſpect, with regard to the acquitting of permanent contracts entered into while the value of the money unit had attached itſelf to the loweſt currency in conſequence of the principle above laid down; then the reſtoring the money unit to that ſtandard where it ought to have remained (to wit, to the mean proportion) is an injury to all debtors, who have contracted ſince the time that the proportion of the metals began to vary.

This is clear from the former reaſoning. The moment the market price of the metals differs from that in the coin, every one who has payments to make, pays in that ſpecies which is the higheſt rated in the coin; conſequently, he who lends, lends in that ſpecies. If after the contract, therefore, the unit is carried

ried up to the mean proportion, this muſt be a loſs to him who had borrowed.

From this we may perceive, why there is leſs inconvenience from the varying of the proportion of the metals, where the ſtandard is fixed to one of them, than when it is fixed to both. In the firſt caſe, it is at leaſt uncertain whether the ſtandard or the merchandiſe ſpecies is to riſe; conſequently, it is uncertain whether the debtors or the creditors are to gain by a variation. If the ſtandard ſpecies ſhould riſe, the creditors will gain; if the merchandiſe ſpecies riſes, the debtors will gain; but when the unit is attached to both ſpecies, then the creditors never can gain, let the metals vary as they will; if ſilver riſes, then debtors will pay in gold; if gold riſes, the debtors will pay in ſilver. But whether the unit be attached to one or to both ſpecies, the infallible conſequence of a variation is, that one half of the difference is either gained or loſt by debtors and creditors. The invariable unit is conſtantly the mean proportional between the two meaſures.

5. *How the Variations of the intrinſic value of the Unit of Money muſt affect all the domeſtic Intereſts of a Nation.*

If the changing the content of the buſhel by which grain is meaſured, would affect the intereſt of thoſe who are obliged to pay, or who are entitled to receive, a certain number of buſhels of grain for the rent of lands; in the ſame manner muſt every variation in the value of the unit of account affect all perſons who, in permanent contracts, are obliged to make payments, or who are obliged to receive ſums of money ſtipulated in multiples or in fractions of that money unit.

Every variation, therefore, upon the intrinſic value of the money unit, has the effect of benefiting the claſs of creditors at the expence of debtors, or *vice verſa*.

This conſequence is deduced from an obvious principle. Money is more or leſs valuable in proportion as it can purchaſe more or leſs of every kind of merchandiſe. Now, without entering anew into the cauſes of the riſe and fall of prices, it is agreed upon all hands, that whether an augmentation of the general maſs of money in circulation has the effect of raiſing prices in general or not, any augmentation of the quantity of the metals appointed to be put into the money unit, muſt at leaſt affect the value of that money unit, and make it purchaſe more of any commodity than before: that is to ſay, 113 grains of fine gold, the preſent weight of a pound ſterling in gold, can buy 113 pounds of flour; were the pound ſterling raiſed to 114 grains of the ſame metal, it would buy 114 pounds of flour; conſequently, were the pound ſterling augmented by one grain of gold, every miller who paid a rent of ten pounds a-year, would be obliged to ſell 1140 pounds of his flour, in order to procure ten pounds to pay his rent, in place of 1130 pounds of flour, which he ſold formerly to procure the ſame ſum; conſequently, by this innovation, the miller muſt loſe yearly ten pounds of flour, which his maſter conſequently muſt gain. From this example, it is plain, that every augmentation of metals put into the pound ſterling, either of ſilver or gold, muſt imply an advantage to the whole claſs of creditors who are paid in pounds ſterling, and conſequently muſt be a proportional loſs to all debtors who muſt pay by the ſame denomination.

6. *Of the Diſorder in the Britiſh Coin, ſo far as it occaſions the melting down or the exporting of the Specie.*

The defects in the Britiſh coin are three.

1mo, The proportion between the gold and ſilver in it is found to be as 1 to $15\frac{2}{10}$, whereas the market price may be ſuppoſed to be nearly as 1 to $14\frac{1}{2}$.

2do, Great part of the current money is worn and light.

3tio, From the ſecond defect proceeds the third, to wit, that there are ſeveral currencies in circulation which paſs for the ſame value, without being of the ſame weight.

4to, From all theſe defects reſults the laſt and greateſt inconvenience, to wit, that ſome innovation muſt be made, in order to ſet matters on a right footing.

The Engliſh, beſides the unit of their money which they call the pound ſterling, have alſo the unit of their weight for weighing the precious metals.

This is called the *pound troy*, and conſiſts of 12 ounces, every ounce of 20 pennyweights, and every pennyweight of 24 grains. The pound troy, therefore, conſiſts of 240 pennyweights and 5760 grains.

The fineneſs of the ſilver is reckoned by the number of ounces and pennyweights of the pure metal in the pound troy of the compoſed maſs; or, in other words, the pound troy, which contains 5760 grains of ſtandard ſilver, contains 5328 grains of fine ſilver, and 432 grains of copper, called *alloy*.

Thus ſtandard ſilver is 11 ounces 2 pennyweights of fine ſilver in the pound troy to 18 pennyweights copper, or 111 parts fine ſilver to nine parts alloy.

Standard gold is 11 ounces fine to 1 ounce ſilver or copper employed for alloy, which together make the pound troy; conſequently, the pound troy of ſtandard gold contains 5280 grains fine, and 480 grains alloy, which alloy is reckoned of no value.

This pound of ſtandard ſilver is ordered, by ſtatute of the 43d of Elizabeth, to be coined into 62 ſhillings, 20 of which make the pound ſterling; conſequently, the 20 ſhillings contain 1718.7 grains of fine ſilver, and 1858.06 ſtandard ſilver.

The pound troy of ſtandard gold, $\frac{11}{12}$ fine, is ordered, by an act of King Charles II. to be cut into $44\frac{1}{2}$ guineas: that is to ſay, every guinea contains 129.43 grains of ſtandard gold, and 118.644 of fine gold; and the pound ſterling, which is $\frac{20}{21}$ of the guinea, contains 112.994, which we may ſtate at 113 grains of fine gold.

The coinage in England is entirely defrayed at the expence of the ſtate. The mint price for the metals is the very ſame with the price of the coin. Whoever carries to the mint an ounce of ſtandard ſilver, receives for it in ſilver coin 5s. 2d. or 62d.: whoever carries an ounce of ſtandard gold receives in gold coin 3l. 17s. $10\frac{1}{2}$d. the one and the other making exactly an ounce of the ſame fineneſs with the bullion. Coin, therefore, can

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have no value in the market above bullion; consequently, no loss can be incurred by those who melt it down.

When the guinea was first struck, the government (not inclining to fix the pound sterling to the gold coin of the nation) fixed the guinea at 20 shillings, (which was then below its proportion to the silver), leaving it to seek its own price above that value, according to the course of the market.

By this regulation no harm was done to the English silver standard; because the guinea, or 118.644 grains fine gold, being worth more, at that time, than 20 shillings, or 1718.7 grains fine silver, no debtor would pay with gold at its standard value; and whatever it was received for above that price was purely conventional.

Accordingly guineas sought their own price until the year 1728, that they were fixed a-new, not below their value as at first, but at what was then reckoned their exact value, according to the proportion of the metals, viz. at 21 shillings; and at this they were ordered to pass current in all payments.

This operation had the effect of making the gold a standard as well as the silver. Debtors then paid indifferently in gold as well as in silver, because both were supposed to be of the same intrinsic as well as current value; in which case no inconvenience could follow upon this regulation. But in time silver came to be more demanded; the making of plate began to prevail more than formerly, and the exportation of silver to the East Indies increasing yearly, made the demand for it greater, or perhaps brought its quantity to be proportionally less than before. This changed the proportion of the metals; and by slow degrees they have come from that of 1 to 15.2 (the proportion they were supposed to have when the guineas were fixed and made a lawful money at 21 shillings) to that of 14.5, the present *supposed* proportion.

The consequence of this has been, that the same guinea which was worth 1804.6 grains fine silver, at the time it was fixed at 21s. is now worth no more than 1719.9 grains of fine silver according to the proportion of $14\frac{1}{2}$ to 1.

Consequently debtors, who have always the option of the legal species in paying their debts, will pay pounds sterling no more in silver but in gold; and as the gold pounds they pay in are not intrinsically worth the silver pounds they paid in formerly according to the statute of Elizabeth, it follows that the pound sterling in silver is really no more the standard, since nobody will pay at that rate, and since nobody can be compelled to do it.

Besides this want of proportion between the metals, the silver coined before the reign of George I. is now become light by circulation; and the guineas coined by all the princes since Charles II. pass by tale, though many of them are considerably diminished in their weight.

Let us now examine what profit the want of proportion and the want of weight in the coin can afford to the money-jobbers in melting it down or exporting it.

Did every body consider coin only as the measure for reckoning value, without attending to its value as a metal, the deviations of gold and silver coin from perfect exactness, either as to proportion or weight, would occasion little inconvenience.

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Great numbers, indeed, in every modern society, consider coin in no other light than that of money of account; and have great difficulty to comprehend what difference any one can find between a light shilling and a heavy one, or what inconvenience there can possibly result from a guinea's being some grains of fine gold too light to be worth 21 shillings standard weight. And did every one think in the same way, there would be no occasion for coin of the precious metals at all; leather, copper, iron, or paper, would keep the reckoning as well as gold and silver.

But although there be many who look no farther than at the stamp on the coin, there are others whose sole business it is to examine its intrinsic worth as a commodity, and to profit of every irregularity in the weight and proportion of metals.

By the very institution of coinage, it is implied, that every piece of the same metal, and same denomination with regard to the money-unit, shall pass current for the same value.

It is, therefore, the employment of money-jobbers, to examine, with a scrupulous exactness, the precise weight of every piece of coin which comes into their hands.

The first object of their attention is, the price of the metals in the market: a jobber finds, at present, that with 14.5 pounds of fine silver bullion, he can buy one pound of fine gold bullion.

He therefore buys up with gold coin all the new silver as fast as it is coined, of which he can get at the rate of 15.2 pounds for one in gold; these 15.2 pounds silver coin he melts down into bullion, and converts that back into gold bullion, giving at the rate of only 14.5 pounds for one.

By this operation he remains with the value of $\frac{7}{10}$ of one pound weight of silver bullion clear profit upon the $15\frac{1}{2}$ pounds he bought; which $\frac{7}{10}$ is really lost by the man who inadvertently coined silver at the mint, and gave it to the money-jobber for his gold. Thus the state loses the expence of the coinage, and the public the convenience of change for their guineas.

But here it may be asked, Why should the money-jobber melt down the silver coin? can he not buy gold with it as well without melting it down? He cannot; because when it is in coin he cannot avail himself of its being new and weighty. Coin goes by tale, not by weight; therefore, were he to come to market with his new silver coin, gold bullion being sold at the mint price, we shall suppose, viz. at 3l. 17s. $10\frac{1}{2}$d. sterling money per ounce, he would be obliged to pay the price of what he bought with heavy money, which he can equally do with light.

He therefore melts down the new silver coin, and sells it for bullion, at so many pence an ounce; the price of which bullion is, in the English market, always above the price of silver at the mint, for the reasons now to be given.

When you sell standard silver bullion at the mint, you are to be paid in weighty money; that is, you receive for your bullion the very same weight in standard coin; the coinage costs nothing: but when you sell bullion in the market, you are paid in worn-out silver,

ſilver, in gold, in bank notes, in ſhort, in every ſpecies of lawful current money. Now all theſe payments have ſome defect: the ſilver you are paid with is worn and light; the gold you are paid with is overrated, and perhaps alſo light; and the bank notes muſt have the ſame value with the ſpecie with which the bank pays them; that is, with light ſilver or overrated gold.

It is for theſe reaſons, that ſilver bullion, which is bought by the mint at 5s. 2d. per ounce of heavy ſilver money, may be bought at market at 65 pence the ounce in light ſilver, overrated gold, or bank notes, which is the ſame thing.

Further, We have ſeen how the impoſition of coinage has the effect of raiſing coin above the value of bullion, by adding a value to it which it had not as a metal.

Juſt ſo, when the unit is once affixed to certain determined quantities of both metals, if one of the metals ſhould afterwards riſe in value in the market, the coin made of that metal muſt loſe a part of its value as coin, although it retains it as a metal. Conſequently, as in the firſt caſe it acquired an additional value by being coined, it muſt now acquire an additional value by being melted down. From this we may conclude, that when the ſtandard is affixed to both the metals in the coin, and when the proportion of that value is not made to follow the price of the market, that ſpecies which riſes in the market is melted down, and the bullion is ſold for a price as much exceeding the mint price as the metal has riſen in its value.

If, therefore, in England, the price of ſilver bullion is found to be at 65 pence the ounce, while at the mint it is rated at 62; this proves that ſilver has riſen $\frac{3}{65}$ above the proportion obſerved in the coin, and that all coin of ſtandard weight may conſequently be melted down with a profit of $\frac{3}{65}$. But as there are ſeveral other circumſtances to be attended to which regulate and influence the price of bullion, we ſhall here paſs them in review, the better to diſcover the nature of this diſorder in the Engliſh coin, and the advantages which money-jobbers may draw from it.

The price of bullion, like that of every other merchandiſe, is regulated by the value of the money it is paid with.

If bullion, therefore, ſells in England for 65 pence an ounce, paid in ſilver coin, it muſt ſell for 65 ſhillings the pound troy; that is to ſay, the ſhillings it is commonly paid with do not exceed the weight of $\frac{1}{65}$ of a pound troy: for if the 65 ſhillings with which the pound of bullion is paid weighed more than a pound troy, it would be a ſhorter and better way for him who wants bullion to melt down the ſhillings and make uſe of the metal, than to go to market with them in order to get leſs.

We may, therefore, be very certain, that no man will buy ſilver bullion at 65 pence an ounce, with any ſhilling which weighs above $\frac{1}{65}$ of a pound troy.

We have gone upon the ſuppoſition that the ordinary price of bullion in the Engliſh market is 65 pence per ounce. This has been done upon the authority of ſome late writers on this ſubject: it is now proper to point out the cauſes which may make it deviate from that value.

I. It may, and certainly will vary, in the price, according as the currency is better or worſe. When the expence of a war, or a wrong balance of trade, have carried off a great many heavy guineas, it is natural that bullion ſhould riſe; becauſe then it will be paid for more commonly in light gold and ſilver; that is to ſay, with pounds ſterling, below the value of 113 grains fine gold, the worth of the pound ſterling in new guineas.

II. This wrong balance of trade, or a demand for bullion abroad, becoming very great, may occaſion a ſcarcity of the metals in the market, as well as a ſcarcity of the coin; conſequently, an advanced price muſt be given for it in proportion to the greatneſs and height of the demand. In this caſe, both the ſpecie and the bullion muſt be bought with paper. But the riſe in the price of bullion proceeds from the demand for the metals and the competition between merchants to procure them, and not becauſe the paper given as the price is at all of inferior value to the ſpecie. The leaſt diſcredit of this kind would not tend to diminiſh the value of the paper; it would annihilate it at once. Therefore, ſince the metals muſt be had, and that the paper cannot ſupply the want of them when they are to be exported, the price riſes in proportion to the difficulties in finding metals elſewhere than in the Engliſh market.

III. A ſudden call for bullion, for the making of plate. A goldſmith can well afford to give 67 pence for an ounce of ſilver, that is to ſay, he can afford to give one pound of gold for 14 pounds of ſilver, and perhaps for leſs, notwithſtanding that what he gives be more than the ordinary proportion between the metals, becauſe he indemnifies himſelf amply by the price of his workmanſhip; juſt as a tavern keeper will pay any price for a fine fiſh, becauſe, like the goldſmith, he buys for other people.

IV. The mint price has as great an effect in bringing down the price of bullion, as exchange has in raiſing it. In countries where the metals in the coin are juſtly proportioned, where all the currencies are of legal weight, and where coinage is impoſed, the operations of trade make the price of bullion conſtantly to fluctuate between the value of the coin and the mint price of the metals.

Now let us ſuppoſe that the current price of ſilver bullion in the market is 65 pence the ounce, paid in lawful money, no matter of what weight or of what metal. Upon this the money-jobber falls to work. All ſhillings which are above $\frac{1}{65}$ of a pound troy, he throws into his melting pot, and ſells them as bullion for 65d. per ounce; all thoſe which are below that weight he carries to market, and buys bullion with them at 65d. per ounce.

What is the conſequence of this?

That thoſe who ſell the bullion, finding the ſhillings which the money-jobber pays with perhaps not above $\frac{1}{66}$ of a pound troy, they on their ſide raiſe the price of their bullion to 66d. the ounce.

This makes new work for the money-jobber; for he muſt always gain. He now weighs all ſhillings as they come to hand; and as formerly he threw into his melting pot thoſe only which were worth more than $\frac{1}{65}$ of a pound troy, he now throws in all that are in value

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lue above $\frac{1}{66}$. He then ſells the melted ſhillings at 66d. the ounce, and buys bullion with the light ones at the ſame price.

This is the conſequence of ever permitting any ſpecies of coin to paſs by the authority of the ſtamp, without controlling it at the ſame time by the weight: and this is the manner in which money-jobbers gain by the currency of light money.

It is no argument againſt this expoſition of the matter to ſay, that ſilver bullion is ſeldom bought with ſilver coin; becauſe the pence in new guineas are worth no more than the pence of ſhillings of 65 in the pound troy: that is to ſay, that 240 pence contained in $\frac{20}{21}$ of a new guinea, and 240 pence contained in 28 ſhillings of 65 to the pound troy, differ no more in the intrinſic value than 0.83 of a grain of fine ſilver upon the whole, which is a mere trifle.

Whenever, therefore, ſhillings come below the weight of $\frac{1}{65}$ of a pound troy, then there is an advantage in changing them for new guineas; and when that is the caſe, the new guineas will be melted down, and profit will be found in ſelling them for bullion, upon the principles we have juſt been explaining.

We have already given a ſpecimen of the domeſtic operations of the money-jobbers; but theſe are not the moſt prejudicial to national concerns. The jobbers may be ſuppoſed to be Engliſhmen; and in that caſe the profit they make remains at home: but whenever there is a call for bullion to pay the balance of trade, it is evident that this will be paid in ſilver coin; never in gold, if heavy ſilver can be got; and this again carries away the ſilver coin, and renders it at home ſo rare, that great inconveniences are found for want of the leſſer denominations of it. The loſs, however, here is confined to an inconvenience; becauſe the balance of trade being a debt which muſt be paid, we do not conſider the exportation of the ſilver for that purpoſe as any conſequence of the diſorder of the coin. But beſides this exportation which is neceſſary, there are others which are arbitrary, and which are made only with a view to profit of the wrong proportion.

When the money-jobbers find difficulty in carrying on the traffic we have deſcribed, in the Engliſh market, becauſe of the competition among themſelves, they carry the ſilver coin of the country, and ſell it abroad for gold, upon the ſame principles that the Eaſt India Company ſend ſilver to China in order to purchaſe gold.

It may be demanded, What hurt this trade can do to Britain, ſince thoſe who export ſilver bring back the ſame value in gold? Were this trade carried on by natives, there would be no loſs; becauſe they would bring home gold for the whole intrinſic value of the ſilver. But if we ſuppoſe foreigners ſending over gold to be coined at the Engliſh mint, and changing the gold into Engliſh ſilver coin, and then carrying off this coin, it is plain that they muſt gain the difference, as well as the money-jobbers. But it may be anſwered, That having given gold for ſilver at the rate of the mint, they have given value for what they have received. Very right; but ſo did Sir Hans Sloane, when he paid five guineas for an overgrown toad: he got value for his money; but it was value only to himſelf. Juſt ſo, whenever the Engliſh government ſhall be obliged to reſtore the proportion of the metals (as they muſt do), this operation will annihilate that imaginary value which they have hitherto ſet upon gold; which imagination is the only thing which renders the exchange of their ſilver againſt the foreign gold equal.

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But it is farther objected, that foreigners cannot carry off the heavy ſilver; becauſe there is none to carry off. Very true; but then they have carried off a great quantity already: or if the Engliſh Jews have been too ſharp to allow ſuch a profit to fall to ſtrangers, (which may or may not have been the caſe), then this diſorder is an effectual ſtop to any more coinage of ſilver for circulation.

7. *Of the Diſorder in the Britiſh Coin, ſo far as it affects the Value of the Pound Sterling Currency.*

From what has been ſaid, it is evident, that there muſt be found in England two legal pounds ſterling, of different values; the one worth 113 grains of fine gold, the other worth 1718.7 grains of fine ſilver. We call them different: becauſe theſe two portions of the precious metals are of different values all over Europe.

But beſides theſe two different pounds ſterling, which the change in the proportion of the metals has created, the other defects of the circulating coin produce ſimilar effects. The guineas coined by all the princes ſince King Charles II. have been of the ſame ſtandard weight and fineneſs, $44\frac{1}{2}$ in a pound troy of ſtandard gold $\frac{11}{12}$ fine: theſe have been conſtantly wearing ever ſince they have been coined; and in proportion to their wearing they are of leſs value.

If, therefore, the new guineas are below the value of a pound ſterling in ſilver, ſtandard weight, the old muſt be of leſs value ſtill. Here then is another currency, that is, another pound ſterling; or indeed, more properly ſpeaking, there are as many different pounds ſterling as there are guineas of different weights. This is not all; the money-jobbers having carried off all the weighty ſilver, that which is worn with uſe, and reduced even below the ſtandard of gold, forms one currency more, and totally deſtroys all determinate proportion between the money unit and the currencies which are ſuppoſed to repreſent it.

It may be aſked, how, at this rate, any ſilver has remained in England? It is anſwered, that the few weighty ſhillings which ſtill remain in circulation, have marvellouſly eſcaped the hands of the money-jobbers: and as to the reſt, the rubbing and wearing of theſe pieces has done what the ſtate might have done; that is to ſay, it has reduced them to their due proportion with the lighteſt gold.

The diſorder, therefore, of the Engliſh coin has rendered the ſtandard of a pound ſterling quite uncertain. To ſay that it is 1718.7 grains of fine ſilver, is quite ideal. Who are paid in ſuch pounds? To ſay that it is 113 grains of pure gold, may alſo not be true; becauſe there are many currencies worſe than the new guineas.

What then is the conſequence of all this diſorder? What effect has it upon the current value of a pound ſterling? And which way can the value of that be determined?

The operations of trade bring value to an equation, notwithſtanding the greateſt irregularities poſſible; and

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value over all the world by the means of foreign exchange. This is a kind of ideal ſcale for meaſuring the Britiſh coin, although it has not all the properties of that deſcribed above.

Exchange conſiders the pound ſterling as a value determined according to the combination of the values of all the different currencies, in proportion as payments are made in the one or the other; and as debtors generally take care to pay in the worſt ſpecies they can, it conſequently follows, that the value of the pound ſterling ſhould fall to that of the loweſt currency.

Were there a ſufficient quantity of worn gold and ſilver to acquit all bills of exchange, the pound ſterling would come down to the value of them; but if the new gold be alſo neceſſary for that purpoſe, the value of it muſt be proportionably greater.

All theſe combinations are liquidated and compenſated with one another, by the operations of trade and exchange; and the pound ſterling, which is ſo different in itſelf, becomes thereby, in the eyes of commerce a determinate unit; ſubject, however, to variations, from which it never can be exempted.

Exchange, therefore, is one of the beſt meaſures for valuing a pound ſterling, preſent currency. Here occurs a queſtion:

Does the great quantity of paper money in England tend to diminiſh the value of the pound ſterling?

We anſwer in the negative. Paper money is juſt as good as gold or ſilver money, and no better. The variation of the ſtandard, as we have already ſaid, muſt influence the intereſts of debtors and creditors proportionally everywhere. From this it follows, that all augmentation of the value of the money unit in the ſpecie muſt hurt the debtors in the paper money; and all diminutions, on the other hand, muſt hurt the creditors in the paper money as well as everywhere elſe. The payments, therefore, made in paper money, never can contribute to the regulation of the ſtandard of the pound ſterling; it is the ſpecie received in liquidation of that paper money which alone can contribute to mark the value of the Britiſh unit; becauſe it is affixed to nothing elſe.

From this we may draw a principle, "That in countries where the money unit is entirely affixed to the coin, the actual value of it is not according to the legal ſtandard of that coin, but according to the mean proportion of the actual worth of thoſe currencies in which debts are paid.

From this we ſee the reaſon why the exchange between England and all other trading towns in Europe has long appeared ſo unfavourable. People calculate the real par, upon the ſuppoſition that a pound ſterling is worth 1718.7 grains troy of fine ſilver, when in fact the currency is not perhaps worth 1638, the value of a new guinea in ſilver, at the market proportion of 1 to 14.5; that is to ſay, the currency is but 95.3 per cent. of the ſilver ſtandard of the 43d of Elizabeth. No wonder then if the exchange be thought unfavourable.

From the principle we have juſt laid down, we may gather a confirmation of what we advanced concerning the cauſe of the advanced price of bullion in the Engliſh market.

When people buy bullion with current money at a determinate price, that operation, in conjunction with the courſe of exchange, ought naturally to mark the actual value of the pound ſterling with great exactneſs.

If therefore the price of ſtandard bullion in the Engliſh market, when no demand is found for the exportation of the metals, that is to ſay, when paper is found for paper upon exchange, and when merchants verſed in theſe matters judge exchange (that is, remittances) to be at par, if then ſilver bullion cannot be bought at a lower price than 65 pence the ounce, it is evident that this bullion might be bought with 65 pence in ſhillings, of which 65 might be coined out of the pound troy Engliſh ſtandard ſilver; ſince 65 per ounce implies 65 ſhillings for the 12 ounces or pound troy.

This plainly ſhows how ſtandard ſilver bullion ſhould ſell for 65 pence the ounce, in a country where the ounce of ſtandard ſilver in the coin is worth no more than 62; and were the market price of bullion to ſtand uniformly at 65 pence per ounce, that would ſhow the value of the pound ſterling to be tolerably fixed. All the heavy ſilver coin is now carried off; becauſe it was intrinſically worth more than the gold it paſſed for in currency. The ſilver therefore which remains is worn down to the market proportion of the metals, as has been ſaid; that is to ſay, 20 ſhillings in ſilver currency are worth 113 grains of fine gold, at the proportion of 1 to 14.5 between gold and ſilver. Now,

as 1 is to 14.5, ſo is 113 to 1638:

ſo the 20 ſhillings current weigh but 1638 grains fine ſilver, inſtead of 1718.7, which they ought to do according to the ſtandard.

Now let us ſpeak of ſtandard ſilver, ſince we are examining how far the Engliſh coin muſt be worn by uſe.

The pound troy contains 5760 grains. This, according to the ſtandard, is coined into 62 ſhillings; conſequently, every ſhilling ought to weigh 92.9 grains. Of ſuch ſhillings it is impoſſible that ever ſtandard bullion ſhould ſell at above 62 pence per ounce. If therefore ſuch bullion ſells for 65 pence, the ſhillings with which it is bought muſt weigh no more than 88.64 grains ſtandard ſilver: that is, they muſt loſe 4.29 grains, and are reduced to $\frac{1}{65}$ of a pound troy.

But it is not neceſſary that bullion be bought with ſhillings: no ſtipulation of price is ever made farther, than at ſo many pence ſterling per ounce. Does not this virtually determine the value of ſuch currency with regard to all the currencies in Europe? Did a Spaniard, a Frenchman, or a Dutchman, know the exact quantity of ſilver bullion which can be bought in the London market for a pound ſterling, would he inform himſelf any farther as to the intrinſic value of that money unit? would he not underſtand the value of it far better from that circumſtance than by the courſe of any exchange, ſince exchange does not mark the intrinſic value of money, but only the value of that money tranſported from one place to another?

The price of bullion, therefore, when it is not influenced by extraordinary demand, (ſuch as for the payment of a balance of trade, or for making an ex-

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If it be therefore true, that a pound sterling cannot purchase above 1638 grains of fine silver bullion, it will require not a little logic to prove that it is really, or has been for these many years, worth any more; notwithstanding that the standard weight of it in England is regulated by the laws of the kingdom at 1718.7 grains of fine silver.

If to this valuation of the pound sterling drawn from the price of bullion, we add the other drawn from the course of exchange; and by this we find, that when paper is found for paper upon exchange, a pound sterling cannot purchase above 1638 grains of fine silver in any country in Europe: upon these two authorities we may very safely conclude (as to the matter of fact at least) that the pound sterling is not worth more, either in London or in any other trading city; and if this be the case, it is just worth 20 shillings of 65 to the pound troy.

If therefore the mint were to coin shillings at that rate, and pay for silver bullion at the market price, that is, at the rate of 65 pence per ounce in those new coined shillings, they would be in proportion to the gold; silver would be carried to the mint equally with gold, and would be as little subject to be exported or melted down.

It may be inquired in this place, how far the coining the pound troy into 65 shillings is contrary to the laws of England?

The moment a state pronounces a certain quantity of gold to be worth a certain quantity of silver, and orders these respective quantities of each metal to be received as equivalents of each other, and as lawful money in payments, that moment gold is made a standard as much as silver. If therefore too small a quantity of gold be ordered or permitted to be considered as an equivalent for the unit, the silver standard is from that moment debased; or indeed, more properly speaking, all silver money is from that moment proscribed; for who, from that time, will ever pay in silver, when he can pay cheaper in gold? Gold, therefore, by such a law, is made the standard, and all declarations to the contrary are against the matter of fact.

Were the king, therefore, to coin silver at 65 shillings in the pound, it is demonstration, that by such an act he would commit no adulteration upon the standard: the adulteration is already committed. The standard has descended to where it is, by slow degrees, and by the operation of political causes only; and nothing prevents it from falling lower but the standard of the gold coin. Let guineas be now left to seek their value as they did formerly, and let light silver continue to go by tale, we shall see the guineas up at 30 shillings in 20 years time, as was the case in 1695.

It is as absurd to say that the standard of Queen Elizabeth has not been debased by enacting that the English unit shall be acquitted with 113 grains of fine gold, as it would be to affirm that it would not be debased from what it is at present by enacting that a pound of butter should everywhere be received in payment for a pound sterling; although the pound sterling should continue to consist of three ounces, 17 pennyweights, and 10 grains of standard silver, according to the statute of the 43d of Elizabeth. In that case, most debtors would pay in butter; and silver would, as at present, acquire a conventional value as a metal, but would be looked upon no longer as a standard, or as money. Money.

If therefore, by the law of England, a pound sterling must consist of 1718.7 grains troy of fine silver; by the law of England also, 113 grains of gold must be of the same value: but no law can establish that proportion; consequently, in which ever way a reformation be brought about, some law must be reversed; consequently, expediency, and not compliance with law, must be the motive in reforming the abuse.

From what has been said, it is not at all surprising that the pound sterling should in fact be reduced nearly to the value of the gold. Whether it ought to be kept at that value is another question. All that we here decide is, that coining the pound troy into 65 shillings would restore the proportion of the metals, and render both species common in circulation. But restoring the weight and proportion of the coin is not the difficulty which prevents a reformation of the English coinage.

8. *Circumstances to be attended to in a New Regulation of the British Coin.*

To people who do not understand the nature of such operations, it may have an air of justice to support the unit at what is commonly believed to be the standard of Queen Elizabeth, viz. at 1718.7 grains of fine silver.

The regulating the standard of both silver and gold to $\frac{11}{12}$ fine, and the pound sterling to four ounces standard silver, as it stood during the reign of Queen Mary I. has also its advantages, as Mr Harris has observed. It makes the crown-piece to weigh just one ounce, the shilling four pennyweights, and the penny eight grains: consequently, were the new statute to bear, that the weight of the coin should regulate its currency upon certain occasions, the having the pieces adjusted to certain aliquot parts of weight would make weighing easy, and would accustom the common people to judge of the value of money by its weight, and not by the stamp.

In that case, there might be a conveniency in striking the gold coins of the same weight with the silver; because the proportion of their values would then constantly be the same with the proportion of the metals. The gold crowns would be worth at present, 3l. 12s. 6d. the half-crowns 1l. 16s. 3d. the gold shillings 14s. 6d. and the half 7s. 3d. This was anciently the practice in the Spanish mints.

The interests within the state can be nowise perfectly protected, but by permitting conversions of value from the old to the new standard, whatever it be, and by regulating the footing of such conversions by act of parliament, according to circumstances.

For this purpose, we shall examine those interests which will chiefly merit the attention of government, when they form a regulation for the future of acquitting

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ting permanent contracts already entered into. Such as may be contracted afterwards will naturally follow the new standard.

The landed interest is no doubt the most considerable in the nation. Let us therefore examine, in the first place, what regulations it may be proper to make, in order to do justice to this great class, with respect to the land tax on one hand, and with respect to their lessees on the other.

The valuation of the lands of England was made many years ago, and reasonably ought to be supported at the real value of the pound sterling at that time, according to the principles already laid down. The general valuation, therefore, of the whole kingdom will rise according to this scheme. This will be considered as an injustice; and no doubt it would be so, if for the future, the land tax be imposed as heretofore, without attending to this circumstance; but as that imposition is annual, as it is laid on by the landed interest itself, who compose the parliament, it is to be supposed that this great class will at least take care of their own interest.

Were the valuation of the lands to be stated according to the valuation of the pound sterling of 1718.7 grains of silver, which is commonly supposed to be the standard of Elizabeth, there would be no great injury done: this would raise the valuation only 5 per cent. and the land tax in proportion.

There is no class of inhabitants in all England so much at their ease, and so free from taxes, as the class of farmers. By living in the country, and by consuming the fruits of the earth without their suffering any alienation, they avoid the effect of many excises, which, by those who live in corporations, are felt upon many articles of their consumption, as well as on those which are immediately loaded with these impositions. For this reason it will not, perhaps, appear unreasonable, if the additional 5 per cent. on the land tax were thrown upon this class, and not upon the landlords.

With respect to leases, it may be observed, that we have gone upon the supposition that the pound sterling in the year 1728 was worth 1718.7 grains of fine silver, and 113 grains of fine gold.

There would be no injustice done the lessees of all the lands in the kingdom, were their rents to be fixed at the mean proportion of these values. We have observed how the pound sterling has been gradually diminishing in its worth from that time by the gradual rise of the silver. This mean proportion, therefore, will nearly answer to what the value of the pound sterling was in 1743; supposing the rise of the silver to have been uniform.

It may be farther alleged in favour of the landlords, that the gradual debasement of the standard has been more prejudicial to their interest in letting their lands, than to the farmers in disposing of the fruits of them. Proprietors cannot so easily raise their rents upon new leases, as farmers can raise the prices of their grain according to the debasement of the value of the currency.

The pound sterling, thus regulated at the mean proportion of its worth, as it stands at present, and as it stood in 1728, may be realized in 1678.6 grains of fine silver, and 115.76 grains fine gold; which is 2.4 per cent. above the value of the present currency. No injury, therefore, would be done to lessees, and no unreasonable gain would accrue to the landed interest, in appointing conversions of all land rents at $2\frac{1}{2}$ per cent. above the value of the present currency.

Without a thorough knowledge of every circumstance relating to Great Britain, it is impossible to lay down any plan. It is sufficient here briefly to point out the principles upon which it must be regulated.

The next interest to be considered is that of the nation's creditors. The right regulation of their concerns will have a considerable influence in establishing public credit upon a solid basis, by making it appear to all the world, that no political operation upon the money of Great Britain can in any respect either benefit or prejudice the interest of those who lend their money upon the faith of the nation. The regulating also the interest of so great a body, will serve as a rule for all creditors who are in the same circumstances, and will upon other accounts be productive of greater advantages to the nation in time coming.

In 1749, a new regulation was made with the public creditors, when the interest of the whole redeemable national debt was reduced to 3 per cent. This circumstance infinitely facilitates the matter with respect to this class, since, by this innovation of all former contracts, the whole national debt may be considered as contracted at, or posterior to, the 25th December 1749.

Were the state, by an arbitrary operation upon money (which every reformation must be), to diminish the value of the pound sterling in which the parliament at that time bound the nation to acquit those capitals and the interest upon them, would not all Europe say, That the British parliament had defrauded their creditors? If therefore the operation proposed to be performed should have a contrary tendency, viz. to augment the value of the pound sterling with which the parliament at that time bound the nation to acquit those capitals and interests, must not all Europe also agree, That the British parliament had defrauded the nation?

The convention with the ancient creditors of the state, who, in consequence of the debasement of the standard, might have justly claimed an indemnification for the loss upon their capitals, lent at a time when the pound sterling was at the value of the heavy silver, removes all causes of complaint from that quarter. There was in the year 1749 an innovation in all their contracts; and they are now to be considered as creditors only from the 25th of December of that year.

Let the value of the pound sterling be inquired into during one year preceding and one posterior to the transaction of the month of December 1749. The great sums borrowed and paid back by the nation during that period, will furnish data sufficient for that calculation. Let this value of the pound be specified in troy grains of fine silver and fine gold bullion, without mentioning any denomination of money according to the exact proportion of the metals at that time. And let this pound be called the *pound of national credit.*

This first operation being determined, let it be enacted, that the pound sterling, by which the state is to

 borrow

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borrow for the future, and that in which the creditors are to be paid, ſhall be the exact mean proportion between the quantities of gold and ſilver above ſpecified, according to the actual proportion of the metals at the time ſuch payments ſhall be made: or that the ſums ſhall be borrowed or acquitted, one half in gold and one half in ſilver, at the reſpective requiſitions of the creditors or of the ſtate, when borrowing. All debts contracted poſterior to 1749 may be made liable to converſions.

The conſequence of this regulation will be the inſenſible eſtabliſhment of a bank money. Nothing would be more difficult to eſtabliſh, by a poſitive revolution, than ſuch an invariable meaſure; and nothing will be found ſo eaſy as to let it eſtabliſh itſelf by its own advantages. This bank money will be liable to much fewer inconveniencies than that of Amſterdam. There the perſons tranſacting muſt be upon the ſpot; here, the ſterling currency may, every quarter of a year, be adjuſted by the exchequer to this invariable ſtandard, for the benefit of all debtors and creditors who incline to profit of the ſtability of this meaſure of value.

This ſcheme is liable to no inconvenience from the variation of the metals, let them be ever ſo frequent or hard to be determined; becauſe upon every occaſion where there is the ſmalleſt doubt as to the actual proportion, the option competent to creditors to be paid half in ſilver and half in gold will remove.

Such a regulation will alſo have this good effect, that it will give the nation more juſt ideas of the nature of money, and conſequently of the influence it ought to have upon prices.

If the value of the pound ſterling ſhall be found to have been by accident leſs in December 1749 than it is at preſent; or if at preſent the currency be found below what it has commonly been ſince 1749; in juſtice to the creditors, and to prevent all complaints, the nation may grant them the mean proportion of the value of the pound ſterling from 1749 to 1760, or any other which may to parliament appear reaſonable.

This regulation muſt appear equitable in the eyes of all Europe; and the ſtrongeſt proof of it will be, that it will not produce the ſmalleſt effect prejudicial to the intereſt of the foreign creditors. The courſe of exchange with regard to them will ſtand preciſely as before.

A Dutch, French, or German creditor, will receive the ſame value for his intereſt in the Engliſh ſtocks as heretofore. This muſt ſilence all clamours at home, being the moſt convincing proof, that the new regulation of the coin will have made no alteration upon the real value of any man's property, let him be debtor or creditor.

The intereſt of every other denomination of creditors, whoſe contracts are of a freſh date, may be regulated upon the ſame principles. But where debts are of an old ſtanding, juſtice demands, that attention be had to the value of money at the time of contracting. Nothing but the ſtability of the Engliſh coin, when compared with that of other nations, can make ſuch a propoſal appear extraordinary. Nothing is better known in France than this ſtipulation added to obligations, *Argent au cours de ce jour*; that is to ſay, That the ſum ſhall be repaid in coin of the ſame intrinſic value with what has been lent. Why ſhould ſuch a clauſe be thought reaſonable for guarding people againſt arbitrary operations upon the numerary value of the coin, and not be found juſt upon every occaſion where the numerary value of it is found to be changed, let the cauſe be what it will?

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The next intereſt we ſhall examine is that of trade. When men have attained the age of 21, they have no more occaſion for guardians. This may be applied to traders; they can parry with their pen every inconvenience which may reſult to other people from the changes upon money, provided only the laws permit them to do themſelves juſtice with reſpect to their engagements. This claſs demands no more than a right to convert all reciprocal obligations into denominations of coin of the ſame intrinſic value with thoſe they have contracted in.

The next intereſt is that of buyers and ſellers; that is, of manufacturers with regard to conſumers, and of ſervants with reſpect to thoſe who hire their perſonal ſervice.

The intereſt of this claſs requires a moſt particular attention. They muſt, literally ſpeaking, be put to ſchool, and taught the firſt principles of their trade, which is buying and ſelling. They muſt learn to judge of price by the grains of ſilver and gold they receive: they are children of a mercantile mother, however warlike the father's diſpoſition. If it be the intereſt of the ſtate that their bodies be rendered robuſt and active, it is no leſs the intereſt of the ſtate that their minds be inſtructed in the firſt principles of the trade they exerciſe.

For this purpoſe, tables of converſion from the old ſtandard to the new muſt be made, and ordered to be put up in every market, in every ſhop. All duties, all exciſes, muſt be converted in the ſame manner. Uniformity muſt be made to appear everywhere. The ſmalleſt deviation from this will be a ſtumbling block to the multitude.

Not only the intereſt of the individuals of the claſs we are at preſent conſidering, demands the nation's care and attention in this particular; but the proſperity of trade, and the wellbeing of the nation, are alſo deeply intereſted in the execution.

The whole delicacy of the intricate combinations of commerce depends upon a juſt and equable vibration of prices, according as circumſtances demand it. The more, therefore, the induſtrious claſſes are inſtructed in the principles which influence prices, the more eaſily will the machine move. A workman then learns to ſink his price without regret, and can raiſe it without avidity. When principles are not underſtood, prices cannot gently fall, they muſt be pulled down; and merchants dare not ſuffer them to riſe, for fear of abuſe, even although the perfection of an infant manufacture ſhould require it.

The laſt intereſt is that of the bank of England, which naturally muſt regulate that of every other.

Had this great company followed the example of other banks, and eſtabliſhed a bank-money of an invariable ſtandard as the meaſure of all their debts and credits, they would not have been liable to any inconvenience upon a variation of the ſtandard.

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The bank of England was projected about the year 1694, at a time when the current money of the nation was in the greateſt diſorder, and government in the greateſt diſtreſs both for money and for credit. Commerce was then at a very low ebb; and the only, or at leaſt the moſt profitable, trade of any, was jobbing in coin, and carrying backwards and forwards the precious metals from Holland to England. Merchants profited alſo greatly from the effects which the utter diſorder of the coin produced upon the price of merchandiſe.

At ſuch a juncture the reſolution was taken to make a new coinage; and upon the proſpect of this, a company was found, who, for an excluſive charter to hold a bank for 13 years, willingly lent the government upwards of a million ſterling at 8 per cent (in light money we ſuppoſe), with a proſpect of being repaid both intereſt and capital in heavy. This was not all: part of the money lent was to be applied for the eſtabliſhment of the bank; and no leſs than 4000l. a year was allowed to the company, above the full intereſt, for defraying the charge of the management.

Under ſuch circumſtances the introduction of bank-money was very ſuperfluous, and would have been very impolitic. That invention is calculated againſt the raiſing of the ſtandard: but here the bank profited of that riſe in its quality of creditor for money lent; and took care not to commence debtor by circulating their paper until the effect of the new regulation took place in 1695; that is, after the general re-coinage of all the clipped ſilver.

From that time till now, the bank of England has been the baſis of the nation's credit, and with great reaſon has been conſtantly under the moſt intimate protection of every miniſter.

The value of the pound ſterling, as we have ſeen, has been declining ever ſince the year 1601, the ſtandard being fixed to ſilver during all that century, while the gold was conſtantly riſing. No ſooner had the proportion taken another turn, and ſilver begun to riſe, than the government of England threw the ſtandard virtually upon the gold, by regulating the value of the guineas at the exact proportion of the market. By theſe operations, however, the bank has conſtantly been a gainer (in its quality of debtor) upon all the paper in circulation; and therefore has loſt nothing by not having eſtabliſhed a bank-money.

The intereſt of this great company being eſtabliſhed upon the principles we have endeavoured to explain, it is very evident, that the government of England never will take any ſtep in the reformation of the coin which in its conſequences can prove hurtful to the bank. Such a ſtep would be contrary both to juſtice and to common ſenſe. To make a regulation which, by raiſing the ſtandard, would prove beneficial to the public creditors, to the prejudice of the bank (which we may call the *public debtor*), would be an operation upon public credit like that of a perſon who is at great pains to ſupport his houſe by props on all ſides, and who at the ſame time blows up the foundation of it with gunpowder.

We may therefore conclude, that with regard to the bank of England, as well as every other private banker, the notes which are conſtantly payable upon demand muſt be made liable to a converſion at the actual value of the pound ſterling at the time of the new regulation.

That the bank will gain by this, is very certain; but the circulation of their notes is ſo ſwift, that it would be abſurd to allow to the then poſſeſſors of them that indemnification which naturally ſhould be ſhared by all thoſe through whoſe hands they have paſſed, in proportion to the debaſement of the ſtandard during the time of their reſpective poſſeſſion.

Beſides theſe conſiderations, which are in common to all ſtates, the government of Great Britain has one peculiar to itſelf. The intereſt of the bank, and that of the creditors, are diametrically oppoſite: every thing which raiſes the ſtandard hurts the bank; every thing which can ſink it hurts the creditors: and upon the right management of the one and the other, depends the ſolidity of public credit. For theſe reaſons, without the moſt certain proſpect of conducting a reſtitution of the ſtandard to the general advantage as well as approbation of the nation, no miniſter will probably ever undertake ſo dangerous an operation.

We ſhall now propoſe an expedient which may remove at leaſt ſome of the inconveniences which would reſult from ſo extenſive an undertaking as that of regulating the reſpective intereſts in Great Britain by a poſitive law, upon a change in the value of their money of account.

Suppoſe then, that, before any change is made in the coin, government ſhould enter into a tranſaction with the public creditors, and aſcertain a permanent value for the pound ſterling for the future, ſpecified in a determined proportion of the fine metals in common bullion, without any regard to money of account, or to any coin whatever.

This preliminary ſtep being taken, let the intended alteration of the ſtandard be proclaimed a certain time before it is to commence. Let the nature of the change be clearly explained, and let all ſuch as are engaged in contracts which are diſſolvable at will upon the preſtations ſtipulated, be acquitted between the parties, or innovated as they ſhall think proper; with certification, that, poſterior to a certain day, the ſtipulations formerly entered into ſhall be binding according to the denominations of the money of account in the new ſtandard.

As to permanent contracts, which cannot at once be fulfilled and diſſolved, ſuch as leaſes, the parliament may either preſcribe the methods and terms of converſion; or a liberty may be given to the parties to annul the contract, upon the debtor's refuſing to perform his agreement according to the new ſtandard. Contracts, on the other hand, might remain ſtable, with reſpect to creditors who would be ſatisfied with payments made on the footing of the old ſtandard. If the riſe intended ſhould not be very conſiderable, no great injuſtice can follow ſuch a regulation.

Annuities are now thoroughly underſtood, and the value of them is brought to ſo nice a calculation, that nothing will be eaſier than to regulate theſe upon the footing of the value paid for them, or of the ſubject affected by them. If by the regulation, land rents are made to riſe in denomination, the annuities charged upon them ought to riſe in proportion; if in intrinſic value, the annuity ſhould remain as it was.

9. *Regulations*

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9. *Regulations which the Principles of this Inquiry point out as expedient to be made by a new Statute for regulating the British Coin.*

Let us now examine what regulations it may be proper to make by a new ftatute concerning the coin of Great Britain, in order to preferve always the fame exact value of the pound fterling realized in gold and in filver, in fpite of all the incapacities inherent in the metals to perform the functions of an invariable fcale or meafure of value.

1. The firft point is to determine the exact number of grains of fine gold and fine filver which are to compofe it, according to the then proportion of the metals in the London market.

2. To determine the proportion of thefe metals with the pound troy; and in regard that the ftandard of gold and filver is different, let the mint price of both metals be regulated according to the pound troy fine.

3. To fix the mint price within certain limits; that is to fay, to leave to the king and council, by proclamation, to carry the mint price of bullion up to the value of the coin, as is the prefent regulation, or to fink it to *per cent.* below that price, according as government fhall incline to impofe a duty upon coinage.

4. To order, that filver and gold coin fhall be ftruck of fuch denominations as the king fhall think fit to appoint; in which the proportion of the metals above determined fhall be conftantly obferved through every denomination of the coin, until neceffity fhall make a new general coinage unavoidable.

5. To have the number of grains of the fine metal in every piece marked upon the exergue, or upon the legend of the coin, in place of fome initial letters of titles, which not one perfon in a thoufand can decypher; and to make the coin of as compact a form as poffible, diminifhing the furface of it as much as is confiftent with beauty.

6. That it fhall be lawful for all contracting parties to ftipulate their payments either in gold or filver coin, or to leave the option of the fpecies to one of the parties.

7. That where no particular ftipulation is made, creditors fhall have power to demand payment, half in one fpecies, half in the other; and when the fum cannot fall equally into gold and filver coins, the fractions to be paid in filver.

8. That in buying and felling, when no particular fpecies has been ftipulated, and when no act in writing has intervened, the option of the fpecies fhall be competent to the buyer.

9. That all fums paid or received by the king's receivers, or by bankers, fhall be delivered by weight, if demanded.

10. That all money which fhall be found under the legal weight, from whatever caufe it may proceed, may be rejected in every payment whatfoever; or if offered in payment of a debt above a certain fum, may be taken according to its weight, at the then mint price, in the option of the creditor.

11. That no penalty fhall be incurred by thofe who melt down or export the nation's coin; but that wafhing, clipping, or diminifhing the weight of any part of it fhall be deemed felony, as much as any other theft, if the perfon fo degrading the coin fhall afterwards make it circulate for lawful money.

To prevent the inconveniencies proceeding from the variation in the proportion between the metals, it may be provided,

12. That upon every variation of proportion in the market price of the metals, the price of both fhall be changed, according to the following rule:

Let the price of the pound troy fine gold in the coin be called *G*.

Let the price of ditto in the filver be called *S*.

Let the new proportion between the market price of the metals be called *P*.

Then ftate this formula:

$\frac{G}{2P}+\frac{S}{2}=$ to a pound troy fine filver, in fterling currency.

$\frac{S}{2}+P+\frac{G}{2}=$ to a pound troy fine gold, in fterl. currency.

This will be a rule for the mint to keep the price of the metals conftantly at par with the price of the market; and coinage may be impofed, as has been defcribed, by fixing the mint price of them at a certain rate below the value of the fine metals in the coin.

13. As long as the variation of the market-price of the metals fhall not carry the price of the rifing metal fo high as the advanced price of the coin above the bullion, no alteration need be made on the denomination of either fpecies.

14. So foon as the variation of the market price of the metals fhall give a value to the rifing fpecies, above the difference between the coin and the bullion; then the king fhall alter the denominations of all the coin, filver and gold, adding to the coins of the rifing metal exactly what is taken from thofe of the other. An example will make this plain:

Let us fuppofe that the coinage has been made according to the proportion of 14.5 to 1; that 20 fhillings, or 4 crown-pieces, fhall contain, in fine filver, 14.5 times as many grains as the guinea, or the gold pound, fhall contain grains of fine gold. Let the new proportion of the metals be fuppofed to be 14 to 1. In that cafe, the 20 fhillings, or the 4 crowns, will contain $\frac{1}{28}$ more value than the guinea. Now fince there is no queftion of making a new general coinage upon every variation, in order to adjuft the proportion of the metals in the weight of the coins, that proportion might be adjufted by changing their refpective denominations according to this formula:

Let the 20 fhillings, or 4 crowns, in coin, be called *S*. Let the guinea be called *G*. Let the difference between the old proportion and the new, which is $\frac{1}{29}$ be called *P*. Then fay.

$S-\frac{P}{2}=$ a pound fterling, and $G+\frac{P}{2}=$ a pound fterl.

By this it appears that all the filver coin muft be raifed in its denomination $\frac{1}{58}$, and all the gold coin muft be lowered in its denomination $\frac{1}{58}$; yet ftill $S+G$ will be equal to two pounds fterling, as before, whether they be confidered according to the old or according to the new denominations.

But it may be obferved, that the impofition of coinage rendering the value of the coin greater than the value

Money.

value of the bullion, that circumſtance gives a certain latitude in fixing the new denominations of the coin, ſo as to avoid minute fractions. For, providing the deviation from the exact proportion ſhall fall within the advanced price of the coin, no advantage can be taken by melting down one ſpecies preferably to another; ſince, in either caſe, the loſs incurred by melting the coin muſt be greater than the profit made upon ſelling the bullion. The mint price of the metals, however, may be fixed exactly, that is, within the value of a farthing upon a pound of fine ſilver or gold. This is eaſily reckoned at the mint; although upon every piece in common circulation the fractions of farthings would be inconvenient.

15. That notwithſtanding of the temporary variations made upon the denomination of the gold and ſilver coins, all contracts formerly entered into, and all ſtipulations in pounds, ſhillings, and pence, may continue to be acquitted according to the old denominations of the coins, paying one-half in gold and one-half in ſilver: unleſs in the caſe where a particular ſpecies has been ſtipulated; in which caſe, the ſums muſt be paid according to the new regulation made upon the denomination of that ſpecies, to the end that neither profit or loſs may reſult to any of the parties.

16. That notwithſtanding the alterations on the mint price of the metals, and in the denomination of the coins, no change ſhall be made upon the weight of the particular pieces of the latter, except in the caſe of a general re-coinage of one denomination at leaſt: that is to ſay, the mint muſt not coin new guineas, crowns, &c. of a different weight from thoſe already in currency, although by ſo doing the fractions might be avoided. This would occaſion confuſion, and the remedy would ceaſe to be of any uſe upon a new change in the proportion of the metals. But it may be found convenient, for removing the ſmall fractions in ſhillings and ſixpences, to recoin ſuch denominations altogether, and to put them to their integer numbers of twelve and of ſix pence, without changing in any reſpect their proportion of value to all other denominations of the coin: this will be no great expence, when the bulk of the ſilver coin is put into 5 ſhilling pieces.

By this method of changing the denominations of the coin, there never can reſult any alteration in the value of the pound ſterling; and although fractions of value may now and then be introduced, in order to prevent the abuſes to which the coin would otherwiſe be expoſed by the artifice of thoſe who melt it down, yet ſtill the inconvenience of ſuch fractions may be avoided in paying, according to the old denominations, in both ſpecies, by equal parts. This will alſo prove demonſtratively, that no change is thereby made in the true value of the national unit of money.

17. That it be ordered, that ſhillings and ſixpences ſhall only be current for 20 years; and all other coins, both gold and ſilver, for 40 years, or more. For aſcertaining which term, there may be marked, upon the exergue of the coin, the laſt year of their currency, in place of the date of their fabrication. This term elapſed, or the date effaced, that they ſhall have no more currency whatſoever; and, when offered in payment, may be received as bullion at the actual price of the mint, or refuſed, at the option of the creditor.

18. That no foreign coin ſhall have any *legal* currency, except as bullion at the mint price.

By theſe and the like regulations may be prevented, 1*mo*, The melting or exporting of the coin in general. 2*do*, The melting or exporting one ſpecies, in order to ſell it as bullion at an advanced price. 3*tio*, The profit in acquitting obligations preferably in one ſpecies to another. 4*to*, The degradation of the ſtandard, by the wearing of the coin, or by a change in the proportion between the metals. 5*to*, The circulation of the coin below the legal weight. 6*to*, The profit that other nations reap by paying their debts more cheaply to Great Britain than Great Britain can pay her's to them.

And the great advantage of it is, that it is an uniform plan, and may ſerve as a perpetual regulation, compatible with all kinds of denominations of coins, variations in the proportion of the metals, and with the impoſition of a duty upon coinage, or with the preſerving it free; and further, that it may in time be adopted by other nations, who will find the advantage of having their money of account preſerved perpetually at the ſame value, with reſpect to the denominations of all foreign money of account eſtabliſhed on the ſame principles.——But for a fuller diſcuſſion of this ſubject we muſt refer our readers to Mr Wheatley's Eſſay on the Theory of Money and Principles of Commerce. London 1807; and to a Treatiſe on the Coins of the Realm, in a letter to the king, by the Earl of Liverpool, London 1805.

A TABLE

A TABLE OF COINS,

Showing the Quantity of Fine Metal contained in them.

The number of grains of fine metal in every coin is fought for in the regulations of the mint of the country where it is coined, and is expreffed in the grains in ufe in that mint. From that weight it is converted into thofe of other countries according to the following proportions :

3840 Troy grains, 4676.35 Paris grains, 5192.8 Holland aces or grains, and 4649.06 Colonia grains, are fuppofed to be equal weights; and the coins in the Table are converted according to thofe proportions.

	Table of Coins reduced to Grains of fine Metal according to the Troy, Paris, Colonia, and Holland weights.	Gold Coins.				Silver Coins.			
		Troy.	Paris.	Colonia.	Holland.	Troy.	Paris.	Colonia.	Holland.
English Coins.	1 A Guinea by ftatute — — — —	118.651	144.46	143.65	160.45				
	2 A Crown by ftatute — — — —	— —	— —	— —	— —	429.68	523.2	520.2	581.
	3 A Shilling by ftatute — — — —	— —	— —	— —	— —	85.935	104.65	104.	116.2
	4 A Silver Pound Sterling by ftatute 1601 — —	— —	— —	— —	— —	1718.7	2093.	2080.8	2324.1
	5 A Gold Pound Sterling by ftatute 1728 — —	113.	137.61	136.8	152.8				
	6 A Silver Pound Sterling in currency $=\frac{20}{63}$lb. Troy —	— —	— —	— —	— —	1639.38	1996.4	1984.7	2216.
	7 A Silver Pound Sterling at the proportion of gold to filver as 1 to $14\frac{1}{2}$	113.	137.61	136.8	152.8	1638.5	1995.3	1983.7	2215.7
	8 A Gold Pound Sterling at the fame proportion of 1 to $14\frac{1}{2}$	118.4	144.18	143.34	160.11	1718.7	2093.	2080.8	2324.1
	9 A Pound Sterling at the mean proportion in gold and in filver	115.769	140.98	140.16	156.55	1678.6	2044.2	2032.2	2269.9
	10 A Shilling current $=\frac{1}{63}$ of a pound Troy — —	— —	— —	— —	— —	81.961	99.8	99.	110.82
	11 A Guinea in Silver or 21 Shillings ftandard weight —	— —	— —	— —	— —	1804.0	2197.6	2184.8	2440.3
	12 A Guinea at the proportion of 1 to $14\frac{1}{2}$, worth in Silver —	— —	— —	— —	— —	1720.4	2095.1	2082.8	2326.4
	13 A Pound Troy, or 12 ounces Englifh weight — —	5760.	7019.2	6973.5	7789.2				
French Coins.	1 A Louis d'or — — — — —	113.27	137.94	137.13	153.17				
	2 A Crown of fix livres — — — —	— —	— —	— —	— —	409.94	499.22	496.3	554.3
	3 A Crown of three ditto — — — —	— —	— —	— —	— —	204.97	249.61	248.15	277.1
	4 A Livre — — — — —	— —	— —	— —	— —	68.34	83.23	82.74	92.42
	5 A Louis d'or, or 24 livres in filver — — —	— —	— —	— —	— —	1639.7	1996.9	1985.2	2217.4
	6 A Marc of Paris weight, fine gold or filver — —	3783.87	4608.	4581.1	5116.9	3783.87	4608.	4581.1	5116.9
	7 A Marc of gold coin effective weight, in fine — —	3398.3	4138.5	4114.3	4593.4				
	8 A Mark of filver coin effective weight, in fine — —	— —	— —	— —	— —	3402.3	4143.4	4119.2	4600.9
German Coins.	1 A Carolin legal weight — — — —	115.45	140.6	139.78	156.12				
	2 A Ducat of the Empire ditto — — —	52.8	64.37	64.	71.48				
	3 A Florin of Convention — — — —	— —	— —	— —	— —	179.73	218.87	217.6	243.
	4 A Dollar of Convention — — — —	— —	— —	— —	— —	269.59	328.31	326.4	364.5
	5 A Dollar of Exchange, the Carolin = 9 flor. 42 kreutzers	17.85	21.74	21.615	24.14				
	6 A Florin current $=\frac{1}{11}$ of a Carolin — — —	10.54	12.84	12.77	14.26				
	7 A Carolin in filver, at the proportion of 1 to $14\frac{1}{2}$ —	— —	— —	— —	— —	1674.	2038.6	2026.8	2263.8
Dutch Coins.	1 A Dutch Ducat — — — — —	51.76	6.3	62.67	70.				
	2 A Florin in Silver — — — — —	— —	— —	— —	— —	148.	180.3	179.2	200.21

UNIVERSAL TABLE

Of the present State of the REAL and IMAGINARY MONEYS of the WORLD.

† This mark is prefixed to the Imaginary Money, or Money of Account.

All Fractions in the Value English are Parts of a PENNY.

= This mark signifies *is*, *make*, or *equal to*.

EUROPE, Northern Parts.

ENGLAND AND SCOTLAND.

London, Bristol, Liverpool, &c.

Edinburgh, Glasgow, Aberdeen, &c.

			£.	s.	d.
A Farthing			0	0	$0\frac{1}{4}$
2 Farthings	=	a Halfpenny	0	0	$0\frac{1}{2}$
2 Halfpence		a Penny	0	0	1
4 Pence		a Groat	0	0	4
6 Pence		a Half Shilling	0	0	6
12 Pence		a Shilling	0	1	0
5 Shillings		a Crown	0	5	0
20 Shillings		† a Pound Sterling	1	0	0
21 Shillings		a Guinea	1	1	0

IRELAND,

Dublin, Cork, Londonderry, &c.

			£.	s.	d.
A Farthing			0	0	$0\frac{3}{13}$
2 Farthings	=	a Halfpenny	0	0	$0\frac{6}{13}$
2 Halfpence		† a Penny	0	0	$0\frac{12}{13}$
$6\frac{1}{2}$ Pence		a Half Shilling	0	0	6
12 Pence		† a Shilling Irish	0	0	$11\frac{3}{40}$
13 Pence		a Shilling	0	1	0
65 Pence		a Crown	0	5	0
20 Shillings		† a Pound Irish	0	18	$5\frac{1}{2}$
$22\frac{3}{4}$ Shillings		a Guinea	1	1	0

FLANDERS AND BDABANT.

Ghent, Ostend, &c. Antwerp, Brussels, &c.

			£.	s.	d.
† A Pening			0	0	$0\frac{9}{160}$
4 Peningens	=	an Urche	0	0	$0\frac{4}{90}$
8 Peningens		† a Grote	0	0	$0\frac{9}{20}$
2 Grotes		a Petard	0	0	$0\frac{9}{10}$
6 Petards		† a Scalin	0	0	$5\frac{2}{5}$
7 Petards		a Scalin	0	0	$6\frac{3}{10}$
40 Grotes		† a Florin	0	1	6
$17\frac{1}{2}$ Scalins		a Ducat	0	9	3
240 Grotes		† a Pound Flem.	0	9	0

HOLLAND AND ZEALAND.

Amsterdam, Rotterdam, Middleburg, Flushing, &c.

			£.	s.	d.
† A Pening			0	0	$0\frac{21}{320}$
8 Peningens	=	† a Grote	0	0	$0\frac{21}{40}$
2 Grotes		a Stiver	0	0	$1\frac{1}{20}$
6 Stivers		a Scalin	0	0	$6\frac{3}{10}$
20 Stivers		a Guilder	0	1	9
50 Stivers		a Rixdollar	0	4	$4\frac{1}{4}$

EUROPE, Northern Parts.

HOLLAND, &c.

			£.	s.	d.
60 Stivers	=	a Dry Guilder	0	5	3
105 Stivers		a Ducat	0	9	3
6 Guilders		† a Pound Flem.	0	10	6

GERMANY.

HAMBURG. *Altona, Lubec, Bremen, &c.*

			£.	s.	d.
† A Tryling	=		0	0	$0\frac{3}{128}$
2 Trylings		† a Sexling	0	0	$0\frac{3}{64}$
2 Sexlings		a Fening	0	0	$0\frac{3}{32}$
12 Fenings		a Shilling Lub.	0	0	$1\frac{1}{8}$
16 Shillings		† a Marc	0	1	6
2 Marcs		a Slet Dollar	0	3	0
3 Marcs		a Rixdollar	0	4	6
$6\frac{1}{4}$ Marcs		a Ducat	0	9	$4\frac{1}{2}$
120 Shillings		† a Pound Flem.	0	11	3

HANOVER. *Lunenburg, Zell, &c.*

			£.	s.	d.
† A Fening	=		0	0	$0\frac{7}{48}$
3 Fenings		a Dreyer	0	0	$0\frac{7}{16}$
8 Fenings		a Marien	0	0	$0\frac{1}{6}$
12 Fenings		a Grosh	0	0	$0\frac{3}{4}$
8 Groshen		a Half Gulden	0	1	2
16 Groshen		a Gulden	0	2	4
24 Groshen		† a Rixdollar	0	3	6
32 Groshen		a Double Gulden	0	4	8
4 Guldens		a Ducat	0	9	2

SAXONY AND HOLSTEIN.

Dresden, Leipsic, &c. Wismar, Keil, &c.

			£.	s.	d.
† An Heller	=		0	0	$0\frac{7}{96}$
2 Hellers		a Fening	0	0	$0\frac{7}{48}$
6 Hellers		a Dreyer	0	0	$0\frac{7}{16}$
16 Hellers		a Marien	0	0	$1\frac{1}{6}$
12 Fenings		a Grosh	0	0	$1\frac{3}{4}$
16 Groshen		a Gould	0	2	4
24 Groshen		† a Rixdollar	0	3	6
32 Groshen		a Specie Dollar	0	4	8
4 Goulds		a Ducat	0	9	4

BRANDENBURG AND POMERANIA.

Berlin, Potsdam, &c. Stetin, &c.

			£.	s.	d.
† A Denier	=		0	0	$0\frac{2}{270}$
9 Deniers		a Polchen	0	0	$0\frac{7}{30}$
18 Deniers		a Grosh	0	0	$0\frac{7}{15}$
3 Polchens		an Abrass	0	0	$0\frac{7}{10}$
20 Groshen		† a Marc	0	0	$9\frac{1}{3}$

30 Groshen

EUROPE, Northern Parts.

GERMANY.

BRANDENBURG, &c.

		£.	s.	d.
30 Groſhen	a Florin	0	1	2
90 Groſhen	†a Rixdollar	0	3	6
108 Groſhen	an Albertus	0	4	2
8 Florins	a Ducat	0	9	4

COLOGN. *Mentz, Triers, Liege, Munich, Munſter, Paderbourn, &c.*

		£.	s.	d.
A Dute		0	0	$0\frac{7}{80}$
3 Dutes =	a Cruitzer	0	0	$0\frac{21}{80}$
2 Cruitzers	an Albus	0	0	$0\frac{21}{40}$
8 Dutes	a Stiver	0	0	$0\frac{7}{10}$
3 Stivers	a Plapert	0	0	$2\frac{1}{10}$
4 Plaperts	a Copſtuck	0	0	$2\frac{2}{5}$
40 Stivers	a Guilder	0	2	4
2 Guilders	a Hard Dollar	0	4	8
4 Guilders	a Ducat	0	9	4

BOHEMIA, SILESIA, AND HUNGARY.
Prague, Breſlaw, Preſburg, &c.

		£.	s.	d.
A Fening		0	0	$0\frac{7}{60}$
2 Fenings =	a Dreyer	0	0	$0\frac{3}{30}$
3 Fenings	a Groſh	0	0	$0\frac{7}{20}$
4 Fenings	a Cruitzer	0	0	$0\frac{7}{15}$
2 Cruitzers	a White Groſh	0	0	$0\frac{14}{15}$
60 Cruitzers	a Gould	0	2	4
90 Cruitzers	†a Rixdollar	0	3	6
2 Goulds	a Hard Dollar	0	4	8
4 Goulds	a Ducat	0	9	4

AUSTRIA AND SWABIA.
Vienna, Trieſte, &c. Augsburg, Blenheim, &c.

		£.	s.	d.
A Fening		0	0	$0\frac{7}{60}$
2 Fenings =	a Dreyer	0	0	$0\frac{7}{30}$
4 Fenings	a Cruitzer	0	0	$0\frac{7}{15}$
14 Fenings	a Groſh	0	0	$0\frac{19}{30}$
4 Cruitzers	a Batzen	0	0	$1\frac{13}{15}$
15 Batzen	a Gould	0	2	4
90 Cruitzers	†a Rixdollar	0	3	6
30 Batzen	a Specie dollar	0	4	8
60 Batzen	a Ducat	0	9	4

FRANCONIA. *Francfort, Nuremburg, Dettingen, &c.*

		£.	s.	d.
A Fening		0	0	$0\frac{7}{60}$
4 Fenings	a Cruitzer	0	0	$0\frac{7}{15}$
3 Cruitzers	a Keyſer Groſh	0	0	$1\frac{2}{5}$
4 Cruitzers	a Batzen	0	0	$1\frac{13}{15}$
15 Cruitzers	an Ort Gould	0	0	7
16 Cruitzers	a Gould	0	2	4
90 Cruitzers	†a Rixdollar	0	3	6
2 Goulds	a Hard Dollar	0	4	8
240 Cruitzers	a Ducat	0	9	4

POLAND AND PRUSSIA.
Cracow, Warſaw, &c. Dantzic, Koningsberg, &c.

		£.	s.	d.
A Shelon		0	0	$0\frac{7}{45}$
3 Shelons =	a Groſh	0	0	$0\frac{7}{15}$
5 Groſhen	a Couſtic	0	0	$2\frac{1}{3}$
3 Couſtics	a Tinſe	0	0	7

EUROPE, Northern Parts.

POLAND, &c.

		£.	s.	d.
18 Groſhen =	an Ort	0	0	$8\frac{2}{5}$
30 Groſhen	a Florin	0	1	2
90 Groſhen	†a Rixdollar	0	3	6
8 Florins	a Ducat	0	9	4
5 Rixdollars	a Frederic d'Or	0	17	6

LIVONIA.
Riga, Revel, Narva, &c.

		£.	s.	d.
A Blacken		0	0	$0\frac{7}{96}$
6 Blackens =	a Groſh	0	0	$0\frac{7}{15}$
9 Blackens	a Vording	0	0	$0\frac{7}{10}$
2 Groſhen	a Whiten	0	0	$0\frac{14}{15}$
6 Groſhen	a Marc	0	0	$2\frac{4}{5}$
30 Groſhen	a Florin	0	1	2
90 Groſhen	†a Rixdollar	0	3	6
108 Groſhen	an Albertus	0	4	$2\frac{6}{15}$
64 Whitens	a Copperplate Dollar	0	5	0

DENMARK, ZEALAND, AND NORWAY.
Copenhagen, Sound, &c. Bergen, Drontheim, &c.

		£.	s.	d.
A Skilling		0	0	$0\frac{9}{16}$
6 Skillings =	a Duggen	0	0	$3\frac{3}{8}$
16 Skillings	†a Marc	0	0	9
20 Skillings	a Rixmarc	0	0	$11\frac{1}{4}$
24 Skillings	a Rixort	0	1	$1\frac{1}{2}$
4 Marcs	a Crown	0	3	0
6 Marcs	a Rixdollar	0	4	6
11 Marcs	a Ducat	0	8	3
14 Marcs	a Hatt Ducat	0	10	6

SWEDEN AND LAPLAND.
Stockholm, Upſal, &c. Thorn, &c.

		£.	s.	d.
† A Runſtick		0	0	$0\frac{7}{36}$
2 Runſticks =	a Stiver	0	0	$0\frac{7}{18}$
8 Runſticks	a Copper Marc	0	0	$1\frac{5}{9}$
3 Copper Marcs	a Silver Marc	0	0	$4\frac{2}{3}$
4 Copper Marcs	a Copper Dollar	0	0	$6\frac{2}{9}$
9 Copper Marcs	a Caroline	0	1	2
3 Copper Dollars	a Silver Dollar	0	1	$6\frac{2}{3}$
3 Silver Dollars	a Rixdollar	0	4	8
2 Rixdollars	a Ducat	0	9	4

RUSSIA AND MUSCOVY.
Peterſburg, Archangel, &c. Moſcow, &c.

		£.	s.	d.
A Poluſca		0	0	$0\frac{27}{200}$
2 Poluſcas =	a Denuſca	0	0	$0\frac{27}{100}$
2 Denuſcas	†a Copec	0	0	$0\frac{27}{50}$
3 Copecs	an Altin	0	0	$1\frac{31}{50}$
10 Copecs	a Grievener	0	0	$5\frac{2}{5}$
25 Copecs	a Polpotin	0	1	$1\frac{1}{2}$
50 Copecs	a Poltin	0	2	3
100 Copecs	a Ruble	0	4	6
2 Rubles	a Xervonitz	0	9	0

BASIL. *Zurich, Zug, &c.*

		£.	s.	d.
A Rap		0	0	$0\frac{1}{24}$
3 Rapen =	a Fening	0	0	$0\frac{1}{8}$
4 Fenings	a Cruitzer	0	0	$0\frac{1}{2}$
12 Fenings	†a Sol	0	0	$1\frac{1}{2}$

EUROPE, Southern Parts.

SWITZERLAND.

BASIL, &c.

			£.	s.	d.
15 Fenings	=	a Coarſe Batzen	0	0	$1\frac{7}{8}$
18 Fenings		a Good Batzen	0	0	$2\frac{1}{4}$
20 Sols		† a Livre -	0	2	6
60 Cruitzers		a Gulden -	0	2	6
108 Cruitzers		a Rixdollar, -	0	4	6

ST GALL. *Apenſal, &c.*

			£.	s.	d.
A Heller		- -	0	0	$0\frac{1}{16}$
2 Hellers	=	a Fening -	0	0	$0\frac{1}{8}$
4 Fenings		a Cruitzer -	0	0	$0\frac{1}{2}$
12 Fenings		†a Sol -	0	0	$1\frac{1}{2}$
4 Cruitzers		a Coarſe Batzen	0	0	2
5 Cruitzers		a Good Batzen	0	0	$2\frac{1}{2}$
20 Sols		†a Livre -	0	2	6
60 Cruitzers		a Gould -	0	2	6
102 Cruitzers		a Rixdollar -	0	4	3

BERN. *Lucern, Neufchatel, &c.*

			£.	s.	d.
A Denier		- -	0	0	$0\frac{1}{10}$
4 Deniers	=	a Cruitzer -	0	0	$0\frac{2}{5}$
3 Cruitzers		†a Sol -	0	0	$1\frac{1}{5}$
4 Cruitzers		a Plapert -	0	0	$1\frac{3}{5}$
5 Cruitzers		a Gros -	0	0	2
6 Cruitzers		a Batzen -	0	0	$2\frac{2}{5}$
20 Sols		†a Livre -	0	2	0
75 Cruitzers		a Gulden -	0	2	6
135 Cruitzers		a Crown -	0	4	6

GENEVA. *Pekay, Bonne, &c.*

			£.	s.	d.
A Denier		- -	0	0	$0\frac{1}{32}$
2 Deniers	=	a Denier current	0	0	$0\frac{1}{16}$
12 Deniers		a Small Sol	0	0	$0\frac{3}{8}$
12 Deniers current		a Sol current	0	0	$0\frac{3}{4}$
12 Small Sols		†a Florin -	0	0	$4\frac{1}{2}$
20 Sols current		†a Livre current	0	1	3
$10\frac{1}{2}$ Florins		a Patacon -	0	3	$11\frac{1}{4}$
$15\frac{3}{4}$ Florins		a Croiſade -	0	5	$10\frac{7}{8}$
24 Florins		a Ducat -	0	9	0

FRANCE and NAVARRE.

Liſle, Cambray, Valenciennes, &c.

			£.	s.	d.
A Denier		- -	0	0	$0\frac{1}{24}$
12 Deniers	=	a Sol -	0	0	$0\frac{1}{2}$
15 Deniers		†a Patard -	0	0	$0\frac{5}{8}$
15 Patards		†a Piette -	0	0	$9\frac{3}{4}$
20 Sols		a Livre Tournois	0	0	10
20 Patards		†a Florin -	0	1	$0\frac{1}{2}$
60 Sols		an Ecu of Ex.	0	2	6
$10\frac{1}{2}$ Livres		a Ducat -	0	9	3
24 Livres		a Louis d'Or	1	0	0

Dunkirk, St Omers, St Quintin, &c.

			£.	s.	d.
A Denier		- -	0	0	$0\frac{1}{24}$
12 Deniers	=	a Sol -	0	0	$0\frac{1}{2}$
15 Deniers		†a Patard	0	0	$0\frac{5}{8}$
15 Sols		†a Piette	0	0	$7\frac{1}{2}$
20 Sols		†a Livre Tournois	0	0	10
3 Livres		an Ecu of Ex.	0	2	6
24 Livres		a Louis d'Or	1	0	0
$25\frac{1}{2}$ Livres		a Guinea -	1	1	0
$32\frac{2}{5}$ Livres		a Moeda -	1	7	0

Paris, Lyons, Marſeilles, &c. Bourdeaux, Bayonne, &c.

			£.	s.	d.
A Denier		- -	0	0	$0\frac{1}{24}$
3 Deniers	=	a Liard -	0	0	$0\frac{1}{8}$
2 Liards		a Dardene -	0	0	$0\frac{1}{4}$
12 Deniers		a Sol -	0	0	$0\frac{1}{2}$
20 Sols		†a Livre Tournois	0	0	10
60 Sols		an Ecu of Ex. -	0	2	6
6 Livres		an Ecu -	0	5	0
10 Livres		†a Piſtole -	0	8	4
24 Livres		a Louis d'Or -	1	0	0

PORTUGAL. *Liſbon, Oporto, &c.*

			£.	s.	d.
† A Re		-	0	0	$0\frac{27}{400}$
10 Rez	=	a Half Vintin	0	0	$0\frac{27}{40}$
20 Rez		a Vintin	0	0	$1\frac{7}{20}$
5 Vintins		a Teſtoon -	0	0	$6\frac{3}{4}$
4 Teſtoons		a Cruſade of Ex.	0	2	3
24 Vintins		a New Cruſade	0	2	$8\frac{2}{5}$
10 Teſtoons		†a Milre -	0	5	$7\frac{1}{2}$
48 Teſtoons		a Moeda -	1	7	0
64 Teſtoons		a Joaneſe -	1	16	0

EUROPE, Southern Parts.

SPAIN and CATALONIA.

Madrid, Cadiz, Seville, &c. New Plate.

			£.	s.	d.
A Maravedie		- -	0	0	$0\frac{43}{272}$
2 Maravedies	=	a Quartil, -	0	0	$0\frac{43}{136}$
34 Maravedies		a Rial -	0	0	$5\frac{3}{8}$
2 Rials		a Piſtarine	0	0	$10\frac{3}{4}$
8 Rials		†a Piaſtre of Ex.	0	3	7
10 Rials		a Dollar -	0	4	6
375 Maravedies		†a Ducat of Ex.	0	4	$11\frac{1}{2}$
32 Rials		†a Piſtole of Ex.	0	14	4
36 Rials		a Piſtole -	0	16	9

Gibraltar, Malaga, Denia, &c. Velon.

			£.	s.	d.
†A Maravedie		- -	0	0	$0\frac{23}{272}$
2 Maravedies	=	an Ochavo -	0	0	$0\frac{23}{136}$
4 Maravedies		†a Quartil	0	0	$0\frac{23}{68}$
34 Maravedies		†a Rial Velon	0	0	$2\frac{7}{8}$
15 Rials		a Piaſtre of Ex.	0	3	7
512 Maravedies		†a Piaſtre -	0	3	7
60 Rials		†a Piſtole of Ex.	0	14	4
2048 Maravedies		a Piſtole of Ex.	0	16	9
78 Rials		a Piſtole -	0	16	9

Barcelona, Saragoſſa, Valencia, &c. Old Plate.

			£.	s.	d.
A Maravedie		- -	0	0	$0\frac{27}{128}$
16 Maravedies	=	a Soldo -	0	0	$3\frac{3}{8}$
2 Soldos		a Rial Old Plate	0	0	$6\frac{3}{4}$
20 Soldos		†a Libra -	0	5	$7\frac{1}{2}$
24 Soldos		†a Ducat -	0	6	9
16 Soldos		†a Dollar -	0	4	6
22 Soldos		†a Ducat -	0	6	$2\frac{1}{4}$
21 Soldos		†a Ducat -	0	5	$10\frac{7}{8}$
60 Soldos		a Piſtole -	0	16	9

ITALY.

GENOA. *Novi, &c.* CORSICA. *Baſtia, &c.*

			£.	s.	d.
A Denari		- -	0	0	$0\frac{43}{1200}$
12 Denari	=	a Soldi -	0	0	$0\frac{43}{100}$
4 Soldi		a Chevalet	0	0	$1\frac{18}{25}$
20 Soldi		†a Lire -	0	0	$8\frac{3}{5}$
30 Soldi		a Teſtoon	0	1	$0\frac{9}{10}$

EUROPE, Southern Parts.

ITALY.

GENOA, &c.

			£.	s.	d.
5 Lires	=	a Croiſade -	0	3	7
115 Soldi		† a Pezzo of Ex.	0	4	2
6 Teſtoons		a Genouine	0	6	2
20 Lires		a Piſtole -	0	14	4

PIEDMONT, SAVOY, AND SARDINIA.
Turin, Chamberry, Cagliari, &c.

			£.	s.	d.
A Denari		- - -	0	0	$0\frac{1}{16}$
3 Denari	=	a Quatrini -	0	0	$0\frac{3}{16}$
12 Denari		a Soldi -	0	0	$0\frac{3}{4}$
12 Soldi		† a Florin -	0	0	9
20 Soldi		† a Lire -	0	1	3
6 Florins		a Scudi -	0	4	6
7 Florins		a Ducatoon -	0	5	3
13 Lires		a Piſtole -	0	16	3
16 Lires		a Louis d'Or	1	0	0

Milan, Modena, Parma, Pavia, &c.

			£.	s.	d.
A Denari		- - -	0	0	$0\frac{3}{82}$
3 Denari	=	a Quatrini -	0	0	$0\frac{9}{82}$
12 Denari		a Soldi -	0	0	$0\frac{18}{41}$
20 Soldi		† a Lire -	0	0	$8\frac{32}{41}$
115 Soldi		a Scudi current	0	4	$2\frac{1}{2}$
117 Soldi		† a Scudi of Ex.	0	4	3
6 Lires		a Philip -	0	4	$4\frac{1}{2}$
22 Lires		a Piſtole -	0	16	0
23 Lires		a Spaniſh Piſtole	0	16	9

Leghorn, Florence, &c.

			£.	s.	d.
A Denari		- - -	0	0	$0\frac{5}{144}$
4 Denari	=	a Quatrini -	0	0	$0\frac{5}{36}$
12 Denari		a Soldi -	0	0	$0\frac{5}{12}$
5 Quatrini		a Craca -	0	0	$0\frac{25}{36}$
8 Cracas		a Quilo -	0	0	$5\frac{5}{9}$
20 Soldi		† a Lire -	0	0	$8\frac{1}{3}$
6 Lires		a Piaſtre of Ex.	0	4	2
$7\frac{1}{2}$ Lires		a Ducat -	0	5	$2\frac{1}{2}$
22 Lires		a Piſtole -	0	15	6

ROME. *Civita Vecchia, Ancona.*

			£.	s.	d.
A Quatrini		- -	0	0	$0\frac{3}{10}$
5 Quatrini	=	a Bayoc -	0	0	$0\frac{3}{4}$
8 Bayocs		a Julio -	0	0	6
10 Bayocs		a Stampt Julio	0	0	$7\frac{1}{2}$
24 Bayocs		a Teſtoon -	0	1	6
10 Julios		a Crown current	0	5	0
12 Julios		† a Crown ſtampt	0	6	0
18 Julios		a Chequin -	0	9	0
31 Julios		a Piſtole -	0	15	6

NAPLES. *Gaeta, Capua, &c.*

			£.	s.	d.
A Quatrini		- -	0	0	$0\frac{2}{15}$
3 Quatrini	=	a Grain -	0	0	$0\frac{2}{5}$
10 Grains		a Carlin -	0	0	4
40 Quatrini		a Paulo -	0	0	$5\frac{1}{3}$
20 Grains		a Tarin -	0	0	8
40 Grains		a Teſtoon -	0	1	4
100 Grains		a Ducat of Ex.	0	3	4
23 Tarins		a Piſtole -	0	15	4
25 Tarins		a Spaniſh Piſtole	1	16	9

EUROPE, Southern Parts.

ITALY.

SICILY and MALTA. *Palermo, Meſſina, &c.*

			£.	s.	d.
A Pichila		- - -	0	0	$0\frac{1}{39}$
6 Pichili	=	a Grain -	0	0	$0\frac{2}{13}$
8 Pichili		a Ponti -	0	0	$0\frac{8}{39}$
10 Grains		a Carlin -	0	0	$1\frac{7}{13}$
20 Grains		a Tarin -	0	0	$3\frac{1}{13}$
6 Tarins		† a Florin of Ex.	0	0	$7\frac{6}{13}$
13 Tarins		a Ducat of Ex.	0	3	4
60 Carlins		† an Ounce -	0	7	$8\frac{4}{13}$
2 Ounces		a Piſtole -	0	15	4

Bologna, Ravenna, &c.

			£.	s.	d.
A Quatrini		- -	0	0	$0\frac{1}{16}$
6 Quatrini	=	a Bayoc -	0	0	$0\frac{3}{8}$
10 Bayocs		† a Julio -	0	0	6
20 Bayocs		a Lire -	0	1	0
3 Julios		a Teſtoon -	1	1	6
80 Bayocs		a Schudi of Ex.	0	4	3
105 Bayocs		a Ducatoon -	0	5	3
100 Bayocs		a Crown -	0	5	0
31 Julios		a Piſtole -	0	15	6

VENICE. *Bergham, &c.*

			£.	s.	d.
A Picoli		- - -	0	0	$0\frac{1}{36}$
12 Picoli	=	a Soldi -	0	0	$0\frac{1}{3}$
$6\frac{1}{2}$ Soldi		† a Gros -	0	0	$2\frac{1}{6}$
18 Soldi		a Jule -	0	0	6
20 Soldi		† a Lire -	0	0	$6\frac{2}{3}$
3 Jules		a Teſtoon -	0	1	6
124 Soldi		a Ducat current	0	3	$5\frac{1}{3}$
24 Gros		† a Ducat of Ex.	0	4	4
17 Lires		a Chequin -	0	9	2

Turkey. *Morea, Candia, Cyprus, &c.*

			£.	s.	d.
A Mangar		- - -	0	0	$0\frac{3}{20}$
4 Mangars	=	† an Aſper -	0	0	$0\frac{3}{5}$
3 Aſpers		a Parac -	0	0	$1\frac{4}{5}$
5 Aſpers		a Beſtic -	0	0	3
10 Aſpers		an Oſtic -	0	0	6
20 Aſpers		a Solota -	0	1	0
80 Aſpers		† a Piaſtre -	0	4	0
100 Aſpers		a Caragrouch -	0	5	0
10 Solotas		a Xeriff -	0	10	0

ARABIA. *Medina, Mecca, Mocha, &c.*

			£.	s.	d.
A Carret		- - -	0	0	$0\frac{1}{8}$
$5\frac{1}{2}$ Carrets	=	a Caveer -	0	0	$0\frac{125}{200}$
7 Carrets		a Comaſhee -	0	0	$0\frac{9}{16}$
80 Carrets		a Larin -	0	0	$10\frac{1}{8}$
18 Comaſhees		an Abyſs -	0	1	$4\frac{1}{5}$
60 Comaſhees		† a Piaſtre -	0	4	6
80 Caveers		a Dollar -	0	4	6
100 Comaſhees		a Sequin -	0	7	6
80 Larins		† a Tomond -	3	7	6

PERSIA. *Iſpahan, Ormus Gombroon, &c.*

			£.	s.	d.
A Coz		- - - -	0	0	$0\frac{2}{5}$
4 Coz	=	a Biſti -	0	0	$1\frac{3}{5}$
10 Coz		a Shahee -	0	0	4
20 Coz		a Mamooda -	0	0	8
25 Coz		a Larin -	0	0	10
4 Shahees		an Abaſhee -	0	1	4

5 Abaſhees

ASIA. MOGUL.

			£.	s.	d.
5 Abashees	=	an Or	0	8	6
12 Abashees		a Bovello	0	16	0
50 Abashees		† a Tomond	3	6	8

GUZZERAT. *Surat, Cambay, &c.*

A Pecka			0	0	$0\frac{15}{64}$
2 Peckas	=	a Pice	0	0	$0\frac{15}{32}$
4 Pices		a Fanam	0	0	$1\frac{7}{8}$
5 Pices		a Viz	0	0	$2\frac{11}{32}$
10 Pices		an Ana	0	0	$7\frac{1}{2}$
4 Anas		a Rupee	0	2	6
2 Rupees		an English Crown	0	5	0
14 Anas		a Pagoda	0	8	9
4 Pagodas		a Gold Rupee	1	15	0

MALABAR.

Bombay, Dabul, &c.

† A Budgrook			0	0	$0\frac{27}{800}$
2 Budgrooks	=	† a Re	0	0	$0\frac{27}{400}$
5 Rez		a Pice	0	0	$0\frac{27}{80}$
16 Pices		a Laree	0	0	$5\frac{2}{5}$
20 Pices		a Quarter	0	0	$6\frac{3}{4}$
240 Rez		a Xeraphim	0	1	$4\frac{1}{5}$
4 Quarters		a Rupee	0	2	3
14 Quarters		a Pagoda	0	8	0
60 Quarters		a Gold Rupee	1	15	0

Goa, Visapour, &c.

† A Re			0	0	$0\frac{27}{400}$
2 Rez	=	a Bazaraco	0	0	$0\frac{27}{200}$
2 Bazaracos		a Pecka	0	0	$0\frac{27}{100}$
20 Rez		a Vintin	0	0	$1\frac{7}{20}$
4 Vintins		a Laree	0	0	$5\frac{2}{5}$
3 Larees		a Xeraphim	0	1	$4\frac{1}{5}$
42 Vintins		a Tangu	0	4	6
4 Tangus		a Paru	0	18	0
8 Tangus		a Gold Rupee	1	15	0

COROMANDEL. *Madrass, Pondicherry, &c.*

A Cash			0	0	$0\frac{5}{32}$
5 Cash	=	a Viz	0	0	$0\frac{3}{16}$
2 Viz		a Pice	0	0	$0\frac{3}{8}$
6 Pices		a Pical	0	0	$2\frac{1}{4}$
8 Pices		a Fanam	0	0	3
10 Fanams		a Rupees	0	2	6
2 Rupee		an English Crown	0	5	0
36 Fanams		a Pagoda	0	8	9
4 Pagodas		a Gold Rupee	1	15	0

BENGAL. *Callicut, Calcutta, &c.*

A Pice			0	0	$0\frac{5}{32}$
4 Pices	=	a Fanam	0	0	$0\frac{5}{8}$
6 Pices		a Viz	0	0	$0\frac{15}{16}$
12 Pices		an Ana	0	0	$1\frac{7}{8}$
10 Anas		a Fiano	0	1	$6\frac{3}{4}$
16 Anas		a Rupee	0	2	6
2 Rupees		a French Ecu	0	5	0
2 Rupees		an English Crown	0	5	0
56 Anas		a Pagoda	0	8	9

ASIA.

SIAM. *Pegu, Malacca, Cambodia, Sumatra, Java, Borneo, &c.*

			£.	s.	d.
A Cori			0	0	$0\frac{3}{4000000}$
800 Cori	=	a Fettee	0	0	$0\frac{3}{50}$
125 Fettees		a Sateleer	0	0	$7\frac{1}{2}$
250 Fettees		a Sooco	0	1	3
500 Fettees		a Tutal	0	2	6
900 Fettees		a Dollar	0	4	6
2 Ticals		a Rial	0	5	0
4 Soocos		an Ecu	0	5	0
8 Sateleers		a Crown	0	5	0

CHINA. *Pekin, Canton, &c.*

A Caxa			0	0	$0\frac{2}{25}$
10 Caxa	=	a Candereen	0	0	$0\frac{4}{5}$
10 Candereens		a Mace	0	0	8
35 Candereens		a Rupee	0	2	6
2 Rupees		a Dollar	0	4	6
70 Candereens		a Rixdollar	0	4	$4\frac{1}{2}$
7 Maces		an Ecu	0	5	0
2 Rupees		a Crown	0	5	0
10 Maces		† a Tale	0	6	8

JAPAN. *Jeddo, Meaco, &c.*

A Piti			0	0	$0\frac{1}{5}$
20 Pitis	=	a Mace	0	0	4
15 Maces		an Ounce Silver	0	4	$10\frac{1}{3}$
20 Maces		a Tale	0	6	8
30 Maces		an Ingot	0	9	$8\frac{2}{3}$
13 Ounces Silver		an Ounce Gold	3	3	0
2 Ounces Gold		a Japanese	6	6	0
2 Japaneses		a Double	12	12	0
21 Ounces Gold		† a Cattee	66	3	0

AFRICA.

EGYPT. *Old and New Cairo, Alexandria, Sayde, &c.*

An Asper			0	0	$0\frac{5}{9}$
3 Aspers	=	a Medin	0	0	$1\frac{2}{3}$
24 Medins		an Italian Ducat	0	3	4
80 Aspers		† a Piastre	0	4	0
30 Medins		a Dollar	0	4	6
96 Aspers		a Ecu	0	5	0
32 Medins		a Crown	0	5	0
200 Aspers		a Sultanin	0	10	0
70 Medins		a Pargo Dollar	0	10	0

BARBARY. *Algiers, Tunis, Tripoli, Una, &c.*

An Asper			0	0	$0\frac{5}{9}$
3 Aspers	=	a Medin	0	0	$1\frac{2}{3}$
10 Aspers		a Rial old Plate	0	0	$6\frac{3}{4}$
2 Rials		a Double	0	1	$1\frac{1}{2}$
4 Doubles		a Dollar	0	4	6
24 Medins		a Silver Chequin	0	3	4
30 Medins		a Dollar	0	4	6
180 Aspers		a Zequin	0	8	10
15 Doubles		a Pistole	0	16	9

MOROCCO. *Santa Cruz, Mequinez, Fez, Tangiers, Sallee, &c.*

A Fluce			0	0	$0\frac{1}{12}$
24 Fluces	=	a Blanquin	0	0	2

4 Blanquils

AFRICA.

MOROCCO, &c.

			£.	s.	d.
4 Blanquils	=	an Ounce	0	0	8
7 Blanquils		an Octavo	0	1	2
14 Blanquils		a Quarto	0	2	4
2 Quartos		a Medio	0	4	8
28 Blanquils		a Dollar	0	4	6
54 Blanquils		a Xequin	0	9	0
100 Blanquils		a Piſtole	0	16	9

AMERICA. WEST-INDIES.

ENGLISH. *Jamaica, Barbadoes, &c.*

			£.	s.	d.
† Halfpenny			0	0	$0\frac{57}{160}$
2 Halfpence	=	† a Penny	0	0	$0\frac{57}{80}$
$7\frac{1}{2}$ Pence		a Bit	0	0	$5\frac{3}{8}$
12 Pence		† a Shilling	0	0	$8\frac{11}{20}$
75 Pence		a Dollar	0	4	6
7 Shillings		a Crown	0	5	0
20 Shillings		† a Pound	0	14	3
24 Shillings		a Piſtole	0	16	9
30 Shillings		a Guinea	1	1	0

FRENCH. *St Domingo, Martinico, &c.*

			£.	s.	d.
† A Half Sol			0	0	$0\frac{117}{640}$
2 Half Sols	=	† a Sol	0	0	$0\frac{117}{320}$
$7\frac{1}{2}$ Sols		a Half Scalin	0	0	$2\frac{11}{16}$
15 Sols		a Scalin	0	0	$5\frac{3}{8}$
20 Sols		† a Livre	0	0	$7\frac{5}{16}$
7 Livres		a Dollar	0	4	6
8 Livres		an Ecu	0	4	$10\frac{1}{2}$
26 Livres		a Piſtole	0	16	9
32 Livres		a Louis d'Or	1	0	0

AMERICA. CONTINENT.

ENGLISH. *Nova Scotia, Virginia, New England, &c.*

			£.	s.	d.
† A Penny			0	0	1
12 Pence	=	† a Shilling	0	1	0
20 Shillings		† a Pound	1	0	0
2 Pounds					
3 Pounds					
4 Pounds					
5 Pounds					
6 Pounds					
7 Pounds					
8 Pounds					
9 Pounds					
10 Pounds					

The value of the Currency alters according to the Plenty or Scarcity of Gold and Silver Coins that are imported.

Canada, Florida, Cayenne, &c.

† A Denier		
12 Deniers	=	† a Sol.
20 Sols		† a Livre.
2 Livres		
3 Livres		
4 Livres		
5 Livres		
6 Livres		
7 Livres		
8 Livres		
9 Livres		
10 Livres		

The value of the Currency alters according to the Plenty or Scarcity of Gold and Silver Coins that are imported.

Note. For all the *Spaniſh*, *Portugueſe*, *Dutch*, and *Daniſh* Dominions, either on the Continent or in the Weſt Indies, ſee the Moneys of the reſpective nations.

Ancient Money. See COINS and MEDALS.

Paper Money. See the article BANK.

MONK anciently denoted, "a perſon who retired from the world to give himſelf up wholly to God, and to live in ſolitude and abſtinence." The word is derived from the Latin *monachus*, and that from the Greek μοναχος, "ſolitary;" of μονος, *ſolus*, "alone."

The origin of monks ſeems to have been this: The perſecutions which attended the firſt ages of the Goſpel forced ſome Chriſtians to retire from the world, and live in deſerts and places moſt private and unfrequented, in hopes of finding that peace and comfort among beaſts which were denied them among them. And this being the caſe of ſome very extraordinary perſons, their example gave ſo much reputation to retirement, that the practice was continued when the reaſon of its commencement ceaſed. After the empire became Chriſtian, inſtances of this kind were numerous; and thoſe whoſe ſecurity had obliged them to live ſeparately and apart, became afterwards united into ſocieties. We may alſo add, that the myſtic theology, which gained ground towards the cloſe of the third century, contributed to produce the ſame effect, and to drive men into ſolitude for the purpoſes of enthuſiaſtic devotion.

The monks, at leaſt the ancient ones, were diſtinguiſhed into *ſolitaries*, *cœnobites*, and *ſarabaites*.

The *ſolitary* are thoſe who live alone, in places remote from all towns and habitations of men, as do ſtill ſome of the hermits. The *cœnobites* are thoſe who live in community with ſeveral others in the ſame houſe, and under the ſame ſuperiors. The *ſarabaites* were ſtrolling monks, having no fixed rule or reſidence.

The houſes of monks again were of two kinds, viz. *monaſteries* and *lauræ*. See MONASTERY and LAURA.

Thoſe we call monks now-a-days are cœnobites, who live together in a convent or monaſtery, who make vows of living according to a certain rule eſtabliſhed by the founder, and wear a habit which diſtinguiſhes their order.

Thoſe that are endowed, or have a fixed revenue, are moſt properly called monks, *monachi*; as the Chartreux, Benedictines, Bernardines, &c. The Mendicants, or thoſe that beg, as the Capuchins and Franciſcans, are more properly called *religious* and *friars*; though the names are frequently confounded.

The firſt monks were thoſe of St Anthony; who, towards the cloſe of the fourth century, formed them into a regular body, engaged them to live in ſociety with each other, and preſcribed to them fixed rules for the direction of their conduct. Theſe regulations, which Anthony had made in Egypt, were ſoon introduced into Paleſtine and Syria by his diſciple Hilarion. Almoſt about the ſame time, Aones or Eugenius, with their companions Gaddanas and Azyzas, inſtituted the monaſtic order in Meſopotamia and the adjacent countries; and their example was followed with ſuch rapid ſucceſs, that

that in a ſhort time the whole eaſt was filled with a lazy ſet of mortals, who, abandoning all human connexions, advantages, pleaſures, and concerns, wore out a languiſhing and miſerable life amidſt the hardſhips of want, and various kinds of ſuffering, in order to arrive at a more cloſe and rapturous communication with God and angels.

From the eaſt this gloomy inſtitution paſſed into the weſt, and firſt into Italy and its neighbouring iſlands; though it is uncertain who tranſplanted it thither. St Martin, the celebrated biſhop of Tours, erected the firſt monaſteries in Gaul, and recommended this religious ſolitude with ſuch power and efficacy, both by his inſtructions and his example, that his funeral is ſaid to have been attended by no leſs than 2000 monks. From hence the monaſtic diſcipline extended gradually its progreſs though the other provinces and countries of Europe. There were beſides the monks of St Baſil (called in the Eaſt *Calogeri*, from καλος γερων, "good old man") and thoſe of St Jerome, the hermits of St Auguſtine, and afterwards thoſe of St Benedict and St Bernard; at length came thoſe of St Francis and St Dominic, with a legion of others; all which ſee under their proper heads, Benedictines, &c.

Towards the cloſe of the 5th century, the monks, who had formerly lived only for themſelves in ſolitary retreats, and had never thought of aſſuming any rank among the ſacerdotal order, were now gradually diſtinguiſhed from the populace, and endowed with ſuch opulence and honourable privileges that they found themſelves in a condition to claim an eminent ſtation among the ſupports and pillars of the Chriſtian community. The fame of their piety and ſanctity was ſo great, that biſhops and preſbyters were often choſen out of their order; and the paſſion of erecting edifices and convents, in which the monks and holy virgins might ſerve God in the moſt commodious manner, was at this time carried beyond all bounds. However their licentiouſneſs, even in this century, was become a proverb; and they are ſaid to have excited the moſt dreadful tumults and ſeditions in various places. The monaſtic orders were at firſt under the immediate juriſdiction of the biſhops, from which they were exempted by the Roman pontiff about the end of the 7th century; and the monks, in return, devoted themſelves wholly to advance the intereſts and to maintain the dignity of the biſhop of Rome. This immunity which they obtained was a fruitful ſource of licentiouſneſs and diſorder, and occaſioned the greateſt part of the vices with which they were afterwards ſo juſtly charged. In the 8th century the monaſtic diſcipline was extremely relaxed both in the eaſtern and weſtern provinces, and all efforts to reſtore it were ineffectual. Nevertheleſs, this kind of inſtitution was in the higheſt eſteem, and nothing could equal the veneration that was paid about the cloſe of the 9th century to ſuch as devoted themſelves to the ſacred gloom and indolence of a convent. This veneration induced ſeveral kings and emperors to call them to their courts, and to employ them in civil affairs of the greateſt moment. Their reformation was attempted by Louis the Meek, but the effect was of ſhort duration. In the 11th century they were exempted by the popes from the authority of their ſovereigns, and new orders of monks were continually eſtabliſhed; inſomuch that in the council of Lateran that was held in the year 1215, a decree was paſſed, by the advice of Innocent III. to prevent any new monaſtic inſtitutions; and ſeveral were entirely ſuppreſſed. In the 15th and 16th cenuries, it appears, from the teſtimonies of the beſt writers, that the monks were generally lazy, illiterate, profligate, and licentious epicures, whoſe views in life were confined to opulence, idleneſs, and pleaſure. However, the Reformation had a manifeſt influence in reſtraining their exceſſes, and rendering them more circumſpect and cautious in their external conduct.

Monks are diſtinguiſhed by the colour of their habits into *black*, *white*, *gray*, &c. Among the monks, ſome are called *monks of the choir*, others *profeſſed monks*, and others *lay monks*; which laſt are deſtined for the ſervice of the convent, and have neither clericate nor literature.

Cloiſtered Monks, are thoſe who actually reſide in the houſe: in oppoſition to *extra*-monks, who have benefices depending on the monaſtery.

Monks are alſo diſtinguiſhed into *reformed*, whom the civil and eccleſiaſtical authority have made maſters of ancient convents, and put in their power to retrieve the ancient diſcipline, which had been relaxed; and *ancient*, who remain in the convent, to live in it according to its eſtabliſhment at the time when they made their vows, without obliging themſelves to any new reform.

Anciently the monks were all laymen, and were only diſtinguiſhed from the reſt of the people by a particular habit and an extraordinary devotion. Not only the monks were prohibited the prieſthood, but even prieſts were expreſsly prohibited from becoming monks, as appears from the letters of St Gregory. Pope Syricius was the firſt who called them to the clericate, on occaſion of ſome great ſcarcity of prieſts, that the church was then ſuppoſed to labour under: and ſince that time, the prieſthood has been uſually united to the monaſtical profeſſion.

Monk, *George*, a perſonage memorable for having been the principal agent in reſtoring Charles II. to his crown, was deſcended from a very ancient family, and born in Devonſhire in 1608. Being an unprovided younger ſon, he dedicated himſelf to arms from his youth, and obtained a pair of colours in the expedition to the Iſle of Rhée: he ſerved afterwards in the Low Countries with reputation, in both King Charles's northern expeditions; and did ſuch ſervice in quelling the Iriſh rebellion, that he was appointed governor of Dublin, but was ſuperſeded by parliamentary authority. Being made major-general of the Iriſh brigade employed in the ſiege of Nantwich in Cheſhire, he was taken priſoner by Sir Thomas Fairfax, and remained confined in the Tower of London until the year 1646; when, as the means of obtaining liberty, he took the covenant, and accepted a command in the Iriſh ſervice under the parliament. He obtained the command in chief of all the parliamentary forces in the north of Ireland, where he did ſignal ſervices, until he was called to account for a treaty made with the Iriſh rebels; a circumſtance which was only obliterated by his future good fortune. He ſerved in Scotland under Oliver Cromwell with ſuch ſucceſs, that he was left there as commander in chief; and he was one of the commiſſioners for uniting that kingdom with the new erected commonwealth.

He

He ferved at fea alfo againft the Dutch; and was treated fo kindly on his return, that Oliver is faid to have grown jealous of him. He was, however, again fent to Scotland as commander in chief, and continued there five years: when he diffembled fo well, and improved circumftances fo dexteroufly, that he aided the defires of a wearied peoole, and reftored the king without any difturbance: for which he was immediately rewarded both with honours and profit: (See BRITAIN, N° 194, &c.)—He was created duke of Albemarle, with a grant of 7000l. *per annum* eftate, befide other emoluments; and enjoyed the confidence of his mafter without forfeiting that of the people. After his death in 1670, there was publifhed a treatife compofed by him while he remained prifoner in the Tower, entitled, "Obfervations on Military and Political Affairs," a fmall folio.

MONK-Fifh. See SQUALUS, ICHTHYOLOGY *Index*.

MONK's Head, or *Wolf's bane*. See ACONITUM, BOTANY *Index*.

MONKEY. See SIMIA, MAMMALIA *Index*.

MONMOUTH, JAMES, DUKE OF, fon to Charles II. by Mrs Lucy Walters, was born at Rotterdam in 1649. Upon the Reftoration, he was called over to England, where the king received him with all imaginable joy, created him earl of Orkney (which was changed into that of Monmouth), and he took his feat in the houfe of peers in the enfuing feffion of parliament. He married Anne, the heirefs of Francis earl of Buccleugh; and hence it came to pafs that he had alfo the title of *Buccleugh*, and took the furname of *Scot*, according to the cuftom of Scotland. In 1668 his father made him captain of his life-guard of horfe; and in 1672 he attended the French king in the Netherlands, and gave proofs of bravery and conduct. In 1673 the king of France made him lieutenant-general of his army, with which he came before Maeftricht, and behaved himfelf with incredible gallantry, being the firft who entered it himfelf. He returned to England, was received with all poffible refpect, and was received chancellor of the univerfity of Cambridge. After this he went to affift the prince of Orange to raife the fiege of Mons, and did not a little contribute towards it. He returned to England; and was fent in quality of his father's general, to quell an infurrection in Scotland, whch he effected; but foon after he fell into difgrace; for, being a Proteftant, he was deluded into ambitious fchemes, upon the hopes of the exclufion of the duke of York: he confpired againft his father and the duke and when the latter came to the throne by the title of *James II.* he openly appeared in arms, encouraged by the Proteftant army; but coming to a decifive battle before he had fufficient forces to oppofe the royal army, he was defeated, taken foon after concealed in a ditch, tried for high treafon, condemned, and beheaded in 1685, aged 36. See BRITAIN, N° 242, 249—265.

MONMOUTH, the capital of the county of Monmouthfhire in England, 129 miles from London.—It has its name from its fituation at the conflux of the Monow or Mynwy, and the Wye, over each of which it has a bridge, and a third over the Frothy.—Here was a caftle in William the Conqueror's time, which Henry III. took from John baron of Monmouth. It afterwards came to the houfe of Lancafter, who beftowed many privileges upon the town. Here Henry V. furnamed *of Monmouth*, was born. The famous hiftorian Geoffrey was alfo born at this place. Formerly it gave the title of *earl* to the family of Carey, and of *duke* to King Charles the Second's eldeft natural fon; but now of *earl* to the Mordaunts, who are alfo earls of Peterborough. It is a populous and well-built place, and carries on a confiderable trade with Briftol by means of the Wye. It has a weekly market, and three fairs.

MONMOUTHSHIRE, a county of England; anciently reckoned a part of Wales, but in Charles II.'s time taken into the Oxford circuit, and made an Englifh county. It is bounded on the north by Herefordfhire, on the eaft by Gloucefterfhire, on the fouth by the river Severn, and on the weft by the Welfh counties of Brecknock and Glamorgan. Its extent from north to fouth is about 30 miles, from eaft to weft 26, and in circumference 110. It is fubdivided into fix hundreds, and 127 parifhes. In 1801, this county contained 8948 houfes, and 9903 families. The whole population amounted to 45,582 perfons. It fends only three members to parliament, that is, one for Monmouth, and two for the county. The air is temperate and healthy; and the foil fruitful, though mountainous and woody. The hills feed fheep, goats, and horned cattle; and the valleys produce plenty of grafs and corn. This county is extremely well watered by feveral fine rivers; for, befides the Wye, which parts it from Gloucefterfhire, the Mynow, which runs between it and Herefordfhire, and the Rumney, which divides it from Glamorganfhire, it has, peculiar to itfelf, the Ufk, which enters this county a little above Abergavenny, runs moftly fouthward, and falls into the Severn by the mouth of the Ebwith; which laft river runs from north to fouth, in the weftern fide of the county. All thefe rivers, efpecially the Wye and Ufk, abound with fifh, particularly falmon and trout.

MONOCEROS, UNICORN, in *Aftronomy*, a fouthern conftellation formed by Hevelius, containing in his catalogue 19 ftars, and in the Britannic Catalogue 31.

MONOCEROS. See MONODON, CETOLOGY *Index*.

MONOCHORD; an inftrument by which the feveral proportions of mufical founds and intervals, as well in the natural as in tempered fcales are tried. Originally it had, as its name implies, only one ftring; but it is better conftructed with two; for, by means of this additional ftring, we have an opportunity of judging of the harmony of two tempered notes in every poffible variety of temperament.

The reader who may wifh for further information refpecting the conftruction and ufe of monochords, may confult the appendix to Mr Atwood's Treatife on Rectilinear Motion, and Mr Jones's obfervations on the fcale of mufic, monochord, &c. in his Phyfiological Difquifitions.

MONOCHORD is alfo ufed for any mufical inftrument that confifts of only one ftring or chord; in this fenfe the trumpet marine may properly be called a *monochord*.

MONOCULUS, a genus of infects of the order of *aptera*. See ENTOMOLOGY *Index*.

MONODON, a genus of fifhes belonging to the order of *cete*. See CETOLOGY *Index*.

MONODY, in ancient poetry, a mournful kind of fong,

fong, fung by a perfon all alone, to give vent to his grief. The word is derived from μονος, "alone," and κιξω, "I fing."

MONOECIA, from μονος, *alone*, and οικος, a *houfe*; the name of the 21ft clafs in Linnæus's fexual method. See BOTANY.

MONOGAMY, compounded of μονος, *folus*, and γαμος, "marriage," the ftate or condition of thofe who have only married once, or are reftrained to a fingle wife. See POLYGAMY.

MONOGLOSSUM, in *Ancient Geography*, a mart town of the Hither India, fituated on the Sinus Canthi, into which the Indus empties itfelf. Said to be Mangalor on the coaft of Malabar. E. Long. 74°, N. Lat. 13°.

MONOGRAM, a character or cypher, compofed of one, two, or more letters interwoven; being a kind of abbreviation of a name, anciently ufed as a feal, badge, arms, &c.

MONOGYNIA, from μονος, *alone*, and γυνη, a *woman*; the name of the firft order or fubdivifion in the firft 13 claffes of Linnæus's fexual method; confifting of plants which, befides their agreement in their claffic character, generally derived from the number of their ftamina, have only one ftyle.

MONOMOTAPA, a country of Africa, has the maritime kingdom of Sofala on the eaft, the river Del Spiritu Santo on the fouth, the mountains of Caffraria on the weft, and the river Cauma on the north, which parts it from Monemugi. The air of this country is very temperate; the land fertile in paftures and all the neceffaries of life, being watered by feveral rivers. The inhabitants are rich in black cattle, which they value more than gold. They have a vaft number of elephants, as appears from the great quantity of ivory that is exported from thence. There is alfo a confiderable trade in gold duft.—The inhabitants are lovers of war, which is the employment followed by all thofe who do not apply themfelves to commerce. This country is divided into feven provinces or petty kingdoms, vaffals to the king; viz. Monomotapa Proper, Quiteve, Manica, Inhambana, Inhemior, Sabia, and Sofala.

MONOPETALOUS, in *Botany*, a term applied to flowers that have only one petal or flower-leaf.

MONOPHYSITES, (from μονος, *folus*, and φυσις, *natura*), a general name given to all thofe fectaries in the Levant who only own one nature in Jefus Chrift; and who maintain, that the divine and human nature of Chrift were fo united as to form only one nature, yet, without any change, confufion, or mixture of the two natures.

The *Monophyfites*, however, properly fo called, are the followers of Severus, a learned monk of Paleftine, who was created patriarch of Antioch in 513, and Petrus Fullenfis.

The Monophyfites were encouraged by the emperor Anaftafius, but depreffed by Juftin and fucceeding emperors. However, this fect was reftored by Jacob Baradæus an obfcure monk, infomuch that when he died bifhop of Edeffa, A. D. 588, he left it in a moft flourifhing ftate in Syria, Mefopotamia, Armenia, Egypt, Nubia, Abyffinia, and other countries. The laborious efforts of Jacob were feconded in Egypt and the adjacent countries, by Theodofius bifhop of Alexandria; and he became fo famous that all the Monophyfites of the eaft confidered him as their fecond parent and founder, and are to this day called *Jacobites*, in honour of their new chief. The Monophyfites are divided into two fects or parties, the one African, the other Afiatic; at the head of the latter is the patriarch of Antioch, who refides for the moft part in the monaftery of St Ananias, near the city of Merdin: the former are under the jurifdiction of the patriarch of Alexandria, who generally refides at Grand Cairo, and are fubdivided into Cophts and Abyffinians. From the 15th century downwards, all the patriarchs of the Monophyfites have taken the name of *Ignatius*, in order to fhow that they are the lineal fucceffors of Ignatius, who was bifhop of Antioch in the firft century, and confequently the lawful patriarch of Antioch. In the 17th century, a fmall body of the Monophyfites in Afia abandoned for fome time the doctrine and inftitution of their anceftors, and embraced the communion of Rome: but the African Monophyfites, notwithftanding that poverty and ignorance which expofed them to the feductions of fophiftry and gain, ftood firm in their principles, and made an obftinate refiftance to the promifes, prefents, and attempts employed by the papal miffionaries to bring them under the Roman yoke: and in the 18th century, thofe of Afia and Africa have perfifted in their refufal to enter into the communion of the Romifh church, notwithftanding the earneft entreaties and alluring offers that have been made from time to time by the pope's legates, to conquer their inflexible conftancy. The Monophyfites propagate their doctrine in Afia with zeal and affiduity, and have not long ago gained over to their communion a part of the Neftorians, who inhabit the maritime coafts of India.

MONOPOLY, one or more perfons making themfelves the fole mafters of the whole of a commodity, manufacture, and the like, in order to make private advantage of it, by felling it again at a very advanced price. Or it is a licenfe or privilege allowed by the king for the fole buying and felling, making, working, or ufing any thing whatfoever.—Monopolies had been carried to an enormous height during the reign of Queen Elizabeth; and were heavily complained of by Sir Edward Coke, in the beginning of the reign of King James I.: but were in great meafure remedied by ftatute 21 Jac. I. c. 3. which declares fuch monopolies to be contrary to law, and void; (except as to patents, not exceeding the grant of 14 years, to the authors of new inventions; and except alfo patents concerning printing, faltpetre, gunpowder, great ordnance, and fhot); and monopolifts are punifhed with the forfeiture of treble damages and double cofts, to thofe whom they attempt to difturb; and if they procure any action, brought againft them for thefe damages, to be ftayed by any extrajudicial order, other than of the court wherein it is brought, they incur the penalties of *præmunire*. Combinations alfo among victuallers or artificers, to raife the price of provifions, or any commodities, or the rate of labour, are in many cafes feverely punifhed by particular ftatutes; and, in general, by ftatute 2 and 3 Edward VI. c. 15. with the forfeiture of 10l. or 20 days imprifonment, with an allowance of only bread and water for the firft offence; 20l. or the pillory for the fecond; and 40l. for the third, or elfe the pillory, lofs of one ear, and perpetual infamy. In the

the same manner, by a constitution of the emperor Zeno, all monopolies and combinations to keep up the price of merchandise, provisions, or workmanship, were prohibited, upon pain of forfeiture of goods and perpetual banishment.

MONOSYLLABLE, in *Grammar*, a word that consists only of one syllable, and is composed either of one or more letters pronounced at the same time. The too frequent use of monosyllables has a very bad effect in English poetry, as Mr Pope both intimates and exemplifies in the same verse, viz.

"And ten slow words oft creep in one dull line."

MONOTHELITES, (compounded of μονος, "single," and θελημα, "will," of θελω, *volo*, "I will,") an ancient sect, which sprung out of the Eutychians; thus called, as only allowing of one will in Jesus Christ.

The opinion of the Monothelites had its rise in 630, and had the emperor Heraclius for an adherent: it was the same with that of the Acephalous Severians. They allowed of two wills in Christ, considered with regard to the two natures; but reduced them to one, by reason of the union of the two natures; thinking it absurd there should be two free wills in one and the same person. They were condemned by the sixth general council in 680, as being supposed to destroy the perfection of the humanity of Jesus Christ, depriving it of will and operation. Their sentiments were afterwards embraced by the Maronites.

MONOTONY, an uniformity of sound, or a fault in pronunciation, when a long series of words is delivered in one unvaried tone. See READING.

MONOTROPA, BIRD'S-NEST; a genus of plants belonging to the monandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

MONREAL. See MONTREAL.

MONRO, DR ALEXANDER, senior, a celebrated physician and anatomist, was the son of Mr John Monro who was for some years a surgeon in the army under King William in Flanders, and who afterwards settled as a surgeon in Edinburgh. The subject of this biographical sketch was born in London in 1697.

He showed an early inclination to the study of physic; and the father, after giving him the best education that Edinburgh then afforded, sent him successively to London, Paris, and Leyden, to improve himself further in his profession. At London, he attended the lectures of Messrs Hawksbee and Whiston on experimental philosophy, and the anatomical demonstrations of Mr Chefelden. At Paris, he attended the hospitals, and the lectures on the different branches of physic and surgery; and, towards the end of autumn 1718, he went to Leyden, and studied under the great Boerhaave.

On his return to Edinburgh in autumn 1719, Messrs Drummond and Macgill, who were then conjunct nominal professors and demonstrators of anatomy to the Surgeons Company, having resigned in his favour, his father prevailed on him to read some public lectures on anatomy, and to illustrate them by showing the curious anatomical preparations which he had made and sent home when abroad. He at the same time persuaded Dr Alston, then a young man, to give some public lectures on botany. Accordingly, in the beginning of the winter 1720, these two young professors began to give regular courses of lectures, the one on the materia medica and botany, the other on anatomy and surgery; which were the first regular courses of lectures on any of the branches of medicine that had ever been read at Edinburgh, and may be looked upon as the opening of that medical school which has since acquired such great reputation all over Europe.

In summer 1721 and 1722, Dr Monro, by the persuasion of his father, read some lectures on chirurgical subjects, particularly on wounds and tumors, which he never would publish, having written them in a hurry and before he had much experience; but inserted from time to time the improvements he thought might be made in surgery, in the volumes of Medical Essays and Observations to be hereafter mentioned.

About the year 1720, his father communicated to the physicians and surgeons at Edinburgh, a plan which he had long formed in his own mind, of having the different branches of physic and surgery regularly taught at Edinburgh; which was highly approved of by them, and by their interest regular professorships of anatomy and medicine were instituted in the university. His son, Dr Monro, was first made university professor of anatomy; and two or three years afterwards, Drs Sinclair, Rutherford, Innes, and Plummer, were made professors of medicine; the professorship of materia medica and botany, which Dr Alston then held, having been added to the university many years before. Immediately after these gentlemen were elected professors, they began to deliver regular courses of lectures on the different branches of medicine, and they and their successors have uniformly continued so to do every winter.

The plan for a medical education at Edinburgh was still incomplete without an hospital, where students could see the practice of physic and surgery, as well as hear the lectures of the professors. A scheme was therefore proposed by Dr Monro's father, and others, particularly the members of the Royal College of Physicians and Board of Surgeons, for raising by subscription a fund for building and supporting an hospital for the reception of diseased poor; and our author published a pamphlet setting forth the advantages that would attend such an institution. In a short time a considerable sum of money was raised, a small house was fitted up, and patients were admitted into it, and regularly attended by many of the physicians and surgeons in town. The fund for this charity increasing very considerably, in a great measure from the activity and influence of that very worthy citizen and magistrate George Drummond, Esq. the foundation was laid of the present large, commodious, and useful hospital, the *Royal Infirmary*; in the planning of which Dr Monro suggested many useful hints, and in particular the elegant room for chirurgical operations was designed and executed under his direction. Provost Drummond and he were nominated the building committee; and the fabric was entirely completed in a short space of time. It has since been so largely endowed, as to be capable of receiving a great number of diseased poor, whose cases the students of physic and surgery have an opportunity of seeing daily treated with the greatest attention and care by physicians and surgeons eminent in their profession; and a register of the particulars of all the cases which have been received

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received into the houſe ſince its firſt opening has been kept, in books appropriated for that purpoſe, for the uſe of the ſtudents.

In order to make the hoſpital of ſtill farther uſe to the ſtudents, Dr Monro frequently, while he continued profeſſor of anatomy, gave lectures on the chirurgical caſes; and Dr Rutherford, then profeſſor of the practice of phyſic, began, in the year 1748, to deliver clinical lectures, to be continued every winter, on the moſt remarkable caſes in the hoſpital.

Dr Monro, though he was elected profeſſor of anatomy in the year 1721, was not received into the univerſity till the year 1725, when he was inducted along with that great mathematician the late Mr Colin Maclaurin, with whom he ever lived in the ſtricteſt friendſhip. From this time he regularly every winter gave a courſe of lectures on anatomy and ſurgery, from October to May, upon a moſt judicious and comprehenſive plan: A taſk in which he perſevered with the greateſt aſſiduity; and without the leaſt interruption, for near 40 years; and ſo great was the reputation he had acquired, that ſtudents flocked to him from the moſt diſtant corners of his majeſty's dominions.

In 1759, our profeſſor entirely relinquiſhed the buſineſs of the anatomical theatre to his ſon Dr Alexander, who had returned from abroad, and had aſſiſted him in the courſe of lectures the preceding year. But after this reſignation, he ſtill endeavoured to render his labours uſeful to mankind, by reading clinical lectures at the hoſpital for the improvement of the ſtudents; of which Dr Duncan, who was one of his pupils, has given the following account. "There I had myſelf the happineſs of being a pupil, who profited by the judicious conduct of his practice, and was improved by the wiſdom and acuteneſs of his remarks. I have indeed to regret that I attended only the laſt courſe of lectures in which he had ever a ſhare, and at a time when he was ſubjected to a diſeaſe which proved at length fatal. Still, however, from what I ſaw and from what I heard, I can venture to aſſert, that it is hardly poſſible to conceive a phyſician more attentive to practice, or a preceptor more anxious to communicate inſtructions. His humanity, in the former of theſe characters, led him to beſtow the moſt anxious care on his patients while they were alive; and his zeal in the latter induced him to make them the ſubject of uſeful leſſons when they happened to die.—In the different ſtations of phyſician, of lecturer, and of manager in the hoſpital, he took every meaſure for inquiring into the cauſes of diſeaſes by diſſection.—He perſonally attended the opening of every body; and he not only dictated to the ſtudents an accurate report of the diſſection, but with nice diſcrimination contraſted the diſeaſed and ſound ſtate of every organ. Thus, in his own perſon, he afforded to the ſtudents a conſpicuous example of the advantages of early anatomical purſuits, as the happieſt foundation for a medical ſuperſtructure. His being at once engaged in two departments, the anatomical theatre and clinical chair, furniſhed him with opportunities both on the dead and living body, and placed him in the moſt favourable ſituation for the improvement of medicine; and from theſe opportunities he derived every poſſible advantage which they could afford."

His father, old Mr Monro, lived to an advanced age; and enjoyed the unſpeakable pleaſure of beholding a ſon, eſteemed and regarded by mankind, the principal actor in the execution of his favourite plan, the great object of his life, the founding a ſeminary of medical education in his native country: The ſon, who ſurvived him near 30 years, had the ſatisfaction to behold this ſeminary of medical education frequented yearly by 300 or 400 ſtudents, many of whom came from the moſt diſtant corners of his majeſty's dominions, and to ſee it arrive to a degree of reputation far beyond his moſt ſanguine hopes, being equalled by few, and inferior to none, in Europe.

Dr Monro was not only very active in the line of his own profeſſion, but as a citizen and general member of the community; for, after he had reſigned the anatomical chair to his ſon, he executed with the ſtricteſt punctuality the duties of ſeveral engagements both of a civil and political nature: He was a director of the Bank of Scotland, a juſtice of the peace, a commiſſioner of high roads, &c. At length, after a life ſpent in the moſt active induſtry, he became afflicted with a tedious and painful diſeaſe, which he bore with equal courage and reſignation till his death, which happened on July 10. 1767, in the 70th year of his age.

Of his works, the firſt in order is his Oſteology, which was written for the uſe of ſtudents, but is capable alſo of affording inſtruction to the oldeſt and moſt experienced practitioner; as, beſides a minute deſcription of the parts copied from nature, it everywhere abounds with new and important obſervations immediately applicable to practice. It has been tranſlated into many different languages; has paſſed through numerous editions; and has been reprinted in foreign countries in the moſt ſuperb manner, accompanied with elegant and maſterly engravings. His deſcription of the Lacteal Sac and Thoracic Duct contains the moſt accurate account of that important part of the body which has been yet publiſhed; and his Anatomy of the Nerves will tranſmit to poſterity an excellent example of accurate diſſection, faithful deſcription, and ingenious reaſoning. The ſix volumes of Medical Eſſays and Obſervations, publiſhed by a ſociety in Edinburgh, are univerſally known and eſteemed. To that ſociety he was appointed ſecretary; but, after the publication of the firſt volume, to which he had largely contributed, the members growing remiſs in their attendance, he became the ſole collector and publiſher of the work: To him we are therefore in a great meaſure indebted for thoſe numerous and important diſcoveries with which this publication has enriched every department of medical knowledge. In the two firſt volumes of the Phyſical and Literary Eſſays, publiſhed by the phyſical ſociety of Edinburgh, in which he had the rank of one of the preſidents, we find ſeveral papers written by him, which are not the leaſt ornaments of that collection. His account of the Succeſs of Inoculation in Scotland may be conſidered as his laſt publication: It demonſtrates his extenſive correſpondence and indefatigable induſtry, and has had great influence in promoting that ſalutary practice. Beſides theſe, he was alſo the author of ſeveral other elegant and maſterly productions, which were either never publiſhed, or were publiſhed without his knowledge and from incorrect copies. A collection of all his works, properly arranged, corrected, and illuſtrated with copperplates, has been publiſhed by Dr

Alexander Monro, his fon and fucceffor in the anatomical chair, in a fplendid quarto volume, printed for Elliot, Edinburgh, 1781; to which is prefixed a life of the author, by another of his fons, Dr Donald, phyfician in London. The obfervation of an excellent judge, the illuftrious Haller, concerning our author's Medical Effays and Obfervations, which now form a part of this collection, may with no lefs juftice be applied to the whole: "It is a book which ought to be in the poffeffion of every medical practitioner."

MONS, an ancient, large, handfome, rich, and very ftrong city of the Auftrian Netherlands, in Hainault. There is a chapter, confifting of 30 ladies of diftinction, who have the liberty of leaving the community when they intend to marry. They have feveral manufactures, and a good trade. It was taken by the allies in 1709, and by the French in July 1746; but rendered back by the treaty of Aix-la-Chapelle, after the fortifications were demolifhed. It ftands partly on a hill, and partly on a plain in a marfhy foil, on the rivers Haine and Trouilli, by which the country about it may be overflowed at pleafure. It was taken by the French in 1794. E. Long. 4. 31. N. Lat. 50. 25.

Mons Sacer, in *Ancient Geography*, a mountain of the Sabines beyond the Anio, to the eaft of Rome; whither the common people retired once and again to avoid the tyranny of the Patricians. From this fecesfion, and the altar of *Jupiter Terribilis* erected there, the mountain took its name.

MONSEIGNEUR, in the plural *Meffeigneurs*, a title of honour and refpect ufed by the French in writing to perfons of fuperior rank or quality, before the late abolition of all ranks.

Dukes, peers, archbifhops, bifhops, and prefidents *à la mortier*, were complimented with the title of *Monfeigneur*. In the petitions prefented to the fovereign courts, they ufed the term *Meffeigneurs*.

Monseigneur, abfolutely ufed, was a title reftrained to the dauphin of France. This cuftom was unknown till the time of Louis XIV. before which the dauphin was ftyled *Monfieur le Dauphin*.

MONSELEMINES, a people inhabiting that part of Biledulgerid, which borders on the territories of the emperor of Morocco. They are a mixed race, defcended from the ancient Arabs and fugitive Moors. Their country extends from about 90 miles beyond Cape Non, to the diftance of 60 miles from St Croix. It is moftly fertile; and, with little cultivation, produces the neceffaries of life. A number of ftreams water the plains, which abound with fig, date, palm, and almond trees. The gardens produce excellent grapes, which the Jews convert into brandy after they have been dried by the Arabs.

The Monfelemine territory is very populous, and would be much more fo, were it not for the almoft continual wars in which the people are engaged againft the emperor of Morocco; for, as this country is the retreat of the rich Moors, who wifh to fly from the tyranny of the emperor, they are too well acquainted with the Moorifh cuftoms to be furprifed by that prince. As foon as a Moorifh army takes the field, the inhabitants mount their horfes, and occupy the paffes of the mountains; while the women and flaves retire to the interior parts of the country, or to the defert, if they are hard preffed. Their horfes, which they break in an admirable manner, are faid to be the beft in the world; obedient to the voice of their mafter, and allowing no ftranger to mount them.

The people derive their name and origin from one Mofeilama, who was contemporary with Mahomet. They refpect the prophet, as do other Mahometans; but neither believe that he was infallible, nor that his defcendants are all infpired by God, nor that their will fhould be a law, nor that fuch faith is neceffary in order to be a good Mahometan. The influence of their high prieft is nearly defpotic; for though he has no troops, he may command the nation, and peace and war depend upon his will. He has no property, yet every thing is at his difpofal; he requires nothing from any, yet all are difpofed to give him.

The Monfelemines, on Friday, meet in their mofques for prayer, and the fame is likewife the day of their principal market, when their goods are expofed to fale in the public fquares. They never attempt to make profelytes; and they treat their Chriftian flaves with humanity, which may perhaps be owing to the avarice of their mafters. The Jews are allowed among them the free exercife of their religion. Polygamy is permitted among them; but the fituation of the women is more refpectable, and they are not fo much fecluded as among the Moors, mingling more in fociety, walking at large, and vifiting their friends. The Monfelemine children are brought up with great care, and are not obliged to exhibit proofs of their courage till they can be confidered as men.

MONSIEUR, in the plural *Meffieurs*, a term or title of civility, ufed by the French in fpeaking to their equals, or thofe a little below them, anfwering to *Mr* or *Sir* among the Englifh.

Monsieur, abfolutely ufed, was a title or quality appropriated to the fecond fon of France, or the king's brother. The king was alfo called *Monfieur*, but that only by the children of France.

MONSONIA, a genus of plants belonging to the polyadelphia clafs. See Botany *Index*.

MONSOON, a regular or periodical wind, in the Eaft Indies, blowing conftantly the fame way, during fix months of the year, and the contrary way the remaining fix.

In the Indian ocean, the winds are partly general, and blow all the year round the fame way, as in the Ethiopic ocean; and partly periodical, i. e. half the year blow one way, and the other half year on the oppofite points: and thofe points and times of fhifting differ in different parts of this ocean. Thefe latter are what we call *monfoons*.

The fhifting of thefe monfoons is not all at once; and in fome places the time of the change is attended with calms, in others with variable winds, and particularly thofe of China, at ceafing to be wefterly, are very fubject to be tempeftuous; and fuch is their violence, that they feem to be of the nature of the Weft India hurricanes, and render the navigation of thofe feas very unfafe at that time of the year. Thefe tempefts the feamen call the *breaking up of the monfoons*.

Monfoons, then, are a fpecies of what we otherwife call *trade winds*. They take the denomination *monfoon* from an ancient pilot, who firft croffed the Indian fea by means hereof. Though others derive the name from

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from a Portuguese word, signifying motion or change of wind and sea.

Lucretius and Apollonius make mention of annual winds which arise every year, *etesia flabria*, which seem to be the same with what in the East Indies we now call *monsoons*. For the physical cause of these winds, see METEOROLOGY.

MONSTER; a birth or production of a living being, degenerating from the proper and usual disposition of parts in the species to which it belongs: As, when there are too many members, or too few; or some of them are extravagantly out of proportion, either on the side of defect or excess. The word comes from the Latin *monstrum*, of *monstrando*, "showing." Whence also the box wherein relicks were anciently kept to be shown, was called *monstrum*. Dugdale mentions an inventory of the church of York with this article, *Item unum monstrum cum ossibus sancti Petri in beryl, et crucifixo in summitate*.

Aristotle defines a monster to be a defect of nature, when, acting towards some end, it cannot attend to it, from some of its principles being corrupted.

Monsters do not propagate their kind; for which reason some rank *mules* among the number of monsters, as also *hermaphrodites*.

Females which bring forth twins, are found most liable to produce monsters. The reason, probably, is owing to this; that though the twins are covered with one common chorion, yet they have each their separate amnios, which by their contiguity may chance to grow together, and so occasion a confusion or blending of the parts. Hence so many double creatures.

Various theories have been proposed by philosophers and physiologists to account for the production of monsters. But after all, it must be confessed, that we are very little acquainted with those deviations from the ordinary course of nature. For each organized being there appears to exist a primitive germ or model of the different species drawn by the Creator, determined by forms and sexes, and realized in the individuals of both sexes, which must unite in order to their reproduction. From this model nature never departs, unless when compelled by circumstances which derange the primitive organization common to the species, and produce what are called *monsters*.

With respect to structure, monsters are of various kinds. Some have an excess or defect in certain parts; such as those which are called *acephalous*, or who want the head; those which have two heads, two arms, two legs, and one body, or which have two bodies and one head, or which have three legs; and those which want the arms or the legs. Others err through an extraordinary and deformed conformation, through an unnatural union of certain parts or viscera, through a great derangement in one or more of their members, and through the extraordinary place which these often occupy in consequence of this derangement or transposition. The monster described by Dr Eller of the academy of Berlin was of this kind. It was a fœtus of nine months, 28 inches long, with an enormous head and frightful countenance; and in the middle of a broad and vast forehead it had a reddish eye, without either eyebrows or eyelids, and sunk deep into a square hole. Immediately below this eye was an excrescence which strongly resembled a penis with a glans, a prepuce, and an urethra: the part covered with hair was likewise below the nape of the neck. In other monsters we meet with the unnatural union of some parts, which, from their destination and functions, ought always to be separate; and the separation of other parts, which, for the same reasons, ought constantly to be united. The reader may see the different ways in which the formation of monsters takes place, in four memoirs by M. Lemery, inserted in *L'Histoire de l'Academie des Sciences*, 1738 and 1739. M. du Verney has likewise published a memoir on the same subject.

In the volume published by the Academy of Sciences in 1724, mention is made by M. Geoffroy of a monster born in Barrois 1722. This monstrous production consisted of two children without the inferior extremities, joined together by a common navel: each of them had a nurse, sucked, and eat pap; and the one sucked while the other slept. The reader may likewise consult the second part of Winslow's Memoirs on Monsters, inserted in the volume published by the Academy of Sciences in 1734, where he will find the history of two very extraordinary twin monsters, who evidenced during their life a great difference in their moral and physical qualities. We are obliged simply to refer to these Memoirs, as they are too long for abridgement.

It is observed by Haller, that in some monsters the natural structure is changed by some shock or passion: in others the structure, independent of any accident is originally monstrous; such as when all the members are reversed from left to right, when the person has six fingers, and in many other instances. M. de Maupertuis mentions, that there is at Berlin a family who have had six fingers on each hand for several generations. M. de Riville saw an instance of this at Malta, of which he has given a description. M. Renou, surgeon at Pommeraye in Anjou, has published an account of some families with six fingers, which are to be found in several parishes of the Lower Anjou, and which have existed there from time immemorial. This deformity is perpetuated in these families even when they intermarry with persons who are free from it. Whether the propagation of these supernumerary organs, which are not only useless but inconvenient and even disagreeable, be owing to the father or mother, their children of both sexes are subject to it indiscriminately. A father or mother with six fingers frequently have a part, and sometimes the whole, of their children, free from this deformity; but it again makes its appearance, and in a very great degree, in the third generation. From this it appears, that this fault in the conformation is hereditary. M. Reaumur has likewise published the history of a family in the island of Malta, the children of which are born with six fingers and six toes. But it deserves to be inquired, Whether these supernumerary fingers are real fingers? The reader may here consult the *Journal de Physique* for November 1774, p. 372. This variety of *sexdigitary* hands and feet is not comprehended in the *Recherches sur quelques conformations monstrueuses des doigts dans l'homme*, which is inserted in the Memoirs of the Academy of Sciences for 1771. In the *Journal de Physique* for August 1776, we find a description of a double uterus and vagina observed in a woman who died in childbed, by Dr Purcell of Dublin: and in that for June 1788, Monster. 1788, we have an account of a man with seven fingers on each hand, by Baron Dietrich.

Several monstrous productions are to be seen in the cabinet at Chantilly. 1. Two calves joined together in the body, with each a separate head and neck, and four legs in whole. 2. Two calves united only by the pelvis, with only one anus and one tail: the whole is supported by six legs, four before and two behind. 3. A lamb with six legs, four of which are behind. 4. The skeleton of a ram, which has likewise six legs. 5. A hermaphrodite deer. 6. The head of a foal, which has only one eye in the middle of the forehead. 7. Some leverets with six and eight legs. 8. A puppy, the lips of which are divided fourfold. 9. Some fœtuses of a hog which have a kind of tube upon their forehead one or two inches long; and another, the hinder part of which is double in every thing. 10. Two double human fœtuses joined by the belly, with four arms and three legs. 11. A young chicken with two bodies and one head. 12. A pigeon and a duck, each with two bills. 13. A duck with two heads. 14. A pigeon with four feet. 15. A capon with three feet; the third being fixed to the anus. 16. Two heads of a calf joined together, each of them with two ears: these two heads were both fixed to one neck. 17. In the *Menagerie* at Chantilly there was formerly to be seen a cow with five feet, the fifth of which was connected with the dug. 18. A rabbit without ears. 19. Two cats, each having two heads. 20. Two leverets newly brought forth, well shaped in the body and legs, but connected together by means of only one head. 21. Several eggs, in the figure of which there occur some monstrous appearances and extraordinary deformities, sufficient to show that they are contrary to to the established form of nature.

Mr Home, surgeon, some time ago presented to Mr John Hunter, the *double skull* of a child, born at Calcutta in May 1783 of poor parents aged 30 and 35, and which lived to be nearly two years old. The body of this child was naturally formed: but the head had the phenomenon of appearing double; another head of the same size, and almost equally perfect, being attached to its upper part. In this extraneous and preternatural head no pulsation could be felt in the arteries of the temples, but the superficial veins were very evident; one of the eyes had been hurt by the fire, upon which the midwife, in her first alarm, threw the child: the other moved readily; but the iris was not affected by the approach of any thing to it. The external ears of this head were very imperfect; the tongue adhered to the lower jaw, except for about half an inch at the lip, which was loose; the jaw was capable of motion, but there were no teeth. The child was shown about the streets of Calcutta for a curiosity; but was rendered unhealthy by confinement, and died at last of a bite of the *cobra de capello*. It was dug up by the East India Company's agent for salt at Tumlock, and the skull is now in the museum of Mr Hunter.

Among the monstrous productions of the animal kingdom, we may rank those individuals which ought only to possess one sex, but in which we observe the union or the appearance of two. See the articles ANDROGYNES and HERMAPHRODITE.

M. Fabri arranges mutilations of the members, distortions, gibbosities, tumors, divisions of the lips or of the palate, compressions of the cranium, and many other deformities of this kind, in the class of *morbific* monstruosities. In that which he calls *connatural* (*connaturelle*) monstruosities, are placed the plurality, transposition, and insertion of the parts. To explain these facts, a great many writers have had recourse to the effect of the imagination of pregnant women.—The causes of the first class of monstruosities are discussed by M. Fabri, who observes, that some of them are *internal* with regard to the mother, and others *external*. By an *internal cause* he here means all those depravations or morbific principles which can affect the fluids, and which vitiate the form and structure of the solids; in particular the uterus, in which such depravations have often been found to occur. To these he adds violent affections of the mind, spasmodic contractions, hysteric convulsions, and the many inconveniences of this kind to which women are extremely subject. External causes comprehend every thing which can act externally upon the fœtus contained in the uterus, such as the pressure of the clothes; and in short every thing which prevents the free dilatation of the belly in women that are pregnant, violent motions, falls, blows, and all accidents of this kind. These external causes, and especially the first, compress the fœtus in the womb, and oblige it to remain in a very confined situation. This according to the observation of Hipocrates, produces those embryos which are born with some entire part wounded. M. Fabri maintains, that all deformities of the fœtus proceed from some mechanical and accidental causes.

The name of *monsters* is likewise given to animals enormous for bulk; such as the elephant among terrestrial quadrupeds, and the shark and the whale among sea animals; to other animals remarkable for fierceness and cruelty; and to animals of an extraordinary species, which, we are told, arises from the copulation of one animal with another of a different genus. According to the report of travellers, Africa abounds with monsters of this kind; and accounts of the East are full of descriptions of sea monsters, which, however are seldom to be seen, such as *sea men*, *mermaids*, &c.

Monsters are more common and more extraordinary in the vegetable than in the animal kingdom, because the different juices are more easily deranged and confounded together. Leaves are often seen, from the internal parts of which other leaves spring forth, and it is not uncommon to see flowers of the ranunculus from the middle of which issues a stalk bearing another flower. M. Bonnet informs us, that in certain warm and rainy years he has frequently met with monsters of this kind in rose trees. This observer saw a rose, from the centre of which issued a square stalk of a whitish colour, tender, and without prickles, which at its top bore two flower buds opposite to each other, and totally destitute of a calyx; a little above the buds issued a petal of a very irregular shape. Upon the prickly stalk which supported the rose, a leaf was observed which had the shape of a trefoil, together with a broad flat pedicle. In the memoirs of the Academy of Sciences for 1707, p. 448, mention is made of a rose, from the centre of the leaves of which issued a rose branch two or three inches long, and furnished with

Monster ‖ Montague.

with leaves. See the ſame Memoirs for 1749, p. 44. and for 1724, p. 20. In the Memoirs for 1775, a very ſingular inſtance is mentioned of a monſtruoſity obſerved by M. Duhamel, in an apple tree ingrafted with clay. At the place of the inſertion, there appeared a bud which produced a ſtalk and ſome leaves; the ſtalk and the pedicle of the leaves were of a pulpy ſubſtance, and had the moſt perfect reſemblance both in taſte and ſmell to the pulp of a green apple. An extraordinary *chamæmelum* is mentioned in the *Acta Helvetica*. M. Bonnet, in his *Recherches ſur l'uſage des feuilles*, mentions likewiſe ſome monſtrous productions which have been found in fruits with kernels, analogous in their nature to thoſe which occur in the flowers of the ranunculus and of the roſe tree. He has ſeen a pear, from the eye of which iſſued a tuft of 13 or 14 leaves, very well ſhaped, and many of them of the natural ſize. He has ſeen another pear which gave riſe to a ligneous and knotty ſtalk, on which grew another pear ſomewhat larger than the firſt.—The ſtalk had probably flouriſhed, and the fruit had formed. The *lilium album polyanthos*, obſerved ſome years ago at Breſlaw, which bore on its top a bundle of flowers, conſiſting of 102 lilies all of the common ſhape, is well known. M. Reynier has mentioned ſome individuals monſtrous with reſpect to the flower, in the *Journal de Phyſique et d'Hiſtoire Naturelle*, for November 1785. He has likewiſe mentioned a monſtrous tulip which is ſeen in the gardens of ſome amateurs; juniper berries with horns; a balſamine with three ſpurs, &c.

Theſe vegetable productions which are ſo extraordinary, and ſo contrary to the common courſe of things, do nevertheleſs preſent deviations ſubject to particular laws, and reducible to certain principles, by diſtinguiſhing ſuch as are perpetuated either by ſeed or by tranſplanting, from thoſe which ſeem to be only accidental. Monſtruoſities which are perpetuated exiſt in the original organization of the ſeed of the plant, ſuch as marked or curled leaves, &c. The word *monſter* is more properly applied to thoſe irregularities in plants, which ariſe from frequent tranſplantation, and from a particular culture, ſuch as double flowers, &c.: but thoſe monſtruoſities which are not perpetuated, and which ariſe from accidental and tranſient cauſes deranging the primitive organization of the plant when it comes to be unfolded, as is the effect of diſeaſes, of heat or cold, of a ſuperfluity or ſcarcity of juices, of a depravation of the veſſels contributing to nutrition, of the ſting of inſects, of contuſions and natural graffs, retain alſo the name of *monſters*. Of this kind are knobs or ſwellings, ſtunting, gall nuts, certain ſtreaks, and other ſimilar defects.

MONT-BLANC. See *Mont-Blanc*.

MONTAGUE, Lady Mary Wortley, accompanied her huſband who was ſent on an embaſſy to Conſtantinople in the beginning of the 18th century. On her return ſhe introduced the practice of inoculation into England, and thence acquired great celebrity. She cultivated the belles lettres; and at one period of her life ſhe was the friend of Pope, and at another his enemy. While they were at enmity with each other, Lady Mary Montague embraced every opportunity of defaming the poet, who well knew how to take revenge. Both of them carried their animoſity to ſo great a height, that they became the ſubject of public converſation. After a long life, full of ſingular and romantic adventures, ſhe died about the year 1760. From her we have *Letters*, written during her travels from the year 1716 to the year 1718. They have been tranſlated into French, and publiſhed at Rotterdam 1764, and at Paris 1783, one vol. 12mo. They are compoſed in a lively, intereſting, and agreeable ſtyle, and contain many curious facts relating to the manners and government of the Turks, which are nowhere elſe to be found. The Baron de Tott, who lived many years at Conſtantinople, attacked them with great ſeverity; but they have been defended with equal zeal by M. Guis of Marſeilles, who has publiſhed a valuable work on Turkey. It need not appear extraordinary, that perſons who have viſited the ſame country ſhould not ſee things in the ſame light. How few travellers agree in their accounts of the ſame objects, which they nevertheleſs pretend to have ſeen and to have examined with attention.

Montague.

MONTAGUE, *Edward Wortley*, ſon of the former, paſſed through ſuch variegated ſcenes, that a bare recital of them would ſavour of the marvellous. From Weſtminſter ſchool, where he was placed for education, he ran away three ſeveral times. He exchanged clothes with a chimney-ſweeper, and he followed for ſome time that ſooty occupation. He next joined himſelf to a fiſherman, and cried flounders in Rotherhithe. He then ſailed as a cabin boy to Spain; where he had no ſooner arrived, than he ran away from the veſſel, and hired himſelf to a driver of mules. After thus vagabondizing it for ſome time, he was diſcovered by the conſul, who returned him to his friends in England. They received him with a joy equal to that of the father of the prodigal ſon in the goſpel. A private tutor was employed to recover thoſe rudiments of learning which a life of diſſipation, of blackguardiſm, and of vulgarity, might have obliterated. Wortley was ſent to the Weſt Indies, where he remained ſome time; then returned to England, acted according to the dignity of his birth, was choſen a member, and ſerved in two ſucceſſive parliaments. His expences exceeding his income, he became involved in debt, quitted his native country, and commenced that wandering traveller he continued to the time of his death. Having viſited moſt of the eaſtern countries, he contracted a partiality for their manners. He drank little wine, a great deal of coffee; wore a long beard; ſmoked much: and, even whilſt at Venice, he was habited in the eaſtern ſtyle. He ſat croſs legged in the Turkiſh faſhion through choice. With the Hebrew, the Arabic, the Chaldaic, and the Perſian languages, he was as well acquainted as with his native tongue. He publiſhed ſeveral pieces. One on the "Riſe and Fall of the Roman Empiree." Another an exploration of "The Cauſes of Earthquakes." As this gentleman was remarkable for the uncommon incidents which attended his life, the cloſe of that life was no leſs marked with ſingularity. He had been early married to a woman who aſpired to no higher a character than that of an induſtrious waſherwoman. As the marriage was ſolemnized in a frolic, Wortley never deemed her ſufficiently the wife of his boſom to cohabit with her. She was allowed a maintenance. She lived contented, and was too ſubmiſſive to be troublesome on account of the conjugal rites. Mr Montague, on the other hand, was a perfect patriarch in his manners. He had wives of almost every nation. When he was with Ali Bey in Egypt, he had his household of Egyptian females, each striving who should be the happy she who could gain the greatest ascendency over this Anglo-Eastern bashaw. At Constantinople, the Grecian women had charms to captivate this unsettled wanderer. In Spain a Spanish brunette, in Italy the olive-complexioned female, were solicited to partake the honours of the bridal bed. It may be asked what became of this group of wives? Mr Montague was continually shifting the place, and consequently varying the scene. Did he travel with his wives as the patriarchs did with their flocks and herds? No such thing. Wortley, considering his wives as bad travelling companions, generally left them behind him. It happened, however, that news reached his ears of the death of the original Mrs Montague the washerwoman. Wortley had no issue by her; and without issue male, a very large estate would revert to the second son of Lord Bute. Wortley, owing the family no obligations, was determined, if possible, to defeat their expectations. He resolved to return to England and marry. He acquainted a friend with his intentions: and he commissioned that friend to advertise for any young decent woman who might be in a pregnant state. Several ladies answered it. One out of the number was selected, as being the most eligible object. She waited with eagerness for the arrival of her expected bridegroom; but, behold, whilst he was on his journey, death very impertinently arrested him in his career.

Montague Island, one of the Hebrides, in the South sea, near Sandwich island. E. Long. 168. 37. S. Lat. 17. 26.

MONTAIGNE, Michel de, a French gentleman, was born in Perigord in 1533. His father educated him with great care, and made him learn Latin as other children learn their mother tongue. His tutors were Nicholas Gronchi, who wrote *De Comitiis Romanorum*; William Guerenti, who wrote on Aristotle; George Buchanan; and M. Anthony Muret. He was also taught Greek by way of recreation; and because some think that starting children out of their sleep spoils their understanding, he was awakened every morning with the sound of music. He was counsellor for a while in the parliament of Bourdeaux; afterwards made mayor of Bourdeaux. He published his *Essays*, so much known in the world, in 1580. Montaigne had a great deal of wit and subtlety, but no small share of conceit and vanity. The learned and ingenious are much divided in their opinion about his works. He died in 1592.

MONTALCINO, a small populous town of Italy, in Tuscany, and in the territory of Sienna, with a bishop's see. It is seated on a mountain, 17 miles south-east of Sienna, and 44 south-east of Florence. E. Long. 11. 30. N. Lat. 43. 7.

MONTALTO, an episcopal town of Italy, in the Marca of Ancona; seated on the river Monacio, 10 miles north of Ascoli, and 45 south of Ancona. E. Long. 13. 30. N. Lat. 42. 54.

MONTANISTS, Christian heretics, who sprang up about the year 171, in the reign of the emperor Marcus Aurelius. They were so called from their leader, the heresiarch Montanus, a Phrygian by birth; whence they are sometimes styled *Phrygians* and *Cataphrygians*.

Montanus, it is said, embraced Christianity in hopes of rising to the dignities of the church. He pretended to inspiration; and gave out, that the Holy Ghost had instructed him in several points, which had not been revealed to the apostles. Priscilla and Maximilla, two enthusiastic women of Phrygia, presently became his disciples; and in a short time he had a great number of followers. The bishops of Asia, being assembled together, condemned his prophecies, and excommunicated those who dispersed them. Afterwards they wrote an account of what had passed to the western churches, where the pretended prophecies of Montanus and his followers were likewise condemned.

The Montanists, finding themselves exposed to the censure of the whole church, formed a schism, and set up a distinct society under the direction of those who called themselves *prophets*. Montanus, in conjunction with Priscilla and Maximilla, was at the head of the sect.

These sectaries made no alteration in the creed. They only held, that the Holy Spirit made Montanus his organ for delivering a more perfect form of discipline than what was delivered by the apostles. They refused communion for ever to those who were guilty of notorious crimes, and believed that the bishops had no authority to reconcile them. They held it unlawful to fly in time of persecution. They condemned second marriages, allowed the dissolution of marriage, and observed three lents.

The Montanists became separated into two branches, one of which were the disciples of Proclus, and the other of Æschines. The latter are charged with following the heterodoxy of Praxes and Sabellius concerning the Trinity.

MONTARGIS, a considerable town of France, in the Orleannois, and capital of the Gatinois; seated on the river Loire, 62 miles south of Paris. E. Long. 2. 36. N. Lat. 48. 1.

MONTAUBAN, a considerable town of France, in Guienne, and territory of Quercy, seated on the river Tarne, 20 miles north of Toulouse. E. Long. 1. 27. N. Lat. 43. 56.

MONTBAZON, a town of France, in Touraine, 135 miles south-west of Paris. E. Long. 0. 45. N. Lat. 47. 17.

MONTBELLIARD, a strong town of France, capital of a province of the same name, between Alsace and the Franche Compte, seated near the rivers Alaine and Doux, 33 miles west of Basle, and 45 north-east of Bezançon. E. Long. 6. 30. N. Lat. 47. 31.

MONTBLANC, a town of Spain, in the province of Catalonia, 15 miles north of Tarragon. E. Long. 1. 5. N. Lat. 41. 20.

MONTBRISION, a considerable town of France, and capital of Forez, seated on the river Veziza, 40 miles west of Vienne, and 250 south by east of Paris. E. Long. 4. 27. N. Lat. 45. 32.

MONTECCHIO, a considerable town of Italy, in the duchy of Reggio, 10 miles south-east of Parma, and eight north-west of Reggio. E. Long. 15. 54. N. Lat. 38. 8.

Monte-Falco || Montesquieu.

MONTE-FALCO, a town of Italy, in the territory of the Church and duchy of Spoletto; seated on a mountain near the river Clitunno, 12 miles west of Spoletto. E. Long. 12. 40. N. Lat. 42. 58.

Monte-Falcone, a town of Italy, in Friuli, with a castle. It belongs to the Venetians, and is near the river Ponzano, 10 miles north-west of Aquileia, and 12 north-west of Trieste. E. Long. 13. 0. N. Lat. 46. 4.

Monte Fiascone, a small but populous town of Italy, in the territory of the Church, with a bishop's see; seated on a mountain, near the lake Bolsena, in a country abounding with excellent wine, 12 miles south-west of Orvieto, and 45 north-west of Rome. E. Long. 12. 4. N. Lat. 42. 26.

Monte-Marano, a populous town of Italy, in the kingdom of Naples, and in the Farther Principato; seated on the river Calore, 18 miles south of Benevento. E. Long. 15. 0. N. Lat. 40. 48.

Monte-Mor-o novo, or *Monte-major el-novo*, a considerable town of Portugal, on the road from Lisbon to Badajoz. W. Long. 9. 35. N. Lat. 38. 42.

Monte-Mor-o-velho, or *Monte-major-el-velho*, a town of Portugal in the province of Beira, with a very large castle, seated in a fertile country, 10 miles south-west of Coimbra, and 83 north of Lisbon. W. Long. 8. 9. N. Lat. 40. 5.

Monte-Peloso, an episcopal town of Italy, in the kingdom of Naples, and in the Basilicata; seated on a mountain near the river Basiento, 14 miles east of Cirenza. E. Long. 16. 28. N. Lat. 40. 46.

Monte Pulsiano, a town of Italy, in Tuscany, with a bishop's see; seated on a high mountain, near the river Chiana, in a country noted for excellent wine, 25 miles south-east of Sienna, and 50 south by east of Florence. E. Long. 11. 49. N. Lat. 43. 10.

Monte-Sancto, formerly called *Mount Athos*, a mountain of Turkey in Europe, on the gulf of Contessa. It is called Monte-Sancto, or the Holy Mount, because there are 22 monasteries thereon, in which are 4000 monks, who never suffer a woman to come near them. It is 17 miles south of Salonichi. E. Long. 24. 39. N. Lat. 40. 27.

Monte-Verde, a town of Italy, in the kingdom of Naples, and in the farther Principato, with a bishop's see: 60 miles east of Naples. E. Long. 15. 42. N. Lat. 40. 51.

MONTEGO BAY, a town of Jamaica, and, next to Kingston, the most flourishing in the island. It has a very considerable commerce. The harbour is capacious; but rather exposed to the north winds, which at certain times in the year blow with great violence. In June 1795, a fire consumed an immense quantity of stores, and great part of the town.

MONTESA, a very strong town of Spain, in the kingdom of Valencia. It is the seat of an order of knighthood of the same name; and is five miles from Xativa. W. Long. 0. 30. N. Lat. 39. 0.

MONTESQUIEU, Charles de Secondat, Baron, a most illustrious Frenchman descended, from an ancient and noble family of Guienne, was born at the castle of La Brede, near Bourdeaux, in 1689. The greatest care was taken of his education; and at the age of 20 he had actually prepared materials for his Spirit of Laws, by well digested extracts from those immense volumes of civil law which he had studied, not barely as a civilian, but as a philosopher. He became a counsellor of the parliament of Bourdeaux in 1714, and was received president à mortier two years after. In 1721 he published his Persian Letters; in which, under the screen of Oriental manners, he satirized those of France, and treated of several important subjects by delicate transient glances: he did not avow this publication; but was no sooner pointed out as the author, than zeal without knowledge, and envy under the mask of it, united at once against the Persian Letters. He was received into the French academy in 1728; and having previously quitted his civil employments, he entirely devoted himself to his genius, and was no longer a magistrate, but a man of letters. Having thus set himself at liberty, he travelled through Germany, Italy, Switzerland, Holland, and England, in which last country he resided three years, and contracted intimacies with the greatest men then alive; for Locke and Newton were dead. The result of his observations was, "that Germany was fit to travel in, Italy to sojourn in, England to think in, and France to live in." On his return he retired for two years to his estate at La Brede, where he finished his work On the Causes of the Grandeur and Declension of the Romans; which appeared in 1734. The reputation acquired by this last work only cleared the way for his greater undertaking, the Spirit of Laws, which was printed at Geneva in 2 vols. 4to, 1750. This was immediately attacked by the adversaries of his Persian Letters, in a multitude of anonymous pamphlets; containing all the reproaches to which a liberal mind is exposed from craft and ignorance. M. Montesquieu drew up a defence of this work; which for truth, moderation, and delicacy of ridicule, may be regarded as a model in its way. This great man was peaceably enjoying that fulness of esteem which his great merits had procured him, when he fell sick at Paris, and died on the 10th of February 1755.—The following character of this great man is drawn by Lord Chesterfield. "His virtues did honour to human nature, his writings justice. A friend to mankind, he asserted their undoubted and unalienable rights with freedom, even in his own country; whose prejudices in matters of religion and government he had long lamented, and endeavoured, not without some success, to remove. He well knew, and justly admired, the happy constitution of this country, where fixed and known laws equally restrain monarchy from tyranny, and liberty from licentiousness. His works will illustrate his name, and survive him, as long as right reason, moral obligation, and the true spirit of laws, shall be understood, respected, and maintained." As to his personal qualities, we are told by his eulogist, M. d'Alembert, that "he was of a sweet, gay, and even temper. His conversation was spirited, agreeable, and instructive. Nobody told a story in a more lively manner, or with more grace and less affectation. He had frequent absence of mind; but always awaked from it by some unexpected stroke that re-animated the languishing conversation. Though he lived with the great, he retired whenever he could to his estate in the country, and there met his books, his philosophy, and his repose. Surrounded at his leisure hours with peasants, after having studied man in the commerce of the world, he studied him in those simple people solely instructed by nature. With them he cheerfully conversed; he endeavoured, like Socrates, to find out their genius, and appeared as happy with them as in the most brilliant assemblies; especially when he reconciled their differences, and by his beneficence relieved them from their distresses."

Besides the works already mentioned, M. Montesquieu wrote several small pieces, as the Temple of Gnidus, Lysimachus, and an Essay upon Taste, which is left unfinished. His works have been collected since his death, and printed at Paris in a splendid edition, in quarto. They have likewise all of them been translated into English.

MONTEZUMA, or MONTEÇUMA, was emperor or king of Mexico when Cortez invaded that country in 1518, invited thither, as he pretended, by the inhabitants, whose children Montezuma, in the blindness of his superstition, had sacrificed to his idols. The warlike animals on which the Spanish officers were mounted, the artificial thunder with which they were armed, the wooden castles on which they had crossed the ocean, the armour with which they were covered, the victories which they gained wherever they went; all these circumstances, added to that foolish disposition to wonder which always characterizes a simple people, so operated upon the minds of the Mexicans, that when Cortez arrived at the city of Mexico, he was received by Montezuma as his master, and by the inhabitants as a god. At first they fell down in the streets when a Spanish valet passed by; but by degrees the court of Montezuma grew familiar with the strangers, and ventured to treat them as men. Montezuma, unable to expel them by force, endeavoured to inspire them with confidence at Mexico by expressions of friendship, while he employed secret means to weaken their power in other quarters. With this view, one of his generals, who had private orders to that purpose, attacked a party of the Spaniards who were stationed at Vera Cruz; and, although his troops were unsuccessful, yet three or four of the Spaniards were killed. The head of one of them was carried to Montezuma. In consequence of this, Cortez did what has been reckoned one of the boldest political strokes that ever was performed. He ran to the palace, followed by fifty of his troops; and, by persuasion and threats, carried the emperor prisoner into the Spanish quarters. He afterwards obliged him to deliver up those who had attacked his troops at Vera Cruz: and, like a general who punishes a common soldier, he loaded Montezuma with chains. He next obliged him to acknowledge himself in public the vassal of Charles V.; and, in name of tribute for this homage, Cortez received 600,000 merks of pure gold. Montezuma soon afterwards fell a sacrifice to his submission to the Spaniards. He and Alvaro, the lieutenant of Cortez, were besieged in the palace by 200.000 Mexicans. The emperor proposed to show himself to his subjects, that he might persuade them to desist from the attack: but the Mexicans no longer considered him in any other light but as the slave of foreign conquerors. In the midst of his speech, he received a blow with a stone which wounded him mortally; and he expired soon after, A. D. 1520.—See CORTEZ. This unfortunate prince left two sons and three daughters, who embraced the Christian faith. The eldest received baptism, and obtained from Charles V. lands, revenues, and the title of count de Montezuma. He died in 1608; and his family is one of the most powerful in Spain.

MONTFERRAT, a province of Italy, with the title of a duchy; bounded on the east by the duchy of Milan, and part of the territory of Genoa; on the north, by the Vercellese and Canavese: on the west, by Piedmont properly so called; and on the south by the territory of Genoa, from whence it is separated by the Apennine mountains. It contains 200 towns and castles; and is very fertile and well cultivated, abounding in corn, wine, oil, and silk. It belongs to the king of Sardinia, and Casal is the capital town.

MONTFORT, a town of France, in Upper Bretagne, seated on the River Men, 12 miles from Rennes. W. Long. 1. 58. N. Lat. 48. 8.

MONTFORT, a handsome and strong town of the Netherlands, in the United Provinces, with an ancient castle; seated on the river Yssel, seven miles from Utrecht. E. Long. 5. 0. N. Lat. 52. 4.

MONTFORT, a town of Germany, in the circle of Suabia, on the confines of Tirol, 16 miles south of Lindow, and the lake Constance. It is capital of a country of the same name, which has been almost all purchased by the house of Austria. E. Long. 9. 51. N. Lat. 47. 22.

MONTFORT-DE-LEMOS, an ancient town of Spain, in the kingdom of Galicia, with a magnificent castle, where the Comarca of Lemos resides. It is seated in a fertile country, 25 miles north-east of Orensa, and 55 south-east of Compostella. W. Long. 7. 9. N. Lat. 42. 28.

MONTFORT-L'AMULY, a town in the Isle of France, with the title of a duchy, 25 miles from Paris. E. Long. 2. 50. N. Lat. 48. 45.

MONTGATZ, a town of Lower Hungary, in the county of Pereczas, with a strong fortress. It is encompassed with a great morass, and art and nature have rendered it almost impregnable. It was defended by the princess Ragotsky, wife of Count Tekeli, when besieged by an army of the imperialists, who were obliged to raise the siege in 1688. E. Long. 21. 55. N. Lat. 46. 26.

MONTGERON, LOUIS-BASILE-CARRE DE, was born at Paris in 1686: his father was master of requests. He was scarcely 25 years of age when he purchased the place of counsellor in parliament, where by his wit and external qualifications he gained considerable reputation. Deeply engaged in all the vices which flow from irreligion, he was converted by an extraordinary circumstance. He went on the 7th of September 1731 to the tomb of Deacon Paris, with an intention to examine, with the rigour of the severest critic, the miracles which were reported to be performed there. But, according to his own account, he felt himself suddenly beat to the earth by innumerable flashes of light with which he was surrounded. His incredulity was converted into flaming zeal, and he became the apostle of the saint whom he formerly ridiculed. From that moment he devoted himself to the fanaticism of *convulsions*, with the same impetuosity of character with which he had run into the most shameful excesses. He had not long been the disciple of Jansenism when he suffered persecution. When the chamber of inquests was banished in 1732, he was sent into the mountains of Auvergne; which, instead

stead of cooling, tended rather to inflame his zeal. During his exile, he formed the plan of collecting the proofs of the miracles wrought at the tomb of the abbé Paris, and of composing what he called a *Demonstration* of them. On his return to Paris, he prepared to execute this plan; and on the 29th of July 1737, he actually presented to the king at Versailles a volume in quarto superbly bound. This work he accompanied with a speech, which is a mixture of zeal and argument in a tolerable style. In consequence of this work, which some consider as a masterpiece of eloquence, and others as a mass of absurdities, he was committed to the Bastile. After a few months confinement, he was sent to an abbey of Benedictine monks in the diocese of Avignon; whence he was, in a short time carried to Viviers. He was afterwards confined in the citadel of Valence, where he died, A. D. 1574, aged 68. The work which he presented to the king was entitled *La verité des Miracles operées par l'intercession de M. Paris, &c. &c.*—The critics, even to this day, seem to be guided in their opinion concerning this book either by hatred or by enthusiasm. "It would be extremely rash (says the abbé de St Pierre, in the second volume of his *Annales*, p. 593.) to maintain with the Molinists, that no miraculous cure was ever performed at the tomb of the abbé Paris; and to say with the Jansenists, that these cures were performed by a supernatural power, would be the height of fanaticism. The truth is (adds the same author), that no miracle appears ever to have been performed at this tomb except in the cure of the human body; in all other cases, there would have been the want of that imagination on which the whole miracle depended." Thus, although Montgeron ventured to compare these prodigies with the miracles of Jesus Christ and his apostles, yet we find no person raised from the dead, no multiplication of loaves, no command obeyed by the elements, and no blind or deaf restored to their sight or hearing. It belongs to the Author of nature alone, or to those who have derived power from him, to work such miracles as are recorded by the evangelists, or in the history of the apostles. Montgeron added a second and third volume on the same subject: he left also in manuscript a work which he composed in prison *contre les Incredules.* Religion, it must be confessed, has had much more powerful advocates. Fortunately Pascal and Bossuet are among the number: and it could well have wanted both Paris and Montgeron, whatever virtues they might possess in other respects.

MONTGOMERY, the capital of a county of the same name in North Wales, 158 miles from London, took its name from Roger de Montgomery earl of Shrewsbury, who built the castle. It is called by the Welsh *Tre Valdwin*, that is, Baldwin's town; having been built by Baldwin, lieutenant of the marches of Wales, in the reign of William I. The Welsh, after having put the garrison to the sword, demolished it in 1095; but Henry III. rebuilt it, and granted it the privileges of a free borough, with other liberties. It is a large and tolerably well built town, in a healthful situation and fertile soil.

MONTGOMERYSHIRE, a county of North Wales, 40 miles in length and 37 in breadth; bounded on the north by Merionethshire and Denbighshire, on the north-east and east by Shropshire, on the south by Radnorshire and Cardiganshire, and on the west by the last mentioned county and part of Merionethshire. It is divided into six hundreds; and contains five market towns, 47 parishes, and 47,978 inhabitants. It lies in the three several dioceses of St Asaph, Bangor, and Hereford; but sends only two members to parliament, one for the county, and one for the town of Montgomery. The air is pleasant and salubrious; but this county, being extremely mountainous, is not very fertile, except in the valleys, which afford some corn and plenty of pasture; but the south, south-east, and north-east parts, being more level, are extremely fruitful, especially a pleasant vale, watered by the Severn.

MONTH, the twelfth part of a year. See CHRONOLOGY, N° 17.

MONTH, in its proper acceptation, is that space of time which the moon takes up in passing from any certain point to the same again, which is called a *periodical month*; or it is the space of time between two conjunctions of the moon with the sun, which is called a *synodical month.* That space of time which the sun takes up in passing through one sign or 12th part of the zodiac, is also called (but improperly) a *month.* So that there are two sorts of months; *lunar*, which are measured by the moon; and *solar*, which are measured by the sun. The lunar periodical month consists of 27 days 7 hours 43 minutes 5 seconds: The lunar synodical month is 29 days 12 hours 44 minutes 3 seconds and 11 thirds. A solar month contains, upon a mean calculation, 30 days 10 hours 29 minutes 5 seconds.

The Jews, Greeks, and Romans, made use of lunar synodical months; but, to avoid fractions, they consisted alternately of 29 and 30 days. The former, the Romans called *cavi*, and the Greeks χοιλοι; the latter were termed *pleni* and πληρεις.

1. The Hebrew months were ranged differently in their sacred and in their civil year.

Order of the Sacred Year.

1 *Nisan*	Answering to our	March.
2 *Jair*		April.
3 *Sivan*		May.
4 *Thammuz*		June.
5 *Ab*		July.
6 *Elul*		August.
7 *Tisri*		September.
8 *Marschevan*		October.
9 *Casleu*		November.
10 *Thebet*		December.
11 *Sebat*		January.
12 *Adar*		February.

Order of the Civil Year.

1 *Tisri*	Answering to our	September.
2 *Marschevan*		October.
3 *Casleu*		November.
4 *Thebet*		December.
5 *Sebat*		January.
6 *Adar*		February.
7 *Nisan*		March.
8 *Jair*		April.
9 *Sivan*		May.
10 *Thammuz*		June.
11 *Ab*		July.
12 *Elul*		August.

These months being lunar cannot exactly answer to our solar months; but every Jewish month must be conceived to answer to two of ours, and partake of both. As these 12 lunar months consisted only of 354 days, the Jews, in order to bring it nearer to the true year, took care every three years to intercalate a 13th month into the number, which they called *Ve-adar*, or the second Adar. The new moon was always the beginning of the month; and it is said the Jews had people posted on elevated places, to give notice to the Sanhedrim as soon as she made her appearance: After this, proclamation was made by sound of trumpet, and "the feast of the new moon, the feast of the new moon," resounded amongst the people.

The ancient Hebrew months were of 30 days each, excepting the last, which consisted of 35; so that the year contained 365 days, with an intercalary month at the end of 120 years, which, by absorbing the odd hours which remained at the conclusion of each year, brought it back nearly to its proper place. This regulation of the year was borrowed from the Egyptians.

2. The months of the Athenian year, as we have before observed, consisted alternately of 29 and 30 days. The first month, according to Meton's reformation of the kalendar, began with the first new moon after the summer solstice, and was called *hecatombæon*, answering to the latter half of June, and the former half of July. The order of the months, with the number of days in each, are as follow:

1 *Hecatombæon*,	30	7 *Posidion*,	30
2 *Metageitnion*,	29	8 *Gamelion*,	29
3 *Boedromion*,	30	9 *Elaphebolion*,	30
4 *Mæmacterion*,	29	10 *Munichion*,	29
5 *Panepsion*,	30	11 *Thargelion*,	30
6 *Anthesterion*,	29	12 *Scirrophorion*,	29

Each month was divided into three decades of days called δεχημερα. The first was called Μηνος αρχομενου or ισαμενου, or the decade of the beginning of the month; the second was Μηνος μεσουντος or the decade of the middle; and the third was Μηνος φθινοντος, παυομενου or ληγοντος, the decade of the expiring month.

The first day of the first decade was termed νεομηνια, because the first month began with the new moon; the second day was δευτερα ισαμενου; the third τριτη ισαμενου, &c. The first day of the second decade was πρωτη μεσουντος, the second δευτερα μεσουντος, &c.—the days of this decade were also called πρωτη επι δεκα, δευτερα επι δεκα, &c. The first day of the third decade was πρωτη επ᾽ εικαδι; the second was δευτερα επ᾽ εικαδι, &c. i. e. the first, second, &c. after 20, because the last decade began on the 20th day. This decade was also counted by inversion thus: φθινοντος δεκατη the 21st, φθινοντος εννατη the 22d, φθινοντος ογδοη the 23d, and so of the rest to the last day of the month, which was called ενη και νεα, the old and the new, because one part of that day belonged to the old and the other to the new moon; but after the time of Demetrius, the last day of the month was called from him Δημητριας; it sometimes was named τριακας.

The Grecian months, thus consisting of 29 and 30 days alternately, fell short of the solar year 11 days 6 hours. To remedy this defect, the cycle of four years, called τετραετηρις, was invented.—In this cycle, after the first two years, they added an intercalated month called εμβολιμος, consisting of 22 days; and again, after the expiration of two years more, they inserted another month of 23 days, the fourth part of a day having in the space of four years amounted to a whole day. See YEAR.

3. The Roman year under Romulus consisted of 10 months only, and began with March, which contained 31 days; then followed April which had 30, May 31, June 30, *Quintilis* 31, *Sextilis* 30, September 30, October 31, November 30, December 30. These 10 months containing no more than 304 days, this account was in a short time found to be deficient. Numa Pompilius, therefore, took away one day from each of these six months, April, June, *Sextilis*, September, November, December; and to the six days thus obtained he added 51, which was the number that Romulus's year, in his opinion, wanted to make it perfect. Numa had now 57 days to dispose of; he therefore divided them, and constituted two other months, January and February; the former consisting of 29 and the latter of 28 days. The month of January, which he placed at the winter solstice, he made instead of March to begin the year. Thus Numa's year consisted of 355 days: but this being found 10 days 6 hours short of the solar year, he made use of the intercalation of 90 days at the expiration of eight years perpetually; which number, being made up of the 11 days and a quarter, kept the year pretty well to its place. The beginning of the year in Julius Cæsar's time had anticipated its true place 67 whole days: these he intercalated betwixt November and December: so that the year consisted, for this one time, of 15 months or 445 days. This reformation was called the *Julian correction*, and and this year the *year of confusion*. At the end of 12 years, by the ignorance of priests, who did not understand intercalation, 12 days had been intercalated for nine. This was observed by Augustus Cæsar, and rectified, by ordering 12 years to pass without any intercalary days. The order and succession of months was the same as that of Numa: But January, March, May, *Quintilis*, *Sextilis*, October, and December, had each 31 days; April, June, September 30, and February, in common years, 28; but every fourth year or bissextile 29. This, with a very little difference, is the account observed at present. *Quintilis*, in compliment to Julius Cæsar was called *July*, because in this month he was born; and *Sextilis*, in honour of Augustus, was called August; both which names are still continued.—See YEAR.

Each month by the Romans was divided into *kalends*, *nones*, and *ides*, all of which were reckoned backwards. The *kalends* were the first day of the month. The *nones* fell on the seventh, and the *ides* on the 15th, of March, May, July, October—but in all other months the *nones* were on the fifth, and the *ides* on the 13th. For the more easy comprehension of the Roman manner of dating, according to this division of the months, here follows a table.

	March May July October	January Auguſt December	April June September November	February.
1	*Kalendæ*	*Kalendæ*	*Kalendæ*	*Kalendæ*
2	6	4	4	4
3	5	3	3	3
4	4	*Prid. Non.*	*Prid. Non.*	*Prid. Non.*
5	3	*Nonæ*	*Nonæ*	*Nonæ.*
6	*Prid. Non.*	8	8	8
7	*Nonæ*	7	7	7
8	8	6	6	6
9	7	5	5	5
10	6	4	4	4
11	5	3	3	3
12	4	*Prid. Idus*	*Prid. Idus*	*Prid. Idus*
13	3	*Idus*	*Idus*	*Idus*
14	*Prid. Idus*	19	18	16
15	*Idus*	18	17	15
16	17	17	16	14
17	16	16	15	13
18	15	15	14	12
19	14	14	13	11
20	13	13	12	10
21	12	12	11	9
22	11	11	10	8
23	10	10	9	7
24	9	9	8	6
25	8	8	7	5
26	7	7	6	4
27	6	6	5	3
28	5	5	4	*Prid. Kal.*
29	4	4	3	
30	3	3	*Prid. Kal.*	
31	*Prid. Kal.*	*Prid. Kal.*		

N. B. Every leap year, February conſiſting of 29 days, the 24th and 25th of that month are written *ſexto Kal. Mart.*; hence leap year is called *Biſſextilis.*

MONTIA, a genus of plants belonging to the triandria claſs, and in the natural method ranking with thoſe of which the order is doubtful. See BOTANY *Index.*

MONTINIA, a genus of plants belonging to the diœcia claſs. See BOTANY *Index.*

MONTMEDI, a ſmall but ſtrong town of France, in Luxemburg, ſeated on the river Chire, which divides it into the upper and lower towns. It is 22 miles ſouth-eaſt of Sedan, 27 ſouth-weſt of Luxemburg, and 135 north-eaſt of Paris. E. Long. 5. 23. N. Lat. 49. 32.

MONTMORENCI, FRANÇOIS HENRY DE. See LUXEMBURG.

MONTMORENCY, a town of France, with the title of a duchy, remarkable for the tombs of the dukes of this name. It is ſeated on a hill, near a large valley, fertile in fruits, eſpecially excellent cherries. E. Long. 2. 24. N. Lat. 48. 59.

MONTPELIER, one of the fineſt towns of France, and the moſt conſiderable in the department of Herault, excepting Thoulouſe, is ſituated in E. Long. 3. 58. N. Lat. 43. 37. This town has been long famous for its ſalubrious air, and on this account has been the frequent reſort of invalids. But the climate, according to ſome travellers, is conſiderably changed, having at times conſtant rains for three months together, and often very thick fogs. Its ſituation, though on an eminence, never could be healthy; for between it and the Mediterranean (which is about three leagues diſtant) it is one continued marſh, covered with noxious vapours, which, when the ſea breeze ſets in, blows directly on the town and the country adjacent; of the ſad effects of which, its unhealthy inhabitants, with their meagre looks, are the moſt convincing proofs.

This city ſtands upon a riſing ground fronting the Mediterranean; on the other ſide is an agreeable plain, extending about the ſame diſtance towards the mountains of the Cevennes. It is reckoned well built, yet the ſtreets are in general narrow and the houſes dark. The inhabitants, many of whom are Proteſtants, are ſuppoſed to amount to 40,000, are ſociable, gay, and good tempered. The trade of Montpelier is very extenſive in wine, cordials, oil, verdigris, and ſaltpetre;—and the manufactures in ſilk and woollen goods are conſiderable. The markets are well ſupplied with fiſh, poultry, butcher's meat, and game, at reaſonable rates. The wine of the country is ſtrong and harſh: Burgundy is dear, and ſo is ſweet wine of Frontignan, though made in the neighbourhood of Cette. Liquors of various ſorts are compounded and diſtilled at Montpelier. The environs are extremely pleaſant, having on one ſide La Place de Peyrou, which forms a fine terrace. From thence on a clear day, may be ſeen to the eaſtward the Alps, which form the frontiers of Italy; to the ſouth weſt, the Pyrenean mountains, which form thoſe of Spain, both at about 50 leagues diſtant; and to the ſouthward a moſt extenſive view of the Mediterranean. Not far from thence is a noble aqueduct, with a double tier of arches; by this, water is brought from a mountain at three leagues diſtance, into two baſons in a ſmall elegant temple at the weſt end of the town. Here alſo is a royal garden, where on certain days public lectures were formerly held on botany. On the other ſide of the town is the eſplanade, a beautiful walk, bordered on each ſide by olive trees, from whence there is a pleaſing proſpect of the ſea and the country adjacent to the town. Previous to the revolution, Montpelier had a univerſity, an academy of ſciences, and it was the ſee of a biſhop.

MONTREAL, an iſland of North America, in the river St Lawrence, nine leagues in length, and three leagues broad, and about 60 miles above Quebec. It was taken from the French by generals Amherſt and Murray on the 8th of September 1760. The ſoil of the iſland is exceedingly rich and good, producing all kinds of European fruits and vegetables in great abundance, with variety of garden fruits. The ſouth ſide is the moſt inhabited, and of courſe beſt cultivated; and beſides the ſettlements, which are numerous, the iſland is adorned with villas, for the retirement of the more wealthy merchants during the ſummer ſeaſon. Since this place has been in the poſſeſſion of Britain, it has ſuffered much by fires, the houſes being moſtly built of wood.

The town of MONTREAL, ſituated on this iſland, and formerly called *Ville Marie*, is the ſecond place in Canada for extent, buildings and ſtrength; and beſides poſſeſſing the advantage of a leſs rigorous climate, for delightfulneſs

delightfulness of situation is infinitely preferable to Quebec. It stands on the side of a hill, sloping to the south, with many agreeable villas upon it, which, with the island of St Helen, and the river (which is here about two miles broad), form a most charming landscape. Though the city is not very broad from north to south, it covers a great length of ground from east to west, and is nearly as large and populous as Quebec. The streets are regular, forming an oblong square; the houses well built, and in particular the public eidfices, which far exceed those of the capital in beauty and commodiousness; the residence of the knights hospitallers being extremely magnificent.—There are several gardens within the walls, in which, however, the proprietors have consulted use more than elegance, particularly those the Sisters of the Congregation, the Nunnery Hospital, the Recollets, Jesuit Seminary, and Governor. The number of inhabitants is said to be between 5000 and 6000. By the situation of the place, the inhabitants are well supplied with all kinds of river fish, some of which are unknown to Europeans, being peculiar to the rivers and lakes of this country. They have likewise plenty of black cattle, horses, hogs, and poultry. The neighbouring shores supply them with a great variety of game in the different seasons; and the island abounds with springs of good water and numerous rivulets. The trade in furs is considerable, and vessels of 200 tons can come up to the town.

Montreal, a town of Spain, in the kingdom of Arragon, with a castle, seated on the river Xiloea, 25 miles north-west of Terville, and 40 south-east of Calataud.—W. Long. 1. 2. N. Lat. 41. 9.

Montreal, a town of Sicily, and in the valley of Mazara, with an archbishop's see; seated on a rivulet, five miles west of Palermo, and 50 north-east of Mazara. E. Long. 13. 31. N. Lat. 38. 14.

Montreal, or Mount Royal, a fortress of Germany, in the circle of the Lower Rhine, and electorate of Triers; seated on the river Moselle, 22 miles north-east of Triers. E. Long. 7. 6. N. Lat. 49. 59.

MONTROSE, a handsome town of North Britain, in the shire of Angus, situated at the mouth of the river Esk, on the German ocean, 46 miles north-east of Edinburgh. The houses are neat, and many of them in the modern taste. The most remarkable public buildings are, the town-house, the church, and an elegant episcopal chapel.—Montrose is a parliament town, and a dukedom in the family of Graham. It stands between two rivers, the south and north Esks, over the latter of which there is a handsome stone bridge, and over the former there is one of wood. The salmon fisheries on these rivers are very extensive, and form a considerable branch of commerce. The harbour is a fine semicircular bason defended by a handsome stone pier. A great number of trading vessels belong to this port. The population of Montrose in 1801 amounted to nearly 8000. W. Long. 2. 32. N. Lat. 36. 40.

Montrose, *Marquis of.* See Graham; and Britain, N° 137, 138, 143, 265.

MONTSERRAT, a mountain of Spain, in Catalonia, one of the most singular in the world for situation, shape, and composition. It stands single, towering over a hilly country like a pile of grotto work or Gothic spires; and its height so great, that to a beholder on the top the neighbouring mountains appear to be sunk to a level with the plain. It is composed of steep rocks, which at a distance seem indented; whence it is said to have received the name *Montserrat* from the Latin word *serra*, a "saw." It is impossible to describe the beauty, richness, and variety, of the landscapes discovered from the most elevated point: but the extensiveness of the prospect may be conceived by the reader, upon being told that the islands of Minorca and Majorca, which are at the distance of 60 leagues, are discovered from this elevation.

Montserrat is particularly famous for the adoration that is paid to an image of the Virgin, which according to tradition was found in a cave in this mountain by some shepherds in the year 880. Over this image, Guthred earl of Barcelona caused a monastery and chapel to be erected; but after remaining in this receptacle upwards of 700 years, Philip II. and Philip III. built a magnificent church for its reception. Innumerable and astonishing miracles are ascribed to this holy image. The convent or monastery is situated in a nook of the mountain; it seems as if vast torrents of water, or some violent convulsion of nature, had split the eastern face of Montserrat, and formed in the cleft a sufficient platform to build the monastery upon. The river Llobregat roars at the bottom, and perpendicular walls of rock of prodigious height, rise from the water edge near half way up the mountain. Upon these masses of white stone rests the small piece of level ground which the monks inhabit. Close behind the abbey, and in some parts impending over it, huge cliffs shoot up in a semicircle to a stupendous elevation: their summits are split into sharp cones, pillars, pipes, and other odd shapes, blanched and bare; but the interstices are filled up with forests of evergreen and deciduous trees and plants. Fifteen hermitages are placed among the woods; nay, some of them on the very pinacles of the rocks, and in cavities hewn out of the loftiest of these pyramids.

The monastery is one of the 45 religious houses of the Spanish congregation of the order of St Benedict; their general chapter is held every fourth year at Valladolid, where the deputies choose abbots and other dignitaries for the ensuing quadrennium. In this monastery, they elect for abbot a Catalan and a Castilian alternately. Their possessions are great, consisting of nine villages lying to the south of the mountain; but the king has lately curtailed their income about 6000 livres a year, by appropriating to his own use the best house in each village, some of which, with their tythes, are worth 200 dollars per annum. Their original foundation, in 866, gave them nothing but the mountain; and to donations and economy they owe the great increase of their landed property. They are bound to feed and harbour for three days all poor pilgrims that come up and pay their homage to the Virgin; and the allowance is a luncheon of bread in the morning, as much more, with broth at noon, and bread again at night. Sometimes, on particular festivals, 7000 persons arrive in one day; but people of condition pay a reasonable price for what they eat.—The number of professed monks, according to Mr Swinburne, is 76 (according to M. Bourgonane 60); of lay brothers, 28; and of singing boys 25; besides physician, surgeon, and servants. The church is a gloomy edifice; and the gilding is much sullied with the

Montserrat. the ſmoke of 85 lamps of ſilver, of various forms and ſizes, that hang round the cornice of the ſanctuary. Funds have been bequeathed by different devotees for furniſhing them with oil. The choir above ſtairs is decorated with the life of Chriſt, in good wooden carving. A gallery runs on each ſide of the chancel, for the convenience of the monks. A large iron grate divides the church from the chapel of the Virgin, where the image ſtands in a niche over the altar, before which burn four tapers in large ſilver candleſticks, the preſent of the duke of Medina Celi. In the ſacriſty, and paſſages leading to it, are preſſes and cupboards full of relicks and ornaments of gold, ſilver, and precious ſtones; they point out, as the moſt remarkable, two crowns for the virgin and her ſon, of ineſtimable value; ſome large diamond rings; an excellent cameo of Meduſa's head; the Roman emperors in alabaſter; and the ſword of St Ignatius. But as no offerings to this miraculous ſtatue can be rejected or otherwiſe diſpoſed of, the ſhelves are crowded with moſt whimſical *ex votos*, viz. ſilver legs, fingers, breaſts, ear rings, watches, two wheeled chaiſes, boats, carts, and ſuch like trumpery.

On different parts of the mountain, as already noticed, are a number of hermitages. Each of theſe ſolitary retreats, which at a diſtance ſeem deſtitute of every thing, has a chapel, a cell, a well in the rock, and a little garden. The inhabitant of one of them, which is dedicated to St Beneto, has the privilege of making an annual entertainment on a certain day; on which day all the other hermits are invited, when they receive the ſacrament from the hands of the mountain vicar, and after divine ſervice dine together. They meet alſo at this hermitage, on the days of the ſaints to which their ſeveral hermitages are dedicated, to ſay maſs and commune with each other. But at other times they live in a very ſolitary and recluſe manner, perform various penances, and adhere to very rigid rules of abſtinence; nor do they ever eat fleſh; nor are they allowed to keep within their walls either dog cat, bird, or any living thing, left their attention ſhould be withdrawn from heavenly to earthly affections. Moſt of theſe hermits are ſaid to be perſons of fortune and family, diſguſted with the world, who have retired thither to devote themſelves to meditation, ſelf-denial, and contrition.

MONTSERRAT, one of the Caribbee iſles, belonging to Great Britain. It is a very ſmall, but very pleaſant iſland, ſo called by Columbus from its reſemblance to the famous mountain near Barcelona in Catalonia. It lies in W. Long. 61. 0. N. Lat. 16. 50. having Antigua to the north-eaſt, St Chriſtopher's and Nevis to the north-weſt, and Guadaloupe lying ſouth ſouth-eaſt at the diſtance of about nine leagues. It is about nine miles in diameter, and is ſuppoſed to contain about 40,000 or 50,000 acres. The climate is warm, but leſs ſo than in Antigua, and is eſteemed very healthy. The ſurface is mountainous, but with pleaſant, rich, and fertile valleys; the hills are covered with cedars and other fine trees. Here are all the animals as well as vegetables and fruits that are to be found in the other iſlands. The inhabitants raiſed formerly a conſiderable quantity of indigo. The produce now is chiefly cotton, rum, and ſugar. There is no good harbour, but three tolerable roads, at Plymouth, Old Harbour, and Ker's Bay.

MONUMENT, in architecture, a building deſtined to preſerve the memory, &c. of the perſon who raiſed it, or the perſon for whom it was raiſed; ſuch are a mauſoleum, a triumphal arch, a pyramid, &c. Monument ‖ Moon.

MOOD, or MODE. See MODE.

MOODS of Syllogiſm. See LOGIC, N° 85.

MOOD, or *Mode*, in grammar, the different manner of conjugating verbs. See GRAMMAR.

MOON, (*Luna* ☽), in aſtronomy, one of the heavenly bodies, uſually ranked among the planets; but with more propriety accounted a ſatellite, or ſecondary planet.

Among the ancients, the moon was an object of prime regard.—By the *Hebrews* ſhe was more regarded than the ſun, and they were more inclined to worſhip her as a deity. The new moons, or firſt days of every month, were kept as feſtivals among them, which were celebrated with ſound of trumpets, entertainments, and ſacrifice. (See Numb. xviii. 11. x. 16. 1 Sam. xx. 5—18.) People were not obliged on theſe days to reſt. The feaſts of new moons were a miniature repreſentation of the feaſt of trumpets, which was held on the firſt of the month Tiſri, which was the beginning of the civil year. The Jews not being acquainted with the phyſical cauſe of eclipſes, looked upon them, whether of ſun or moon, as ſigns of the divine diſpleaſure. The Grecians looked upon the moon as favourable to marriage; and the full moons, or the times of conjunction of ſun and moon, were held the moſt lucky ſeaſons for celebrating marriages; becauſe they imagined the moon to have great influence over generation. The full moon was held favourable for any undertakings by the Spartans: And no motive could induce them to enter upon an expedition, march an army, or attack an enemy, till the full of the moon. The moon was ſuppoſed both by Greeks and Romans to preſide over child-birth.—The patricians at Rome wore a creſcent on their ſhoes, to diſtinguiſh them from the other orders of men. This creſcent was called *Lunula*. Some ſay it was of ivory, others that it was worked upon the ſhoe, and others that it was only a particular kind of fibula or buckle.

For the aſtronomical phenomena connected with the moon, ſee ASTRONOMY *Index*.

Harveſt-Moon.—It is remarkable, that the moon, during the week in which ſhe is full in harveſt, riſes ſooner after ſunſetting than ſhe does in any other full moon week in the year. By doing ſo, ſhe affords an immediate ſupply of light after ſunſet, which is very beneficial to the farmers for reaping and gathering in the fruits of the earth: and therefore they diſtinguiſh this full moon from all the others in the year, by calling it the *harveſt moon*.

Influence of the Moon on the Human Body.—The famous Dr Mead was a believer in the influence of the ſun and *moon* on the *human body*, and publiſhed a book to this purpoſe, entitled *De Imperio Solis ac Lunæ in Corpore humano*: but this opinion has been exploded by moſt philoſophers, as equally unreaſonable in itſelf, and contrary to fact. As the moſt accurate and ſenſible barometer is not affected by the various poſitions of the moon, it is not thought likely that the human body ſhould be affected by them. Several learned and ingenious men, however, ſtill conſider Dr Mead's doctrine as far from being unfounded.

MOON, *Influence of, on the Earth's Atmoſphere*.—It has

has been the opinion of the vulgar in almoſt all ages and countries, that the changes which take place in the ſtate of our atmoſphere, or the changes of the weather, depend in a great meaſure on certain ſituations of the moon. This particular opinion is alluded to by Virgil (A), and is applied in the ſhepherd of Banbury's rules for judging of the weather (B). We have, under METEOROLOGY, N° 90 to 92, given the reſult of ſome obſervations on the connection between the changes of the moon and thoſe of the weather.

It can ſcarcely be doubted that an opinion ſo generally received muſt be founded on ſomething more than fancy or prejudce and; indeed the obſervations of ſeveral eminent meteorologiſts within the laſt thirty years have contributed materially to favour this opinion. Independent of actual obſervation, it appears reaſonable to infer, that a body ſo large, and ſo near the earth, as the moon, whoſe gravitating influence on the earth's ſurface in producing the *flux and reflux of the ſea*, cannot be altogether inactive with reſpect to the air, a fluid much more ſuſceptible of changes than the ſea.

We have already noticed (METEOROLOGY, N° 14.) the theory of Mr Luke Howard, on the moon's influence on the mercury of the barometer, and we are now to give a ſhort account of what has been advanced on her general influence by the philoſophers of the continent. Among theſe, Signior Toaldo may be ſaid to have led the way.

From obſervations made at Padua, during fifty years, on the ſtate of the weather that correſponded to certain changes of the moon, he found that theſe changes were always accompanied by good or bad weather; and he at length became enabled to foretel with ſome degree of certainty what would be the ſtate of the atmoſphere that ſhould follow any ſituation of the moon. There are ten ſituations of the moon, which, according to Toaldo, are capable of producing a ſenſible effect on the earth's atmoſphere. Theſe are the *ſyzigies* * or new and full moon; the quadratures; the *apſides*, or apogee and perigee; the *luniſtices*, or theſe points when the moon is neareſt to our zenith and at the greateſt diſtance from it; and the moon's *equinoxes*. There are three different relations of the moon's motion producing a correſponding number of revolutions, each having a certain duration, and each correſponding to ſome of the above ten ſituations, as it will be ſeen by the following table.

* See *Aſtronomy*, N° 90.

Revolutions.	Situations.
1. *Synodical*, in regard to the ſun; continues 29 days 12 hours 44 minutes.	New moon. Firſt quarter. Full moon. Laſt quarter.
2. *Anomaliſtic*, in regard to the moon's courſe; continues 27 days 13 hours 43 minutes.	Apogeum. Perigeum.
3. *Periodical*, in regard to the moon's paſſing the equator; continues 27 days, 7 hours, 43 minutes.	Aſcending equinoxes. Northern luniſtices. Deſcending equinoxes. Southern luniſtices.

Sig. Toaldo has calculated a ſeries of probabilities that a change of weather will take place on the approach of any one of theſe ten ſituations, and theſe he has expreſſed in a tabular form as follows.

That a change will take place at	New moon	is	6:1
	Firſt quarter		5:2
	Full moon		5:2
	Laſt quarter		5:4
	Perigeum		7:1
	Apogeum		4:1
	Aſcending equinox		13:4
	Northern luniſtice		11:4
	Deſcending equinox		11:4
	Southern luniſtice		3:1

In general, each of the ten ſituations changes the weather that prevailed under the preceding ſituation, and it ſeldom happens that a change of weather takes place without a correſponding change in the lunar ſituations. From the inequality of their revolutions, theſe ſituations are often combined, and by this union their effect in producing changes of the atmoſphere is greatly increaſed, eſpecially when a union takes place between the ſyzigies and apſides. Thus,

That a change will follow	New moon with perigee	is	33:1
	Ditto with apogee		7:1
	Full moon with perigee		10:1
	Ditto with apogee		8:1

Theſe combined ſituations are generally accompanied or followed by ſtorms and tempeſts, eſpecially when they take place near the moon's paſſage over the equator. This is more particularly the caſe in the months of March and September, and we find that at the new and full moon in theſe months, the weather takes a certain character, by which it is diſtinguiſhed for the ſucceeding three or ſix months. The ſame takes place at the ſolſtices, eſpecially at the winter ſolſtice. The new moon does not always, however, produce a change of weather; and this want of effect is moſt likely to happen at thoſe new moons which are moſt diſtant from the apſides.

Though Toaldo conſiders it as perfectly aſcertained that each ſucceeding ſituation of the moon alters that ſtate of the atmoſphere which had been produced by the preceding ſituation; it muſt, however, be obſerved that ſome ſituations of the moon favour good and others bad weather. Thus the perigee, the new and full moon, the paſſage over the equator, and the northern luniſtice are favourable to bad weather, while the apogee

(A)———" lunaſque ſequentes
Ordine reſpicies; nunquam te craſtina fallet
Hora, neque inſidiis noctis capiere ſerenæ.
Georg. I. 424.

(B) 1. Horns of the moon obſcure—*Rain.*
2. When the moon is red—*Wind.*
3. On the fourth day of the new moon, if bright, with ſharp horns—*No winds nor rain till the month be finiſhed.*

Moon.

gee, quadratures, and southern lunistice, are more favourable to good weather.

The changes produced by the influence of the lunar situations, seldom take place on the exact days on which these situations happen, but either precede or follow them; and Toaldo has found that, in the six winter months, the changes of weather commonly precede the lunar situations, whereas in the six summer months they more commonly follow them.

There are certain days before and after new and full moon, which deserve particular attention in forming our judgements of the weather, especially the octants or the fourth day before new and full moon, as at these times the weather is inclined to change, and it may be pretty certainly predicted, that a change will follow at the next lunar situation. Virgil has particularly noticed this fourth day as a sure mark of the succeeding weather (c). If the weather continues unchanged on the fourth, fifth, and sixth day of the moon, it proves that the lunar influence is at that time very weak, and we are to expect no change till the full moon, or perhaps till the next new moon.

Sig. Toaldo compared a diary which he had kept for many years of the state of the barometer with the ten situations of the moon, and from the comparison deduced the following conclusions, viz.

1. That at the time of the moon's apogee, the mercury rises higher by the sixth part of a line than at the perigee.

2. That at the time of the quadratures it is higher by the tenth of a line than at the time of the syzigies.

3. That it is higher by a fourth of a line at the southern than at the northern lunistice. This correspondence of the lunar situations with the ascent of the mercury in the barometer does not hold at the time of the moon's passage through her equinoctial points. The mercury is then higher, especially when she is passing in Libra; and as such situations of the moon generally indicate bad weather, this circumstance is not conformable to meteorological observations.

In this case Toaldo thinks that we must be guided, in our judgement of the weather, rather by the moon than by the barometer.

The case is similar during the coincidence of the equinoctial points with the perigee, at which time the mercury is unusually high; but this coincidence is a sign of great irregularity.

According to Toaldo, the rising and setting of the moon, as well as its superior and inferior passage of the meridian, all which situations he calls the moon's angles, may serve for foretelling rain. The seasons most exposed to rain, are the rising and setting of the moon; while its passage over the meridian is most favourable to good weather. It has ever been observed that during rainy days, the sky always clears a little while the moon is passing the meridian. An exception to this rule must, however, be made when the moon's angle does not coincide with that of the sun.

Bad years take place when the apsides of the moon fall in the four cardinal points of the zodiac. Their intervals, therefore, are as four to five, eight to nine, &c. or as the intervals of the passage of the apsides through the four cardinal points of the zodiac. Thus the year 1777 was, in general, a bad year; and in that year the apsides of the moon were in the equinoctial signs; and it is probable that the years in which the apsides fall in the signs Taurus, Leo, Virgo and Aquarius, will be good and moderate years, as the year 1776 really was; and in that year the apsides of the moon were in Taurus and Virgo.

Every 18th year must be similar. We, however, cannot depend upon a return altogether the same, on account of the three different revolutions of the moon; and therefore it may happen, that the epoch of this extraordinary year may be retarded a year or perhaps two. Though approximations only are here given, this does not prevent their being useful to farmers, if they only pay attention to circumstances. Besides, various exceptions must be made for different parts of the earth; and it is difficult to determine these before-hand, as what regards this system is applicable to the whole globe; but when the result of the system has been improved by local observations, the conjectures for each country will be attended with more certainty.

The 54th year must have a greater similarity to the first than to all the rest; because, at this period, the situations of the moon, in regard to the sun and the earth, are again found in the same points.

The quantity of the rain which falls in nine successive years, is almost equal to that which falls in the next following nine. But this is not the case when we compare in like manner the quantity of rain which falls in six, eight, or ten years *.

The observations of M. Lamarck, though they confirm the opinion of the moon's general influence on the atmosphere, do not agree with those of Toaldo, as to the situations of that luminary which correspond to the changes of the weather. He could not find that agreement between the syzigies and quadratures of the moon and a change of weather, which has been so much dwelt on by Toaldo; but he is of opinion, that we are to consider the *declination* of the moon as the principal cause of her influence on the atmosphere.

Lalande had conceived the idea that when the moon entered the northern hemisphere, or had *north declination*, the weather was most likely to be cold and dry, and that when she passed to the south of the equator, it was likely to be rainy. The observations of Lamarck, however, tend to establish the contrary opinion.

Lamarck considers the two following principles as established by his observations; viz.

1. *That it is in the elevation of the moon above, and her depression below, the equator that we are to search for those regularly varied effects which she produces on our atmosphere.*

2. *That the determinable circumstances, which conspire*

* See *Phil. Mag.* vol. iii.

(c) Luna revertentes cum primum colligit ignes,
Si nigrum obscuro comprenderit aëra cornu;
Maximus agricolis pelagoque parabitur imber.
At, si virgineum suffuderit ore ruborem,
Ventus erit; vento semper rubet aurea Phœbe.
Sin ortu in quarto (namque is certissimus auctor)
Pura, neque obtusis per coelum cornibus ibit;
Totus et ille dies, et qui nascentur ab illo
Exactum ad mensem, pluvia ventisque carebunt.

See Note (b) *Georg.* I 427.

Moon.

ſpire to increaſe or diminiſh the moon's influence in her different declinations, are her apogees and perigees, her conjunctions with and oppoſitions to the ſun; and laſtly, the ſolar ſolſtices and equinoxes.

Conſidering that every lunar month, or every revolution of the moon in the zodiac, may be divided into two diſtinct portions, each containing about fourteen days, and each giving occaſion to a particular atmoſpheric conſtitution, we may aſſume theſe as two circumſtances of importance in meteorology, and we may call one the *boreal* or *northern* conſtitution, viz. that in which the moon paſſes through the ſix northern ſigns of the zodiac, and the other, the *auſtral* or *ſouthern* conſtitution, viz. that in which ſhe traverſes the ſix ſouthern ſigns.

Lamarck is convinced by obſervation, that in theſe climates, during a *boreal conſtitution*, there chiefly prevail ſoutherly, ſouth-weſterly, and weſterly winds, though ſometimes, in the ſummer, the winds paſs to the ſouth-eaſt. In general, during this conſtitution, the barometer exhibits only moderate elevations of the mercury; moſt commonly the ſeaſon is rainy or moiſt, and the air loaded with clouds. And laſtly, it is particularly during this conſtitution that we obſerve the effects of ſtorms and tempeſts, when the cauſes which occaſion them become active.

On the contrary, during an auſtral conſtitution, the winds which chiefly predominate blow from the north and north-weſt, and in the ſummer north-eaſt, and even eaſterly winds. In general during this conſtitution, the barometer exhibits conſiderable elevations in the column of mercury, at leaſt if the wind is not very ſtrong; the weather is then moſt uſually clear, cold and dry, and in the ſummer it is ſeldom (we might almoſt ſay never) during this conſtitution that ſtorms are formed.

Theſe atmoſpheric conſtitutions are not, however, ſo permanently characteriſed as to render it eaſy to diſtinguiſh them at all times by the ſtate of the atmoſphere. The atmoſpheric air is a moveable fluid, and ſo eaſily diſplaced, that it is not ſurpriſing that in the temperate zones, where the influence of the heavenly bodies acts leſs ſtrongly than between the tropics, from various cauſes, that counteract very often the regular influence of the moon, and tend to maſk and even change its effects.

The perturbations which theſe variable cauſes produce on the regular effects of the influence of the moon on the atmoſphere, occaſion in fact many variations in the two atmoſpheric conſtitutions which we have been deſcribing; and this is doubtleſs the reaſon why they have been hitherto diſregarded. M. Lamarck poſitively aſſerts, that theſe perturbations, though frequent, and ſometimes very conſiderable, do not prevent the character of each of theſe conſtitutions from being remarked in the greateſt number of caſes.

The probability that he finds, according to his obſervations, is eſtimated at five out of eight; that is to ſay, out of 48 atmoſpheric conſtitutions comprehended in the lunar year, he eſtimates there will be found at leaſt 30 agreeing with the principles pointed out in his memoir; and he adds, that among the diſturbing cauſes which modify the before-mentioned effects, ſeveral may be foreſeen, and perhaps even appreciated as to their quantity of effect.

He conſiders what is here pointed out as a fact; as an order of things which any one may prove by obſervation *.

Lamarck has alſo endeavoured to aſcertain what truth there may be in the periodical return of the variations of the atmoſphere at the end of nineteen years; and he has found, by comparing meteorological obſervations, that this return is far from being ſo correct as is generally believed.

Aſtronomers alſo know well, that the cycle of nineteen years is not exact within an hour and a half; an error which amounts to a whole day in the courſe of 308 years †.

M. Cotte has alſo beſtowed much attention on this ſubject of the moon's influence; but appears to think that our obſervations are not ſufficiently numerous or accurate, to deduce any thing like a correct theory, and he is not diſpoſed to go ſo far as M. Lamarck.

M. Cotte agrees in general with Mr Luke Howard's obſervations on the moon's influence. (See METEOROLOGY). He noted, during the ſpace of 34 years and five months, (from the 1ſt of January 1768, to the 22d of May 1802), the aſcending and deſcending direction of the barometer in each of the ſyzigies and quarters of the moon which have occurred through that period of time. He ſtates the total ſum of the elevations and depreſſions of the mercury at each of the phaſes as follows.

For $34\frac{1}{2}$ Years.	New Moon.	1ſt Quar.	Full Moon.	2d Quar.
Sum of elevations	218	296	199	290 times.
——— depreſſions	281	229	279	106
Differences	63	67	80	84

Theſe reſults, of nearly 35 years' obſervations, confirm, as will be ſeen, the concluſions drawn by Mr Howard, both from his obſervations for one year at Plaiſtow, and thoſe made for 10 years in the Royal Society's apartments.

It is to be remarked, 1ſt, That the four numbers which expreſs the differences between the elevations and depreſſions are nearly in an exact proportion, ſince $63 : 67 :: 80 : 85\frac{5}{63}$.

2dly, That the two latter phaſes, viz. the full moon and laſt quarter, have more effect than the two firſt.

3dly, He examined what phaſes of the moon correſponded to the greateſt and leaſt height of the mercury for each month during ten years, and obtained the following reſults.

For 10 Years.	New Moon.	1ſt Quar.	Full Moon.	2d Quar.
Greateſt elevation occurred at	26	40	26	28 times.
Greateſt depreſſion occurred at	30	34	29	27
Differences	4	6	3	1

The ſcience may be therefore ſaid to have advanced one ſtep farther towards perfection on this occaſion; and it is to be hoped that, by redoubling our diligence in multiplying obſervations, and combining them in various ways to obtain their reſults, its progreſs may be ſtill accelerated. The uſeful purpoſes which may be thereby anſwered in philoſophy, agriculture, and medicine, may be properly urged to obſervers as the means of

* See *Jour. de Phyſ.* vol. iii. and *Nichol. Jour* 4to, vol. iv.

† *Phil. Mag.* vol. v.

of supporting their ardour, and indemnifying them for those sarcasms and reflections which even some learned men have been pleased to bestow upon observations of this sort, together with their authors. *

*Phil. Mag. vol. xiii.

Moon-Eyes, among horses, when the weakness of the eye increases or decreases according to the course of the moon; so that in the wane of the moon his eyes are muddy and troubled, and at new moon they clear up. This observation is probably inaccurate.

Moon-stone, or *Adularia*. See Adularia, Mineralogy *Index*.

Moon-Wort. See Lunaria, Botany *Index*.

MOOR, in country affairs, denotes a tract of land, usually overrun with heath.

Moor-Cock, or *Gor-Cock*. See Tetrao, Ornithology *Index*.

Moor Land, or *moory soil*, in *Agriculture*, is a black, light, and soft earth, very loose, and without any admixture of stones; and with very little clay or sand.

MOORE, or More, Edward, an ingenious writer, was bred a linen draper, but quitted business to join the retinue of the Muses; and he certainly had a very happy and pleasing talent for poetry. In his Trial of Selim the Persian, he complimented Lord Lyttleton in an elegant kind of panegyric, couched under the appearance of accusation: and his Fables for the Female Sex, for easy versification, poignant satire, and striking morals, approach nearer to the manner of Gay than any other of the numerous imitations of that author. He wrote also three dramatic pieces; The Gamester, a tragedy; The Foundling, and Gil Blas, comedies. The success of these was not such as they merited, the first of them having met with a cold reception, for no other apparent reason but because it too nearly touched a favourite and fashionable vice; and the second having been condemned for its supposed resemblance to Sir Richard Steele's Conscious Lovers, but to which good judges have been inclined to give it greatly the preference. Mr Moore married a lady of the name of *Hamilton*, daughter to Mr Hamilton table-decker to the princesses, who had herself a very poetical turn, and has been said to have assisted him in the writing of his tragedy. One specimen of her poetry, however, was handed about before their marriage, and has since appeared in print in different collections of songs, particularly in one called the *Goldfinch*. It was addressed to a daughter of the famous Stephen Duck; and begins with the following stanza:

Would you think it, my Duck? (for the fault I must own),
Your Jenny at last is quite covetous grown:
Though millions if Fortune should lavishly pour,
I still would be wretched if I had not More.

And after half a dozen stanzas more, in which, with great ingenuity and delicacy, and yet in a manner that expresses a great affection, she has quibbled on our author's name, she concludes with the following lines:

You may wonder, my girl, who this dear one can be,
Whose merit can boast such a conquest as me:
But you shan't know his name, tho' I told you before,
It begins with an M, but I dare not say More.

In the year 1753, Mr Moore commenced a weekly miscellaneous paper, entitled, *The World, by Adam Fitz-Adam*, in which undertaking he was assisted by Lord Chesterfield with some essays. This paper was collected into volumes, and Mr Moore died soon after.

MOORING, the act of confining and securing a ship in a particular station, by chains or cables, which are either fastened to the adjacent shore, or to anchors in the bottom.

A ship may be either moored by the head, or by the head and stern; that is to say, she may be secured by anchors before her, without any behind; or she may have anchors out, both before and behind her; or her cables may be attached to posts, rings, or moorings, which answer the same purpose.

When a ship is moored by the head with her own anchors, they are disposed according to the circumstances of the place where she lies and the time she is to continue therein. Thus, wherever the tide ebbs and flows, it is usual to carry one anchor out towards the flood, and another towards the ebb, particularly where there is little room to range about; and the anchors are laid in the same manner, if the vessel is moored head and stern in the same place. The situation of the anchors, in a road or bay, is usually opposed to the reigning winds, or those which are most dangerous; so that the ship rides therein with the effort of both her cables. Thus if she rides in a bay, or road, which is exposed to a northerly wind and heavy sea from the same quarter, the anchors passing from the opposite bows ought to lie east and west from each other: hence both the cables will retain the ship in her station with equal effort against the action of the wind and sea.

Moorings, in sea language, are usually an assemblage of anchors, chains, and bridles, laid athwart the bottom of a river or haven, to ride the shipping contained therein. The anchors employed on this occasion have rarely more than one fluke, which is sunk in the water near low-water mark. Two anchors being fixed in this manner in the opposite side of the river, are furnished with a chain extending across from one to the other. In the middle of the chain is a large square link, whose lower end terminates in a swivel, which turns round in the chain as about an axis, whenever the ship veers about with the change of the tide. To this swivel link are attached the bridles, which are short pieces of cable, well served, whose upper ends are drawn into the ship at the mooring ports, and afterwards fastened to the masts or cable bolts. A great number of moorings of this sort are fixed in the harbours adjacent to the king's dock-yards, as Deptford, Chatham, Portsmouth, Plymouth, &c.

MOORLANDS, a tract so called, in the north part of Staffordshire, where the land rises gradually into small hills, which run through the midst of England in one continued ridge, rising higher and higher to Scotland, and sending forth many rivers. The soil here is so foul and cold, that the snows lie almost all the year on the tops of the hills; and it is withal very rugged and barren: it, however, yields plenty of coal, lead, copper, rance-marble, and millstones; and some of the limestone hills bear such a sweet though short grass, as is very grateful to the oxen, of which here is a very good breed. It is obſerved here, that the weſt wind always brings rain, and the eaſt and ſouth fair weather; that though this tract is full of bogs, it is as healthy as any other part of the county; and that it produces the ſame plants as the Peak of Derby.

MOORS. See Morocco.

Moors, in the Iſle of Man, thoſe who ſummon the courts for the ſeveral ſheadings; ſuch as the lords bailiffs. Every moor has the like office with our bailiff of the hundred.

MOOSE, or Elk. See Cervus, Mammalia *Index*.

MOOT, a difficult caſe, argued by the young barriſters and ſtudents at the inns of court, by way of exerciſe, the better to qualify them for practice, and to defend the cauſes of their clients. This, which is called *mooting*, is the chief exerciſe of the inns of court. Particular times are appointed for the arguing moot caſes: the place where this exerciſe is performed was anciently called *moot-hall;* and there is a bailiff, or ſurveyor of the moots, annually choſen by the bench to appoint the moot men for the inns of chancery, and to keep an account of the performance of exerciſes. The word is formed either from the Saxon *metan*, *gemetan*, "meeting;" or from the French *mot*, "word."

MOPSUS, in fabulous hiſtory, a celebrated prophet, ſon of Manto and Apollo, during the Trojan war. He was conſulted by Amphimachus, king of Colophon, who wiſhed to know what ſucceſs would attend his arms in a war which he was going to undertake. He predicted the greateſt calamities; but Calchas, who had been a ſoothſayer of the Greeks during the Trojan war, promiſed the greateſt ſucceſſes. Amphimachus followed the opinion of Calchas; but the prediction of Mopſus was fully verified. This had ſuch an effect upon Calchas, that he died ſoon after. His death is attributed by ſome to another mortification of the ſame nature. The two ſoothſayers, jealous of each other's fame, came to a trial of their ſkill in divination. Calchas firſt aſked his antagoniſt, how many figs a neighbouring tree bore? 10,000 except one, replied Mopſus, and one ſingle veſſel can contain them all. The figs were gathered, and his conjectures were true. Mopſus now to try his adverſary, aſked him how many young ones a certain pregnant ſow would bring forth? Calchas confeſſed his ignorance; and Mopſus immediately ſaid that the ſow would bring forth on the morrow ten young ones, of which only one ſhould be a male, all black, and that the females ſhould all be known by their white ſtreaks. The morrow proved the veracity of his prediction; and Calchas died by exceſs of the grief which his defeat produced. Mopſus after death was ranked among the gods, and had an oracle at Malia, celebrated for the true and deciſive anſwers which it gave.—Another *Mopſus*, ſon of Ampyx and Chloris, born at Titareſſa in Theſſaly. He was the prophet and ſoothſayer of the Argonauts, and died at his return from Colchis by the bite of a ſerpent in Libya. Jaſon erected him a monument on the ſea ſhore, where afterwards the Africans built him a temple, where he gave oracles. He has often been confounded with the ſon of Manto, as their profeſſions and their names were alike.

MORÆA, a genus of plants belonging to the triandria claſs; and in the natural method ranking under the 6th order, *Enſatæ*. See Botany *Index*.

MORAI, is the name given at Otaheite in the South ſea to the burying grounds, which are alſo places of worſhip. This is a pile of ſtone raiſed pyramidically upon an oblong baſe or ſquare 267 feet long and 87 wide. On each ſide is a flight of ſteps; thoſe at the ſides being broader than thoſe at the ends; ſo that it terminated not in a ſquare of the ſame figure with the baſe, but in a ridge like the roof of a houſe. There were 11 of theſe ſteps to one of theſe morais, each of which was 4 feet high, ſo that the height of the pile was 44 feet; each ſtep was formed of one courſe of white coral ſtone, which was neatly ſquared and poliſhed; the reſt of the maſs (for there was no hollow within) conſiſted of round pebbles, which, from the regularity of their figure, ſeemed to have been wrought. The foundation was of rock ſtones, which were alſo ſquared. In the middle of the top ſtood an image of a bird carved in wood, and near it lay the broken one of a fiſh carved in ſtone. The whole of this pyramid made part of one ſide of a ſpacious area or ſquare 360 feet by 354, which was walled in with ſtone, and paved with flat ſtones in its whole extent. About 100 yards to the weſt of this building was another paved area or court, in which were ſeveral ſmall ſtages raiſed on wooden pillars about ſeven feet high, which are called by the Indians *ewattas*, and ſeem to be a kind of altars, as upon theſe are placed proviſions of all kinds, as offerings to their gods. On ſome of them were ſeen whole hogs, and on others the ſkulls of above 50, beſides the ſkulls of many dogs. The principal object of ambition among the natives is to have a magnificent morai. The male deities (for they have them of both ſexes) are worſhipped by the men, and the female by the women; and each have morais, to which the other ſex is not admitted, though they have alſo morais common to both.

MORAL PHILOSOPHY, or MORALS.

MORAL PHILOSOPHY is, "The ſcience of manners or duty; which it traces from man's nature and condition, and ſhows to terminate in his happineſs." In other words, it is, "The knowledge of our duty and felicity;" or, "The art of being virtuous and happy."

It is denominated an *art*, as it contains a ſyſtem of rules for becoming virtuous and happy. Whoever practiſes theſe rules, attains an habitual power or facility of becoming virtuous and happy. It is likewiſe called a *ſcience*, as it deduces thoſe rules from the principles and connexions of our nature, and proves that the obſervance of them is productive of our happineſs.

It is an art, and a ſcience of the higheſt dignity, importance, and uſe. Its object is man's duty, or his conduct

duct in the feveral moral capacities and connexions which he fuftains. Its office is to direct that conduct; to fhow whence our obligations arife, and where they terminate. Its ufe, or end, is the attainment of happinefs; and the means it employs are rules for the right conduct of our moral powers.

Moral Philofophy has this in common with Natural Philofophy, that it appeals to nature or fact; depends on obfervation; and builds its reafonings on plain uncontroverted experiments, or upon the fulleft induction of particulars of which the fubject will admit. We muft obferve, in both thefe fciences, how nature is affected, and what her conduct is in fuch and fuch circumftances: Or, in other words, we muft collect the appearances of nature in any given inftance; trace thefe to fome general principles or laws of operation; and then apply thefe principles or laws to the explaining of other phenomena.

Therefore Moral Philofophy inquires, not how man might have been, but how he is, conftituted: not into what principles or difpofitions his actions may be artfully refolved, but from what principles and difpofitions they actually flow: not what he may, by education, habit, or foreign influence, come to be or do, but what, by his nature, or original conftituent principles, he is formed to be and do. We difcover the office, ufe, or deftination of any work, whether natural or artificial, by obferving its ftructure, the parts of which it confifts, their connexion or joint action. It is thus we underftand the office and ufe of a watch, a plant, an eye, or hand. It is the fame with a living creature of the rational or brute kind. Therefore, to determine the office, duty, or deftination of man; or, in other words, what his bufinefs is, or what conduct he is obliged to purfue; we muft infpect his conftitution, take every part to pieces, examine their mutual relations one to the other, and the common effort or tendency of the whole.

It has not been thus, however, that the fcience has always been taught. The earlieft moralifts did not erect fyftems upon a juft analyfis of the powers of the human mind; nor have all thofe who thought fuch a foundation neceffary to be laid, deduced their theories from the very fame principles. As moral truths are not capable of rigid demonftration, it appears to us, that we cannot more properly introduce the fyftem which we have adopted, than by giving our readers a fhort view of the moft celebrated fyftems that have been maintained by others. They will thus have an opportunity of judging for themfelves of the refpective merits of the different theories, and of adopting that which fhall appear to them to place practical virtue on the firmeft bafis.

History of the Science of Morals.

1 Various opinions concerning the criterion of virtue, &c.

Whilft there has been a remarkable agreement among the writers on morality, as to the particular actions which are virtuous and thofe which are vicious; and whilft they have uniformly taught, that it is our duty and our intereft to perform the one and to avoid the other; they have yet differed exceedingly concerning the *teft* or *criterion* of virtue, as well as concerning the *principle* or *motive* by which men are induced to purfue it. One caufe of this difference in opinion refpecting matters of fuch univerfal importance, may perhaps be traced to the miftakes into which philofophers are apt to fall concerning the original ftate of man.

2 Probable caufe of this variety.

It is very generally taken for granted, that the firft men were favages of the loweft rank, and that the race gradually civilized itfelf during the courfe of many fucceeding ages. Without mutual intercourfe, the progrefs of civilization could never have commenced; and as the practice of juftice is abfolutely neceffary to every fpecies of friendly intercourfe, thofe original favages, it is fuppofed, muft have been juft in their dealings, and juft upon fome principle which has its foundation in human nature. But to develope the principle by which favages are influenced in their conduct, no tedious or intricate procefs of reafoning can be neceffary. It muft have a place in every mind, and be inftantaneous in all its decifions. Hence it has been fuppofed, that the principle to which modern philofophers have given the name of the *moral fenfe*, is inftinctive; that it is the fole judge of virtue and vice; and that its admonitions have fuch authority, as to enforce obedience without regard to the confequences of any action.

Other philofophers, who deny that the moral fenfe is inftinctive, and who yet fuppofe that the original ftate of man was favage, are forced to pile hypothefis upon hypothefis, each unnatural in itfelf, and all contradictory to one another, in order to account for the commencement of civilization and the formation of fociety. It has been fuppofed, that the defire of felf-prefervation and the love of power are the governing principles in human nature; that in the favage ftate every man had a right to every thing which he could feize by fraud or force; that all had an innate propenfity to invade each other's property; and that hence war, rapine, and bloodfhed, prevailed univerfally, till the favages difcovered the expediency of uniting under fome form of government for their mutual protection.

But before the original ftate of man had been made the bafis of fuch oppofite theories as thefe, it would furely have been proper to inquire upon what grounds that ftate has been fuppofed to be favage. To us thefe grounds appear to be nothing better than mere imaginations; the dreams of poets, and of fuch philofophers as bend facts to their own fyftems. In the authentic *hiftory* of our fpecies, there is no evidence, indeed there can be no evidence, that the firft men were favages; and every thing which we know of human nature leads us to believe, that had they been fo, the race could never have been civilized but by the miraculous interpofition of fome fuperior being. The only record of the earlieft ages of the world to which the fmalleft credit is due, reprefents all the nations of the earth as having fprung from one pair, and that pair as having been inftructed in their duty by their beneficent Creator. If this be the fact, and no confiftent theift can controvert it, the precepts of morality would be originally conveyed from one generation to another; not in a fyftematical or fcientific form, but as the laws of the Univerfal Sovereign, whofe authority demanded implicit obedience. Accordingly we find, that the firft teachers of morals were men of fuperior rank as well as of eminent talents, who formed collections of maxims derived from their anceftors, "with the view

3 Modes of communicating inftruction by the earlieft moralifts.

view of perfecting ſubordination *, poliſhing manners, and educating youth. Such were the Proverbs of Solomon, the Words of Agur, and the Wiſdom of the ſon of Sirach." Theſe inſtructors did not analyze the human mind into its various faculties, and build a ſyſtem of morals either upon a particular inſtinct pointing to the ſupreme good, or upon the fitneſs of things diſcovered by reaſon. Short iſolated ſentences were the mode in which they conveyed their precepts; which they prefaced by obſerving, that "the fear of the Lord is the beginning of knowledge;" and enforced by the aſſurance, that "length of days, and long life, and peace, ſhould they add to thoſe who obeyed them." The ſayings of the celebrated wiſe men of Greece were collections of apophthegms, made in the ſame manner, and delivered with ſimilar views. Thales and Pythagoras †, who founded the one the Ionic and the other the Italic ſchool, made collections of precepts for the conduct as well of a ſtate as of private life. "Neither the crimes nor the thoughts of bad men (ſaid Thales) are concealed from the gods. The only method of being juſt, is to avoid doing that which we blame in others." Of Pythagoras it is related by Porphyry and Laertius, that from Samos he repaired to Delos, and after preſenting an offering of cakes to Apollo, there received, or pretended to receive, moral dogmas from the prieſteſs; which he afterwards delivered to his diſciples under the character of divine precepts. Amongſt theſe were the following: That, "next to gods and demons, the higheſt reverence is due to parents and legiſlators; and that the laws and cuſtoms of our country are to be religiouſly obſerved."

* *Bruce's Elements of the Science of Ethics.*

† *Bruce's Elements,* and *Enfield's Hiſtory of Philoſophy.*

To theſe maxims or apophthegms, which, for the ſake of delighting the ear and aiding the memory, were ſometimes delivered in verſe, ſucceeded, as has been ſuppoſed, the mode of inſtruction by fable or allegory. But the truth ſeems to be, that this method of communicating moral and political wiſdom was as ancient as the other; for we have a beautiful ſpecimen of it in the ninth chapter of the book which relates the tranſactions of the Judges of Iſrael. The fables of Eſop, too, which were written at a very early period, remain laſting modes of this ſpecies of art among the Greeks.

When the inſtructors of mankind had proceeded thus far as to give an artificial form to their precepts, they ſoon advanced a ſtep farther, and reduced their obſervations into claſſes or predicaments. Pythagoras, who viſited Egypt, has been ſuppoſed to have learned from its prieſts the method of arranging the virtues into diſtinct claſſes. But it is the opinion of an excellent writer ‡, founded on the previous aſpects of ethics, and on the comprehenſive talents of the Samian philoſopher, that the honour of the invention ought to be aſcribed to himſelf. Be this as it may, it was obſerved by the inventor, that "all the maxims of morality might be referred to the duties which men owe to themſelves, and the duties which they owe to each other." Hence the four cardinal virtues of the ancients, PRUDENCE, TEMPERANCE, FORTITUDE, and JUSTICE; of which the firſt three refer to the individual, and the fourth to ſociety.

‡ *Mr Bruce.*

4
The moral principles of Socrates.

Hitherto leſſons in morality had not taken a ſyſtematic form; but they were gradually approaching to it. Socrates was perhaps the firſt Pagan philoſopher who eſtabliſhed all his precepts on one ſure and ſteady baſis. In his lectures and diſcourſes, he ſeems to have had one great object in view ‡, to connect the moral maxims which were fitted to regulate the conduct of mankind, with ſublime conceptions reſpecting the character and government of a ſupreme Being. The firſt principles of virtuous conduct which are common to all mankind, are, according to this excellent moraliſt, laws of God: and the concluſive argument by which he ſupports this opinion is, that no man departs from theſe principles with impunity. "It is frequently poſſible (ſays he) for men to ſcreen themſelves from the penalty of human laws, but no man can be unjuſt or ungrateful without ſuffering for his crime; hence I conclude, that theſe laws muſt have proceeded from a more excellent legiſlator than man." From this it would appear, that in the opinion of Socrates, conſcience, or the moral ſenſe, approving of any action, is the criterion by which it is known to be virtuous, and the will of God that which obliges men to perform it.

‡ *Bruce's Elements,* and *Enfield's Hiſtory,* &c.

5
Origin of the Greek ſects.

Socrates himſelf left no writings behind him, nor, as far as we know, offered any regular and complete theory of ethics. His diſciples, however, who were numerous and diſtinguiſhed, became the founders of the celebrated Greek ſects. Among them the firſt great queſtion was, "what are the foundations of virtue?" and the ſecond, "what are the diſtinctions betwixt good and evil, happineſs and miſery?" The anſwers given to theſe important queſtions divided the philoſophers and their diſciples into diſtinct orders.

6
Theories of Plato,

In anſwer to the former queſtion, Plato taught *, that "virtue is to be purſued for its own ſake; and that being a divine attainment, it cannot be taught, but is the gift of God." This ſeems to differ in nothing, but the name, from the doctrine of thoſe moderns who place the ſole foundation of virtue in the approbation of the moral ſenſe. The founder of the academy indeed has no ſuch phraſe as *moral ſenſe* in any of his writings with which we are acquainted; but if virtue cannot be taught, and if it is to be purſued for its own ſake, it muſt in itſelf be *good,* and the object of ſome feeling, whether called *ſenſe, inſtinct,* or *paſſion.* His ſolution of the ſecond queſtion agitated among the ſects is not indeed very conſiſtent with this neceſſary inference from his anſwer to the firſt; but for his inconſiſtencies we are not accountable. "Our higheſt good (he ſays) conſiſts in the contemplation and knowledge of the firſt good, which is mind or God; and all thoſe things which are called *good* by men, are in reality ſuch only ſo far as they are derived from the firſt and higheſt good. The only power in human nature which can acquire a reſemblance to the ſupreme good, is reaſon; and this reſemblance conſiſts in prudence, juſtice, ſanctity, and temperance."

* *Enfield.*

7
of Ariſtotle,

Ariſtotle, the founder of the Peripatetic ſchool, was the pupil of Plato; but of the two great moral queſtions he gives ſolutions ſomewhat different from thoſe of his maſter. "Virtue (according to him ‡) is either theoretical or practical. Theoretical virtue conſiſts in the due exerciſe of the underſtanding; practical, in the purſuit of what is *right* and *good.* Practical virtue is acquired by habit and exerciſe." This theory ſeems to differ little from that adopted by Cudworth, Clarke, and Price, which ſhall be conſidered afterwards.

‡ *Enfield.*

With

With reſpect to happineſs or good, the doctrine of Ariſtotle is very rational. "Pleaſures (he ſays) are eſſentially different in kind. Diſgraceful pleaſures are wholly unworthy of the name. The pureſt and nobleſt pleaſure is that which a good man derives from virtuous actions. Happineſs, which conſiſts in a conduct conformable to virtue, is either contemplative or active. Contemplative happineſs, which conſiſts in the purſuit of knowledge and wiſdom, is ſuperior to active happineſs, becauſe the underſtanding is the higher part of human nature, and the objects on which it is employed are of the nobleſt kind. The happineſs which ariſes from external poſſeſſions is inferior to that which ariſes from virtuous actions; but both are neceſſary to produce perfect felicity."

8 of the Stoics, * Enfield.

The Stoics, another celebrated ſect of Greek philoſophers, maintained *, that "nature impels every man to purſue whatever appears to him to be good." According to them, "ſelf-preſervation and defence is the firſt law of animated nature. All animals neceſſarily derive pleaſure from thoſe things which are ſuited to them; but the firſt object of purſuit is, not pleaſure, but conformity to nature. Every one, therefore, who has a right diſcernment of what is good, will be chiefly concerned to conform to nature in all his actions and purſuits. This is the origin of moral obligation." With reſpect to happineſs or good, the Stoical doctrine was altogether extravagant: They taught, that "all external things are indifferent, and cannot affect the happineſs of man; that pain, which does not belong to the mind, is no evil; and that a wiſe man will be happy in the midſt of torture, becauſe virtue itſelf is happineſs (A)."

As the Stoics held that there is but one ſubſtance, partly active and partly paſſive, in the univerſe (ſee METAPHYSICS, N° 261, 262), and as they called the active principle *God*, their doctrine, which makes virtue conſiſt in a conformity to *nature*, bears no ſmall reſemblance to that of thoſe moderns who reſt moral obligation on the *Divine will*. It was therefore on better grounds than has been ſometimes ſuppoſed, that Warburton, when characterizing the founders of the three principal ſects in Greece, repreſented ‡ *Plato* as the patron of the *moral ſenſe*; *Ariſtotle*, of the *eſſential differences*; and Zeno, of *arbitrary will*. Theſe principles, when ſeparated from each other, and treated in the manner of the ancients, may not each be able to bear the ſuperſtructure which was raiſed upon it; but the principles of moſt of the other ſects were much leſs pure, and infinitely more dangerous.

‡ *Div. Leg. of Moſes.*

§ *Eternal and immutable Morality.*

9 of Ariſtippus, Democritus, and Protagoras;

Cudworth §, whoſe teſtimony when relating the doctrines of antiquity is entitled to the fulleſt credit, affirms, that Ariſtippus the founder of the Cyrenaic ſchool, Democritus, and Protagoras, with their followers among the atomiſts, taught, that "the diſtinction between virtue and vice is merely arbitrary; that nothing is juſt or unjuſt, ſacred or profane, but as it is agreeable or contrary to eſtabliſhed laws and cuſtoms; that what is juſt to-day, human authority may make unjuſt to-morrow; and that preſent pleaſure is the ſovereign good of man."

10 and of Epicurus.

With theſe impieties, the moral doctrines of Epicurus have very unjuſtly been confounded. The phyſical and metaphyſical ſyſtems of that philoſopher are indeed ſtrange compoſitions of ingenuity and abſurdity, truth and falſehood; and the moral precepts of many of his followers were in the higheſt degree licentious and impure. But his own life was exemplary; and his ethical ſyſtem, if candidly interpreted, is much more rational than that of the Stoics; though it muſt be confeſſed, that no ſect produced men of more determined virtue than the ſchool of Zeno. According to Epicurus *, "the end of living, or the ultimate good which is to be ſought for its own ſake, is happineſs. The happineſs which belongs to man, is that ſtate in which he enjoys as many of the good things, and ſuffers as few of the evils incident to human nature as poſſible; paſſing his days in a ſmooth courſe of tranquillity. Pleaſure is in its own nature good, as pain is in its nature evil. The one is therefore to be purſued, and the other to be avoided, for its own ſake. Pleaſure and pain are not only good and evil in themſelves, but they are the meaſure of what is good or evil in every object of deſire and averſion; for the ultimate reaſon why we purſue one thing and avoid another is, becauſe we expect pleaſure from the former, and apprehend pain from the latter.—That pleaſure, however, which prevents the enjoyment of a greater pleaſure, or produces a greater pain, is to be ſhunned; and that pain which either removes a greater pain, or procures a greater pleaſure, is to be endured."

* *Enfield's Hiſtory.*

Upon theſe ſelf-evident maxims, Epicurus builds his ſyſtem of ethics; and proves, with great force of argument, "that a ſteady courſe of virtue produces the greateſt quantity of happineſs of which human nature is capable." Without a *prudent* care of the body, and a ſteady government of the mind, to guard the one from diſeaſes and the other from the clouds of prejudice, happineſs is unattainable. By *temperance* we enjoy pleaſure, without ſuffering any conſequent inconvenience. *Sobriety* enables us to content ourſelves with ſimple and frugal fare. *Gentleneſs*, as oppoſed to an iraſcible temper, greatly contributes to the tranquillity and happineſs of life, by preſerving the mind from perturbation, and arming it againſt the aſſaults of calumny and malice. *Fortitude* enables us to bear thoſe pains which prudence cannot ſhun, and baniſhes fear from the mind; and the practice of *juſtice* is abſolutely neceſſary to the exiſtence of ſociety, and by conſequence to the happineſs of every individual." Theſe reaſonings come home to every man's boſom; and had not this philoſopher, by denying the providence, if not the being, of God, moſt unhappily excluded from his ſyſtem the very poſſibility of a future ſtate of retribution, his moral philoſophy would have been the moſt rational, and of courſe the moſt uſeful, of any that

(A) Since this ſhort hiſtory was written, a very pleaſing view of Stoiciſm has been given to the public in Ferguſon's Principles of Moral and Political Science; a work which the ſtudent of ethics will do well to conſult. Perhaps the amiable author may unintentionally have ſoftened the auſtere dogmas of the Porch, by transfuſing into them ſomething of the mild ſpirit of the goſpel; but, if ſo, he has much improved the ſyſtem of Zeno.

that was taught in the fchools of Greece. This enormous defect, however, laid it open to the groffeft corruptions; and by his followers it was in fact corrupted fo as to countenance the moft impure and criminal pleafures of fenfe.

11
The eclectic philofophers of Alexandria.

Thefe feveral fyftems of ethics continued to be cultivated with more or lefs purity through all the revolutions of the Grecian ftates, and they were adopted by the Romans after Greece itfelf became a province of the empire. They had been introduced into Egypt during the reigns of the Ptolemies, and were taught with much celebrity in the fchools of Alexandria.—The philofophy which was moft cultivated in thofe fchools was that of Plato; but from a defire of uniformity which took poffeffion of the Alexandrian Platonifts, many of the dogmas of Ariftotle and Zeno, as well as the extravagant fictions of the eaft, were incorporated with the principles of the old academy.—The patrons of this heterogeneous mafs have been called *eclectic* philofophers, becaufe they profeffed to felect from each fyftem thofe doctrines which were rational and important, and to reject every thing which was falfe or futile; but they added nothing to the purity of Plato's ethics, and they increafed the obfcurity and myfticifm of his phyfics and metaphyfics.

12
Extinction and revival of moral fcience in Europe.

After the fubverfion of the Roman empire, every fpecies of philofophy, if fyllogiftic wrangling deferve not that name, was banifhed for ages from the fchools of Europe; and ethics, properly fo called, gave place to ecclefiaftical cafuiftry, and to the ftudy of the civil and canon law. When the Greeks, whom the fury and fanaticifm of Mahomet II. had driven from Conftantinople, introduced into Italy the knowledge of their own language, the cabinets of ancient philofophy were again unlocked; the fyftems of the different fects were adopted with the utmoft avidity; and, without accurate inveftigation of their refpective merits, men became Platonifts, Peripatetics, or Stoics, as fancy or caprice prompted them to choofe their leaders. The αυτος εφη of Ariftotle, in particular, had not lefs authority over his modern admirers than it had of old in the Lyceum at Athens. At length the fpirit of Luther and the genius of Bacon broke thefe fetters, and taught men to think for themfelves as well in fcience as in religion. In phyfics, the effects produced by the writings of Bacon were great and rapid; for in phyfics the ancient theories were totally and radically wrong.—With refpect to morals, however, the cafe was different. Each of the celebrated fchools of antiquity was in poffeffion of much moral truth, blended indeed with error: and long after the Stagyrite and his rivals had loft all influence in phyfical fcience, philofophers of eminence followed them implicitly in the fcience of ethics.

13
Theories of Hobbes,

At this day, indeed, there is hardly a theory of morals at all diftinguifhed, to which fomething very fimilar may not be found in the writings of the ancients.—Hobbes adopted the principles of Democritus and Protagoras, and taught exprefsly that "there is no criterion of juftice or injuftice, good or evil, befides the laws of each ftate; and that it is abfurd to inquire at any perfon except the eftablifhed interpreters of the the law, whether an action be right or wrong, good or evil (B)." Thefe impious abfurdities have been often confuted. Cudworth, who compofed his *True Intellectual Syftem of the Univerfe*, in order to trace the metaphyfical atheifm of Hobbes to its fource, and to expofe it to the public in all its weaknefs, undertook likewife to overthrow his ethical fyftem, in a treatife, entitled *Of Eternal and Immutable Morality*. That work was left unfinifhed; but the theory of its great author was adopted, illuftrated, and very ably fupported, by the doctors Clarke and Price.

14
of Cudworth, Clarke, and Price,

According to thefe three admirable fcholars, "we feel ourfelves irrefiftibly determined to approve fome actions, and to difapprove others. Some actions we cannot but conceive of as *right*, and others as *wrong*; and of all actions we are led to form fome idea, as either *fit* to be performed or *unfit*, or as neither fit nor unfit to be performed, i. e. as *indifferent*. The power within us which thus perceives and determines, they declare to be the *underftanding*; and they add, that it perceives or determines immediately or by intuition, becaufe *right* and *wrong* denote *fimple ideas*. As there are fome propofitions, which when attended to neceffarily determine all minds to *believe* them, fo are there fome actions whofe natures are fuch, that when obferved, all rational beings immediately and neceffarily *approve* them. He that can impartially attend, it is faid, to the nature of his own perceptions, and determine that when he conceives gratitude or beneficence to be *right*, he perceives nothing *true* of them, or *underftands* nothing, but only *fuffers* from a fenfe, has a turn of mind which appears unaccountable: for the more we examine, the more indifputable it will appear to us, that we exprefs *neceffary* truth, when we fay of fome actions that they are right, and of others that they are wrong." It is added, that "we cannot perceive an action to be right without *approving* it, or *approve* it without being confcious of fome degree of *fatisfaction* and complacency; that we cannot perceive an action to be wrong without *difapproving* it, or *difapprove* it without being *difpleafed* with it; and that the *firft* muft be liked, the *laft* difliked; the *firft* loved, the *laft* hated." By the patrons of this fyftem, *obligation* to action, and *rightnefs* of action, are held to be coincident or identical. "Virtue, they affirm, has a real, full, obligatory power, antecedently to all laws, and independently of all will; for obligation is involved in the very nature of it. To affirm that the performance of that which to omit would be wrong is not obligatory, unlefs conducive to private good, or enjoined by a fuperior power, is a manifeft contradiction *."

* *Price's Review*, and *Clarke on the Attributes.*

Few men have deferved better of letters and philofophy than Cudworth, Clarke, and Price; and yet their theory of morals appears to us to be contradictory and unintelligible. It is certainly romantic, and founded upon principles which, if they be denied, no man

(B) Doctrinas de jufto et injufto, bono et malo, præter leges in unaquaque civitate conftitutas, authenticas effe nullas: et utrum aliqua actio jufta vel injufta, bona vel mala futura fit, à nemine inquirendum effe, præterquam ab illis, quibus legum fuarum interpretationem civitas demandaverit. *De Cive*, p. 343.

man by argument can be compelled to grant. There is, ſay they, an abſolute right and wrong, fitneſs and unfitneſs, in actions; but if ſo, the actions which are *right* and *fit* muſt be right and fit for ſomething, becauſe fitneſs, which reſpects no end, is wholly inconceivable. To ſay that any particular action is *fit*, and yet fit for *no particular purpoſe*, is juſt as abſurd as to ſay that the angles at the baſe of an iſoſceles triangle are *equal*, but neither to *one another*, nor to *any other angles;* and we may with no leſs propriety talk of the relation of equality attaching to a particular angle, and to nothing elſe with which the angle is equal, than of the *abſolute* fitneſs or rightneſs of any action or courſe of actions. If it be ſaid that ſuch actions are fit and right, becauſe they tend to promote the harmony of the world and the happineſs of men, this may be granted; but it overturns the intellectual theory from its very foundation. Actions which are fit and right only for their conſequences, are approved and liked for the ſake of thoſe conſequences; and the happineſs of men, among whom the virtuous perſon himſelf is certainly to be included, is the motive or ultimate obligation to their performance.

Similar to this theory, and liable to the ſame objections, is that which reſolves moral approbation into a ſenſe of propriety; for if actions be approved becauſe they are proper, it muſt be becauſe they are proper for ſome *end* or *purpoſe*, propriety in the abſtract being a word without meaning.

15 Of Lord Shafteſbury, Hutcheſon, &c.

Many philoſophers, feeling the force of theſe and of ſimilar objections to the intellectual theory of Cudworth, Clarke, and Price, as well as to a ſenſe of *propriety* in the abſtract, have had recourſe to another hypotheſis, apparently better founded. Obſerving that all mankind decide on the morality of characters and actions inſtantaneouſly, without weighing their conſequences in the balance of reaſon, they ſuppoſe that ſuch deciſions are made by an *inſtinct* of our common nature, implanted in the human breaſt by the hand that formed it. To this inſtinct ſome of them give the name of *conſcience*, and others that of *moral ſenſe*, in contradiction to *external ſenſe* the other great and univerſal inlet of human knowledge. By this *moral ſenſe* we intuitively diſcover an eſſential difference in the *quality* of all thoughts and actions, and a general diſtinction of them into *good* and *evil*, juſt as by the *tongue* and *palate* we diſcover an eſſential difference in the *taſte* of all objects, and a general diſtinction of them into *pleaſant* and *unpleaſant*. The ableſt advocates for this inſtinctive ſyſtem agree, that the moral ſenſe is the immediate and involuntary criterion of only a few general truths, which in their joint operation upon the mind, lay the baſis of moral obligation. Others have carried it to what we think a very dangerous extreme; as by affirming that we cannot prove, in regard to our moral feelings, that they are conformable to any extrinſic and eternal relations of things, they ſeem to wiſh that reaſon were baniſhed from the ſcience of ethics. Were this true, it would in many caſes be impoſſible to diſtinguiſh the prejudices of early education from the pure dictates of original inſtinct, and the moſt pernicious conduct might be ſanctified with the approbation of what would be deemed the ultimate teſt of virtue and vice.

To remedy the defects of the intellectual and inſtinctive theories of morality, Mr Hume blended them together; and, upon the broader baſis of reaſon and internal ſenſe co-operating with each other, he reared a ſyſtem which, though different from thoſe of all his predeceſſors, he rendered plauſible, and ſupported with his uſual ingenuity.

16 Of Mr Hume.

According to him, *ſentiment* and *reaſon* concur in almoſt all moral determinations; and he proves, that for this purpoſe, " there is implanted in the human breaſt a diſintereſted principle of *benevolence* or *ſympathy* which makes men take pleaſure in each other's happineſs. The merit or demerit of actions conſiſts wholly in their utility or natural tendency to add to the ſum of human happineſs; and the ſame he holds to be true of qualities whether bodily or mental. This utility or natural tendency it is the office of reaſon to diſcover; for that faculty alone can trace relations and conſequences. Such qualities or actions as reaſon diſcovers to be uſeful, either to the individual or ſociety, the inſtinctive principle of benevolence makes us inſtantly approve, and this approbation conſtitutes their morality. Thus, temperance, fortitude, courage, induſtry, &c. reaſon diſcovers to be uſeful to him who poſſeſſes them; and upon this diſcovery they are approved of by the ſentiment of ſympathy. They are therefore moral qualities and the ſources of the *private* virtues. In like manner, generoſity, cheerfulneſs of temper, mercy, and juſtice, are diſcovered to be uſeful to ſociety, and are accompanied with the approbation of that ſentiment of ſympathy which makes every man feel a ſatisfaction in the felicity of all other men. They therefore conſtitute the *ſocial* virtues. Of every quality and every action, the merit or demerit, and of conſequence the degree of approbation or diſapprobation which is beſtowed upon it, is in exact proportion to its utility and the circumſtances of the caſe in which it occurs. The ſocial virtues are therefore greater than thoſe which are private, and one ſocial virtue is greater than another; but every quality and every action which is uſeful, either to ſociety or to the individual, is more or leſs virtuous, provided the good of the individual be conſidered as ſubordinate to the good of the public."

This theory is ingenious; and in placing the merit of actions in their utility, it furniſhes a criterion of virtue which can be employed by reaſon; but it ſeems not to be wholly free from error, and it is obviouſly defective. By pretending that the ſame ſentiment of approbation is given to uſeful actions voluntarily performed and to uſeful qualities which are merely conſtitutional, Mr Hume confounds the merit of virtuous habits with the value of natural talents. Yet every man's conſciouſneſs will ſurely tell him, that the feeling or ſentiment which attaches to deeds of juſtice, clemency, and beneficence, is very different from that which attaches to beauty of form, ſtrength of body, vigour of mind, and mere extent of capacity. All theſe actions and qualities are uſeful; but when we approve of the former, beſides attending to their utility, we conſider them as in the man's power, and attribute the merit of them immediately to himſelf. When we approve, or rather admire, the latter on account of their utility, we know them to be not in the man's power, and we attribute the merit of them immediately to the Author of nature.

But the defects of this theory are in practice more pernicious

pernicious that its errors. The author well obferves, that the end of all moral fpeculations is to teach us our duty; and by proper reprefentations of the deformity of vice and beauty of virtue, to beget correfpondent habits, and engage us to avoid the one and embrace the other; but the theory under review holds out no motive fufficient in all cafes for this purpofe.

It is indeed true, as Mr Hume affirms, that the virtues which are immediately ufeful or agreeable to the perfon poffeffed of them, are defirable in a view to felf-intereft, and that a regard to felf-intereft ought to engage us in the purfuit. It is likewife true, that the virtues which are *ufeful* and *agreeable* to others, are generally more defirable than the contrary qualities; for as by the conftitution of our nature no enjoyment is fincere without fome reference to company and fociety; fo no fociety can be agreeable, or even tolerable, where a man feels his prefence unwelcome, and difcovers all around him fymptoms of difguft and averfion. Thefe confiderations he deems fufficient to enforce the duties of humanity, clemency, and beneficence; but he ftates a cafe himfelf, in which they would certainly fail to make a man abftain from his neighbour's property. The greater part of property he confiders, and rightly confiders, as having its foundation in human laws, which are fo calculated as to preferve the peace and promote the general good of the fociety, at the unavoidable expence fometimes of the individual. Now, in particular incidents, a fenfible knave, by fecretly purloining from the hoards of a worthlefs mifer might make himfelf comfortable and independent for life, without caufing any breach in the focial union, and even without hurting a fingle individual. What then fhould hinder him from acting thus? His felf-intereft would be promoted; and if he poffeffed a generous fpirit, he might gratify his fentiment of benevolence or fympathy by doing good with his money to the poor, which the mifer never did. For enforcing the uniform practice of juftice in fuch cafes as this, Mr Hume's theory of morals contains no adequate motive; but a very fufficient one is held out by the fyftem which we are now to confider

17
A fyftem of ethics built upon religion.

That fyftem, which feems to have been unknown to the ancients, is built upon religion, of which indeed it conftitutes a very effential part; and thofe by whom it has been taught, maintain that no other foundation is fufficient to bear a regular fuperftructure of practical ethics. The philofophers of this fchool (D) define virtue to be "the doing good to mankind, in obedience to the will of God, and for the fake of everlafting happinefs." So that with them "the good of mankind" is the *fubject*, "the will of God" the *criterion* or *rule*, and "everlafting happinefs" the *motive*, of human virtue. The moral fenfe, fuppofing it real, they confider as a very inadequate rule of conduct, as being in many cafes difficult to be diftinguifhed from prejudice; and many of them confidently deny its exiftence. The other rules, fuch as the *fitnefs of things*, abftract *right*, the *truth of things*, the *law of reafon*, &c. they confider either as unintelligible, or as relative to fome end by which the rules muft themfelves be tried. The two great queftions, which in the fyftem of thefe religious philofophers demand folution, are: *1ft*, By what means fhall a man in every cafe difcover precifely what is the will of God? and, *2dly*, What evidence have we that there will be a future ftate of retribution and of everlafting happinefs?

Of thefe two queftions, the latter belongs wholly to religion; and to folve it they call in the aid of revelation, as well as of that which is called the religion of nature. The former queftion is in the province of morality; and to find anfwers to it which will apply to every cafe, is the whole bufinefs of their fyftem.

The will of God refpecting human conduct may be difcovered by reafoning *à priori* from his exiftence and attributes, or *à pofteriori* from the tendency of his works. Being himfelf independent and all perfect, it is inconceivable that his view in creating the world could be any thing elfe than to communicate fome portion of his own felicity. (See METAPHYSICS, N° 312.) This conclufion is agreeable to what we perceive of his works, in which there are a thoufand contrivances, all tending to give happinefs to man, and to all animated nature; and of not one of which the natural tendency is to inflict pain, or prove ultimately injurious. Mankind are linked together by various ties, and made to depend in a great meafure upon each other's conduct. That conduct, therefore, which is naturally productive of the greateft fum of human happinefs, muft be agreeable to the will of God; or, in other words, virtuous conduct. That, of which the natural tendency is the reverfe, muft be vitious; and that conduct, if there be any fuch, which tends to produce neither happinefs nor mifery, muft be indifferent, i. e. neither morally good nor morally evil. It is to be obferved, however, that as, previous to their own obedience or difobedience, all men ftand in the fame relation to their Creator, it muft be his will that an equal portion of the happinefs of which human nature is capable be communicated to all by whom that nature is fhared. Whence it follows, that only fuch conduct as, if univerfally purfued by all men in the fame ftation and circumftances, would be productive of the greateft fum of human happinefs on the whole, can be agreeable to the will of the Creator; and that, in judging of the morality of actions, we are not to regard their immediate confequences in a particular cafe, but their natural and ultimate tendency if performed in all cafes.

This is a criterion of virtue which differs widely from the local or occafional utility fet up by Mr Hume; for the particular confequences of an action and its general tendency may often be at variance, fo that what might in certain circumftances be immediately ufeful, would yet be highly criminal and ultimately pernicious. The general tendency of actions, too, may be always known, and known with the utmoft certainty: the whole of their particular confequences can never be difcovered. One thing, however, is evident, that if all men in their refpective ftations would regulate their conduct by the natural tendency

(D) GASTRELL, CUMBERLAND, PUFFENDORFF, NORRIS, BERKELEY, GAY, LAW, RUTHERFORTH, SOAME JENYNS, DR JOHNSON, MR PALEY, and MR GISBORNE, &c.

dency of every action, the *particular* and *general* consequences of their conduct would be the same, and the greatest happiness would result from it of which human nature is in this world capable. And therefore, since it is only through the perverseness of some person or persons concerned, that the *particular consequences* of any action, of which the *natural tendency* is to produce *misery*, can ever bring *happiness* to a single individual; it can no more be the will of God that we make these *occasional* and *distorted* consequences the rule of our conduct, than it can be his will that the *vices* of other men should be the basis of our *virtues*. According to this scheme of morals, which rests all obligation on private happiness, the whole difference between an act of *prudence* and an act of *duty*, is this: That in the former case we consider only what we shall gain or lose in this world; in the latter, what we shall gain or lose in the world to come.

Although the patrons of this theory question the reality of the moral sense as an instinct, they allow that a sentiment of approbation or disapprobation of actions, according as they are virtuous or vitious, is generated by the associating principle (see INSTINCT, and METAPHYSICS, N° 97.); and that this sentiment, though factitious, operates instantaneously as if it were instinctive. They insist that our earliest actions are the result of imitation; that when we first begin to trace consequences, education and the desire of immediate enjoyment are our only guides; that as our mind expands and our knowledge increases, the hopes and fears of futurity become the *motives*, and the will of God the *rule* of our conduct; and that long practice in virtue, upon these principles, produces habits by which we go on with satisfaction in the same course, without looking forward, on every *particular* occasion, to the ultimate consequences and first motives of our actions. Thus do habits of justice, benevolence, clemency, and moral approbation, spring through a proper course of discipline, out of the selfish principle; and when these habits are completely formed and deeply rooted, man has attained the utmost perfection of which he is capable in this state of probation, and is fitted for another of retribution and happiness.

19 Defects and excellency of the system.

That these philosophers have not a just view of human nature, when they deny that there are any innate principles of benevolence in man, we shall endeavour to show when we lay the foundation of that theory which we think deserves to be preferred to all others; but we fully agree with a candid and able writer†, who seems to consider them as under the same mistake, "that their theory of morals has no tendency to weaken the foundations of virtue; and that by the account which it gives of the rise of the social affections, it obviates many of the arguments which had formerly been urged against the selfish system." Nay, we scruple not to confess, that the mode of investigation which it employs in *all cases* to discover the will of God, may in *some cases* be necessary in any system which does not banish the use of reason from the science of ethics. On this account, as well as out of respect to the first moralist ‡ of the age, who affirms, that "it must be embraced by all who are willing to know why they act, or why they forbear, to give any reason of their conduct to themselves or to others," we shall apply it to one of those cases of social duty which Mr Hume's principle of utility could not resolve. Such an example will enable the meanest of our readers to decide between the merits of it and of the theory which we shall adopt; or, as we rather hope, it will show them that the two theories lead to the same practical conclusions.

† *Stuart's Elements of the Philosophy of the Human Mind.*

‡ *Johnson.*

Having thus given our readers a short view of the most celebrated systems of ethics which have prevailed from the earliest ages of the world to the present day, we now proceed, agreeably to our definition of the science, to trace man's duty from his nature and connexions, and to show that the steady practice of virtue must terminate in his ultimate happiness.

PART I.

CHAP. I. *Of* MAN *and his* CONNEXIONS.

20 Man's infant state.

MAN is born a weak, helpless, delicate creature, unprovided with food, clothing, and whatever else is necessary for subsistence or defence. And yet, exposed as the infant is to numberless wants and dangers, he is utterly incapable of supplying the *former*, or securing himself against the *latter*. But, though thus feeble and exposed, he finds immediate and sure resources in the *affection* and *care* of his parents, who refuse no labours, and forego no dangers, to nurse and rear up the tender babe. By these powerful instincts, as by some mighty chain, does nature link the *parent* to the *child*, and form the strongest *moral connexion* on his part, before the child has the least apprehension of it. *Hunger* and *thirst*, with all the sensations that accompany or are connected with them, explain themselves by a language strongly expressive, and irresistibly moving. As the several senses bring in notices and informations of surrounding objects, we may perceive in the young spectator early signs of a growing *wonder* and *admiration*. Bright objects and striking sounds are beheld and heard with a sort of commotion and surprise. But, without resting on any, he eagerly passes on from object to object, still pleased with whatever is newest. Thus the *love* of *novelty* is formed, and the passion of *wonder* kept awake. By degrees he becomes acquainted with the most familiar objects, his parents, his brethren, and those of the family who are most conversant with him. He contracts a *fondness* for them, is uneasy when they are gone, and charmed to see them again. These feelings become the foundation of a *moral attachment* on his side; and by this reciprocal sympathy he forms the domestic alliance with his parents, brethren, and other members of the family. Hence he becomes interested in their concerns; and feels *joy* or *grief*, *hope* or *fear*, on their account, as well as his own. As his affections now point beyond himself to others, he is denominated a *good* or *ill* creature, as he stands *well* or *ill affected* to them. These, then, are the first links of the

Of Man and his Connexions.

moral chain; the early rudiments, or outlines, of his character; his first rude essays towards agency, freedom, manhood.

21 His childhood.

When he begins to make excursions from the nursery, and extends his acquaintance abroad, he forms a little circle of companions, engages with them in play, or in quest of adventures; and leads, or is led by them, as his genius is more or less aspiring. Though this is properly the season in which *appetite* and *passion* have the *ascendant*, yet his *imagination* and *intellectual* powers open apace; and as the various images of things pass before the mental eye, he forms variety of tastes; relishes some things, and dislikes others, as his parents, companions, and a thousand other circumstances, lead him to combine agreeable or disagreeable sets of ideas, or represent to him objects in alluring or odious lights.

As his views are enlarged, his *active* and *social* powers expand themselves in proportion; the *love of action*, of *imitation*, and of *praise*, *emulation*, *curiosity*, *docility*, *a passion for command*, and *fondness of change.*— His passions are quick, variable, and pliant to every impression; his attachments and disgusts quickly succeed each other. He compares things, distinguishes actions, judges of characters, and loves or hates them, as they appear well or ill affected to himself, or to those he holds dear. Meanwhile he soon grows sensible of the consequences of his own actions, as they attract applause, or bring contempt: he triumphs in the former; and is ashamed of the latter, wants to hide them, and blushes when they are discovered. By means of these powers he becomes a fit subject of culture, the moral tie is drawn closer, he feels that he is accountable for his conduct to others as well as to himself, and thus is gradually ripening for society and action.

22 His youth.

As man advances from *childhood* to *youth*, his passions as well as perceptions take a more extensive range. New senses of pleasure invite him to new pursuits; he grows sensible to the attractions of beauty, feels a peculiar sympathy with the sex, and forms a more tender kind of attachment than he has yet experienced. This becomes the cement of a *new moral relation*, and gives a softer turn to his passions and behaviour. In this turbulent period he enters more deeply into a *relish of friendship*, *company*, *exercises*, and *diversions;* the *love of truth*, of *imitation*, and of *design*, grows upon him; and as his connexions spread among his neighbours, fellow citizens, and countrymen, his *thirst of praise*, *emulation*, and *social affections* grow more intense and active. Meanwhile, it is impossible for him to have lived thus long without having become sensible of those more august signatures of order, wisdom, and goodness, which are stamped on the visible creation; and of those strong suggestions within himself of a parent mind, the source of all intelligence and beauty; an object as well as source of that activity, and those aspirations which sometimes rouse his inmost frame, and carry him out of himself to an almighty and all-governing power: Hence arise those sentiments of *reverence*, and those affections of *gratitude*, *resignation*, and *love*, which link the soul with the Author of Nature, and form that most sublime and godlike of all connexions.

23 His manhood.

Man having now reached his prime, either new passions succeed, or the old set are wound up to a higher pitch. For, growing more sensible of his connexions with the public, and that particular community to which he more immediately belongs; and taking withal a larger prospect of human life, and its various wants and enjoyments; he forms more intimate friendship, grasps at power, courts honour, lays down cooler plans of interest, and becomes more attentive to the concerns of society: he enters into family connexions, and indulges those charities which arise from thence. The *reigning* passions of this period powerfully prompt him to provide for the decays of life: and in it *compassion* and *gratitude* exert their influence in urging the *man*, now in full vigour, to requite the affection and care of his parents, by supplying their wants and alleviating their infirmities.

24 Old age.

At length human life verges downwards; and *old age* creeps on apace, with its *anxiety*, *love of ease*, *interestedness*, *fearfulness*, *foresight*, and *love of offspring.* —The experience of the aged is formed to direct, and their coolness to temper, the heat of youth: the former teaches them to look back on past follies; and the latter to look forward into the consequences of things, and provide against the worst. Thus every age has its peculiar genius and set of passions corresponding to that period, and most conducive to the prosperity of the rest. And thus are the *wants* of one period supplied by the *capacities* of another, and the *weaknesses* of one age tally to the *passions* of another.

25 Passions of every age.

Besides these, there are other passions and affections of a less *ambulatory* nature, not peculiar to one period, but belonging to every age, and acting more or less in every breast throughout life. Such are *self-love*, *benevolence*, *love of life*, *honour*, *shame*, *hope*, *fear*, *desire*, *aversion*, *joy*, *sorrow*, *anger*, and the like. The two first are affections of a cooler strain; one pointing to the good of the individual, the other to that of the species: *joy* and *sorrow*, *hope* and *fear*, seem to be only modifications, or different exertions, of the same *original* affections of *love* and *hatred*, *desire* and *aversion*, arising from the different circumstances or position of the object desired or abhorred, as it is present or absent. From these likewise arise other *secondary* or *occasional* passions, which depend, as to their existence and several degrees, upon the original affections being gratified or disappointed; as *anger*, *complacence*, *confidence*, *jealousy*, *love*, *hatred*, *dejection*, *exultation*, *contentment*, *disgust*, which do not form *leading* passions, but rather hold of them.

26 Their joint effects.

By these simple but powerful springs, whether *periodical* or *fixed*, the life of man, weak and indigent as he is, is preserved and secured, and the creature is prompted to a constant round of action, even to supply his own numerous and ever-returning *wants*, and to guard against the various *dangers* and *evils* to which he is obnoxious. By these links men are connected with each other, formed into families, drawn into particular communities, and all united as by a common league into one system or body, whose members feel and sympathise one with another. By this admirable adjustment of the constitution of *man* to his *state*, and the gradual evolution of his powers, order is maintained, society upheld, and human life filled with that variety of passion and action which at once enliven and diversify it.

27 The directing power.

This is a short sketch of the *principal movements* of the

the human mind. Yet theſe movements are not the whole of man; they impel to action, but do not direct it: they need a *regulator* to guide their motions, to meaſure and apply their forces; and accordingly they have one that naturally *ſuperintends* and *directs* their action. We are conſcious of a principle within us, which examines, compares, and weighs things; notes the differences, obſerves the forces, and foreſees the conſequences, of affections and actions. By this power we look back on paſt times, and forward into futurity, gather experiences, eſtimate the real and comparative value of objects, lay out ſchemes, contrive means to execute them, and ſettle the whole order and economy of life. This power we commonly diſtinguiſh by the name of *reaſon* or *reflection*, the buſineſs of which is not to ſuggeſt any original notices or ſenſations, but to canvaſs, range, and make deductions from them.

28
The judging or approving powers.

We are intimately conſcious of another principle within us, which approves of certain *ſentiments*, *paſſions*, and *actions*, and diſapproves of their contraries. In conſequence of the deciſions of this inward judge, we denominate ſome actions and principles of conduct *right*, *honeſt*, *good*; and others *wrong*, *diſhoneſt*, *ill*. The former excite our *eſteem*, *moral complacence*, and *affection*, immediately and originally of themſelves, without regard to their conſequences, and whether they affect our intereſt or not. The latter do as naturally and neceſſarily call forth our *contempt*, *ſcorn*, and *averſion*. That power by which we perceive this difference in affections and actions, and feel a conſequent reliſh or diſlike, is commonly called *conſcience* or the *moral ſenſe*.

That there is ſuch a power as this in the mind of every man of ſound underſtanding, is a fact which cannot be controverted; but whether it be an inſtinctive power, or the reſult of early and deep-rooted aſſociations, has been long and ably debated. The queſtion is of importance in the ſcience of human nature, as well as in aſcertaining the ſtandard of practical virtue; but to us it appears that the contending parties have carried their reſpective opinions to dangerous extremes.

29
An attempt to prove that we have from nature no ſuch powers.

When it is affirmed, as it ſometimes has been, that reaſon has nothing to do in ethical ſcience, but that in every poſſible ſituation our duty is pointed out and the performance of it enforced by mere ſentiment, the conſequence ſeems to be, that virtue and vice are nothing permanent in themſelves, but change their nature according to local circumſtances. Certain it is, that ſentiment has in ſimilar ſituations approved of very different practices in different ages and different nations. At preſent this ſentiment in Europe approves of the univerſal practice of juſtice, and of parents protecting their children, whether well or ill formed, whether ſtrong or weak: but in Sparta we know that theft, if dexterouſly practiſed, was approved, and not unfrequently rewarded; and that the expoſition of lame and deformed children was not only permitted, but abſolutely enjoined. There is nothing which our conſcience or moral ſenſe condemns with greater ſeverity, or views as a crime of a deeper dye, than children's unkind treatment of their aged parents; yet there are ſavages, among whom inſtincts of all kinds ought to prevail in greater purity than in civilized nations, whoſe moral ſenſe permits them to put their aged and decrepid parents to death. If this ſenſe be inſtinctive, and the ſole judge of right and wrong, how comes it to decide ſo differently on the ſame line of conduct in different ages and diſtant countries? The inſtincts of brutes, in ſimilar circumſtances, prompt uniformly to ſimilar actions in every age and in every region where the ſpecies is found; and the external ſenſes of man afford in all nations the ſame unvaried evidence concerning their reſpective objects. To theſe obſervations we may add, that inſtincts muſt be calculated for the ſtate of nature, whatever that ſtate may be, and therefore cannot be ſuppoſed capable of directing our ſteps through all the labyrinths of poliſhed ſociety, in which duties are to be performed that in a ſtate of nature would never have been thought of.

But though for theſe reaſons it is apparent that mere ſentiment, whether called conſcience or the moral ſenſe, would *alone* be a very unſafe guide to virtue in every individual caſe that may occur, we think that thoſe who reſolve all ſuch ſentiment into habit and the effect of education, without giving any part of it to nature, advance an opinion which is equally ill-founded and not leſs dangerous There are, indeed, men who affirm that all benevolence is hypocriſy, friendſhip a cheat, public ſpirit a farce, fidelity a ſnare to procure truſt and confidence; and that while all of us at bottom purſue only our private intereſt, we wear thoſe fair diſguiſes, in order to put thoſe off their guard with whom we have to deal, and to expoſe them the more to our wiles and machinations. Others again, too virtuous to accuſe themſelves and all mankind of direct knavery, yet inſiſt, that whatever affection one may feel, or imagine he feels, for others, no paſſion is or can be diſintereſted; that the moſt generous friendſhip, however ſincere, is only a modification of ſelf-love; and that even unknown to ourſelves we ſeek only our own gratification, while we appear the moſt deeply engaged in ſchemes for the liberty and happineſs of mankind,

30
Examined, and ſhown.

Surely the mildeſt of theſe repreſentations is an exaggerated picture of the ſelfiſhneſs of man. Self-love is indeed a very powerful as well as an eſſential principle in human nature; but that we have likewiſe an inſtinctive principle of benevolence, which, without any particular regard to our own intereſt, makes us feel pleaſure in the happineſs of other men, is a fact which we think admits of very complete proof. For, as Mr Hume well argues, "when a man grieves for a friend who could be of no ſervice to him, but on the contrary ſtood in need of his conſtant patronage and protection, how is it poſſible to ſuppoſe that ſuch paſſionate tenderneſs ariſes from ſelf-intereſt, which has no foundation in nature? What intereſt (aſks the ſame deep thinker) can a fond mother have in view, who loſes her health by her aſſiduous attendance on her ſick child, and afterwards languiſhes and dies of grief when freed by its death from the ſlavery of attendance?—Have we no ſatisfaction (continues he) in one man's company above another's, and no deſire of the welfare of our friend, even though abſence or death ſhould prevent us from all participation in it? Or what is it commonly that gives us any participation in it, even while alive and preſent, but our affection and regard to him?" Nor is it to contemporaries and individuals

alone,

Of Man and his Connexions.

alone, that, independent of all intereſt, we feel a benevolent attachment. We conſtantly beſtow praiſe on actions calculated to promote the good of mankind, though performed in ages very diſtant and in countries moſt remote; and he who was the author of ſuch actions is the object of our eſteem and affection. There is not perhaps a man alive, however ſelfiſh in his diſpoſition, who does not applaud the ſentiment of that emperor, who, recollecting at ſupper that he had done nothing in that day for any one, exclaimed with regret, that the day had been loſt! yet the utmoſt ſubtility of imagination can diſcover no appearance of intereſt that *we* can have in the generoſity of *Titus*, or find any connexion of our preſent happineſs with a character removed ſo far from us both in time and in place. But, as Mr Hume juſtly obſerves, if we even feign a character conſiſting of all the moſt generous and beneficent qualities, and give inſtances in which theſe diſplay themſelves, after an eminent and moſt extraordinary manner, for the good of mankind, we ſhall inſtantly engage the eſteem and approbation of all our audience, who will never ſo much as inquire in what age or country the accompliſhed perſon lived.

Theſe are facts which cannot be controverted; and they are wholly unaccountable, if there be not in human nature an inſtinctive ſentiment of benevolence or ſympathy which feels a diſintereſted pleaſure in the happineſs of mankind. But an end in which we feel pleaſure we are naturally prompted to purſue; and therefore the ſame ſentiment impels every man, with greater or leſs force, to promote the happineſs of other men, which by means of it becomes in reality his own good, and is afterwards purſued from the combined motives of benevolence and ſelf-enjoyment. For in obeying this ſentiment we all feel an inward *complacency*, *ſelf-approbation*, or conſciouſneſs of *worth* or *merit*; and in diſobeying it, which cannot be done but with reluctance, we feel *remorſe*, or a conſciouſneſs of *unworthineſs* or *demerit*. It appears, however, from hiſtory, that the ſentiment, as it is inſtinctive, points only to the good of mankind, without informing us how that good is to be promoted. The means proper for this purpoſe muſt be diſcovered by reaſon; and when they are brought into view, this *ſentiment*, *conſcience*, or *moral ſenſe*, inſtantly ſhows us that it is our duty to purſue them.

31 to originate in the objector's miſtaking the extent of thoſe powers;

Hence we ſee how different lines of conduct may in ſimilar circumſtances be approved of as virtuous in different nations. When the Spartan expoſed his ſickly and deformed child, and when the ſavage put his aged parents to death, neither of them erred from want of ſentiment, or from having ſentiments originally different from ours. Their errors reſulted from a defect in reaſoning. They both imagined that they were obeying the law of benevolence by preventing miſery: for a weak and deformed perſon was very ill qualified to exiſt with any degree of comfort under the military conſtitution of Sparta, where all were ſoldiers, and under the neceſſity of enduring the greateſt hardſhips; and in a ſtate where the people have no fixed habitations, and where the chaſe ſupplies even the neceſſaries of life, an aged and infirm perſon is in danger of periſhing through hunger, by one of the cruelleſt and moſt lingering of deaths. The theft allowed in Sparta, if theft it may be called, was a ſtill leſs deviation from the inſtinctive law of benevolence. Boys were taught to ſlip as cunningly as they could into the gardens and public halls, in order to ſteal away herbs or meat; and if they were caught in the fact, they were puniſhed for their want of dexterity. This kind of theft, ſince it was authorized by the law and the conſent of the citizens, was no robbery; and the intention of the legiſlator in allowing it, was to inſpire the Spartan youth, who were all deſigned for war, with the greater boldneſs, ſubtlety, and addreſs; to inure them betimes to the life of a ſoldier; and to teach them to ſhift for themſelves, and to live upon little. That the Spartan legiſlator did wrong in giving his countrymen a conſtitution, of which ſucceſsful war was the ultimate object; and that ſavages, rather than kill their aged parents, or ſuffer them to die of hunger, ought to cultivate the ground, and abandon the chaſe; is readily granted: but the faults of the one as well as of the other aroſe not from any improper deciſion of the moral ſenſe, but from a defect in their reaſoning powers, which were not able to eſtimate the advantages and diſadvantages of different modes of life. In moral deciſions, therefore, conſcience and reaſon are aiding to each other. The former principle, when ſeparated from the latter, is defective, enjoining only the good of mankind, but unable to point out the means by which it can be moſt effectually promoted; and the latter principle, when ſeparated from the former, only directs a man to do what is moſt prudent, but cannot give him a conception of duty.

32 which are different in nature and kind from the paſſions and affections.

Theſe two powers of *reaſon* and *conſcience* are evidently principles different in *nature* and *kind* from the paſſions and affections. For the paſſions are mere *force* or *power*, *blind impulſes*, acting violently and without choice, and ultimately tending each to their reſpective objects, without regard to the intereſt of the others, or of the whole ſyſtem. Whereas the *directing* and *judging* powers diſtinguiſh and aſcertain the different forces, mutual proportions and relations, which the paſſions bear to each other, and to the whole; recognize their ſeveral degrees of merit, and judge of the whole temper and conduct, as they reſpect either the individual or the ſpecies; and are capable of directing or reſtraining the blind impulſes of paſſion in a due conſiſtency one with the other, and a regular ſubordination to the whole ſyſtem.

33 Diviſion of the paſſions.

This is ſome account of the *conſtituent principles* of our nature, which, according to their different mixtures, degrees, and proportions, mould our character and ſway our conduct in life. In reviewing that large train of affections which fill up the different ſtages of human life, we perceive this obvious diſtinction among them; that ſome of them reſpect the *good* of the *individual*, and others carry us beyond ourſelves to the *good* of the *ſpecies* or *kind*. The former have therefore been called *private*, and the latter *public* affections. Of the firſt ſort are *love of life*, of *pleaſure*, of *power*, and the like. Of the laſt are *compaſſion*, *gratitude*, *friendſhip*, *natural affection*, and the like. Of the *private* paſſions (D), ſome reſpect merely the *ſecurity* and *defence*, of the creature, ſuch as *reſentment* and *fear*; whereas others

(D) Here we uſe paſſions and affections without diſtinction. Their difference will be marked afterwards.

Of Moral Obligation.

others aim at ſome *poſitive* advantage or good, as *wealth*, *eaſe*, *fame*. The former ſort, therefore, becauſe of this difference of objects, may be termed *defenſive* paſſions.

34 Defenſive paſſions

Theſe anſwer to our *dangers*, and prompt us to avoid them if we can, or boldly to encounter them when we cannot.

35 Private or appetitive paſſions.

The other claſs of *private* paſſions, which purſue *private poſitive* good, may be called *appetitive*. However, we ſhall ſtill retain the name of *private* in contradiſtinction to the *defenſive* paſſions. Man has a great variety of wants to ſupply, and is capable of many enjoyments, according to the ſeveral periods of his life, and the different ſituations in which he is placed. To theſe therefore a ſuitable train of *private paſſions* correſpond, which engage him in the purſuit of whatever is neceſſary for his ſubſiſtence or welfare.

36 Public paſſions.

Our *public* or *ſocial* affections are adapted to the ſeveral *ſocial connexions* and *relations* which we bear to others, by making us ſenſible of their dangers, and intereſting us in their wants, and ſo prompting us to ſecure them againſt one and ſupply the other.

This is the firſt ſtep then to diſcover the *duty* and *deſtination* of man, the having analyzed the principles of which he is compoſed. It is neceſſary, in the next place, to conſider in what *order*, *proportion*, and *meaſure*, of thoſe inward principles, *virtue*, or a ſound moral temper and right conduct, conſiſts; that we may diſcover whence *moral obligation* ariſes.

Chap. II. *Of* Duty, *or* Moral Obligation.

37 The meaſure of powers.

It is by the end or deſign of any power or movement that we muſt direct its motions, and eſtimate the degree of force neceſſary to its juſt action. If it want the force requiſite for the obtaining its end, we reckon it defective; if it has too much, ſo as to be carried beyond it, we ſay it is overcharged; and in either caſe it is imperfect and ill contrived. If it has juſt enough to reach the ſcope, we eſteem it right and as it ſhould be.

38 Meaſure of the defenſive paſſions.

Let us apply this reaſoning to the paſſions.

The *defence* and *ſecurity* of the individual being the *aim* of the *defenſive paſſions*, that *ſecurity* and *defence* muſt be the *meaſure* of their *ſtrength* or *indulgence*. If they are ſo *weak* as to prove inſufficient for that end, or if they *carry us beyond it*, i. e. raiſe unneceſſary commotions, or continue longer than is needful, they are unfit to anſwer their original deſign, and therefore are in an unſound and unnatural ſtate. The exerciſe of *fear* or of *reſentment* has nothing deſirable in it, nor can we give way to either without painful ſenſations. Without a certain degree of them, we are naked and expoſed. With too high a proportion of them, we are miſerable, and often injurious to others. Thus *cowardice* or *timidity*, which is the exceſs of fear, inſtead of ſaving us in danger, gives it too formidable an appearance, makes us incapable of attending to the beſt means of preſervation, and diſarms us of *courage*, our natural armour. *Fool-hardineſs*, which is the want of a due meaſure of *fear*, leads us heedleſsly into danger, and lulls us into a pernicious ſecurity. *Revenge*, i. e. *exceſſive reſentment*, by the violence of its commotion, robs us of that *preſence of mind* which is often the beſt guard againſt injury, and inclines us to purſue the aggreſſor with more ſeverity than ſelf-defence requires. *Puſillanimity*, or the want of a juſt indignation againſt wrong, leaves us quite unguarded, and tends to ſink the mind into a paſſive enervated tameneſs. Therefore, "to keep the defenſive paſſions duly proportioned to our dangers, is their natural pitch and tenor."

39 Meaſure of the private paſſions.

The *private* paſſions lead us to purſue ſome *poſitive* ſpecies of *private* good: that *good* therefore which is the object and end of each muſt be the meaſure of their reſpective force, and direct their operation. If they are too *weak* or *ſluggiſh* to engage us in the purſuit of their ſeveral objects, they are evidently *deficient*; but if they defeat their end by their *impetuoſity*, then are they ſtrained beyond the juſt tone of nature. Thus *vanity*, or an *exceſſive paſſion for applauſe*, betrays into ſuch meanneſſes and little arts of popularity, as make us forfeit the honour we ſo anxiouſly court. On the other hand, *a total indifference about the eſteem of mankind*, removes a ſtrong guard and ſpur to virtue, and lays the mind open to the moſt abandoned proſecutions. Therefore, "to keep our private paſſions and deſires proportioned to our *wants*, is the juſt meaſure and pitch of this claſs of affections."

40 Comparative force.

The *defenſive* and *private* paſſions do all agree in general, in their tendency or conduciveneſs to the intereſt or good of the individual. Therefore, when there is a colliſion of intereſt, as may ſometimes happen, that *aggregate of good* or *happineſs*, which is compoſed of the particular goods to which they reſpectively tend, muſt be the common ſtandard by which their *comparative degrees* of ſtrength are to be meaſured: that is to ſay, if any of them, in the degree in which they prevail, are incompatible with the greateſt aggregate of good or moſt extenſive intereſt of the individual, then are they unequal and diſproportionate. For in judging of a particular *ſyſtem* or *conſtitution* of powers, we call that the *ſupreme* or *principal* end, in which the aims of the ſeveral parts or powers coincide, and to which they are ſubordinate; and reckon them in due proportion to each other, and right with regard to the whole, when they maintain that ſubordination of ſubſerviency. Therefore, "to proportion our defenſive and private paſſions in ſuch meaſure to our dangers and wants as beſt to ſecure the individual, and obtain the greateſt aggregate of private good or happineſs, is their juſt balance or comparative ſtandard in caſe of competition."

41 Meaſure of the public affections.

In like manner as the *public* or *ſocial* affections point at the good of others, that *good* muſt be the meaſure of their force. When a particular *ſocial* affection, as *gratitude* or *friendſhip*, which belongs to a particular *ſocial connexion*, viz. that of a *benefactor* or of a *friend*, is too feeble to make us act the *grateful* or *friendly* part, that affection, being inſufficient to anſwer its end, is *defective* and *unſound*. If, on the other hand, a particular paſſion of this claſs counteract or defeat the intereſt it is deſigned to promote, by its violence or diſproportion, then is that paſſion *exceſſive* and *irregular*. Thus *natural affection*, if it degenerates into a *paſſionate* fondneſs, not only hinders the parents from judging coolly of the intereſt of their offſpring, but often leads them into a moſt partial and pernicious indulgence.

42 Colliſion of ſocial affections.

As every kind affection points at the good of its particular object, it is poſſible there may ſometimes be a colliſion of intereſts or goods. Thus the regard due

to

to a *friend* may interfere with that which we owe to a *community*. In ſuch a competition of intereſts, it is evident that the *greateſt* is to be choſen; and that is the greateſt intereſt which contains the greateſt ſum or aggregate of public good, greateſt in *quantity* as well as *duration*. This then is the *common ſtandard* by which the reſpective forces and ſubordinations of the ſocial affections muſt be adjuſted. *Therefore* we conclude that "this claſs of affections are ſound and regular when they prompt us to purſue the *intereſt* of *individuals* in an entire conſiſtency with the *public good*;" or in other words, "when they are duly proportioned to the *dangers* and *wants* of others, and to the various *relations* in which we ſtand to *individuals* or to *ſociety*."

Thus we have found, by an induction of particulars, the *natural pitch* or *tenor* of the *different orders of affection*, conſidered apart by themſelves. Now, as the *virtue* or *perfection* of every creature lies in following its nature, or acting ſuitably to the juſt proportion and harmony of its ſeveral powers; therefore, "the VIRTUE of a creature endowed with ſuch affections as *man* muſt conſiſt in obſerving or acting agreeably to their *natural pitch and tenor*."

43 Balance of affection. But as there are no independent affections in the fabric of the mind, no paſſion that ſtands by itſelf, without ſome relation to the reſt, we cannot pronounce of any one, conſidered APART, that it is either *too ſtrong* or *too weak*. Its ſtrength and juſt proportion muſt be meaſured not only by its ſubſerviency to its own immediate end, but by the reſpect it bears to the whole ſyſtem of affections. Therefore we ſay a paſſion is *too ſtrong*, not only when it defeats its own end, but when it impairs the force of other paſſions, which are equally neceſſary to form a *temper of mind* ſuited to a certain *economy* or *ſtate*; and too weak, not merely on account of its inſufficiency to anſwer its end, but becauſe it cannot ſuſtain its *part* or *office* in the balance of the whole ſyſtem. Thus the *love of life* may be *too ſtrong* when it takes from the *regard* due to one's country, and will not allow one bravely to encounter dangers, or even death, on its account. Again, The *love of fame* may be *too weak* when it throws down the fences which render virtue more ſecure, or weakens the incentives which make it more active and public ſpirited.

44 Limits of private affections. If it be aſked, "How far may the affections towards private good or happineſs be indulged?" One limit was before fixed for the particular indulgence of each, viz. their ſubordination to the common aggregate of good to the private ſyſtem. In theſe therefore a due regard is always ſuppoſed to be had to *health*, *reputation*, *fortune*, the *freedom of action*, the *unimpaired exerciſe of reaſon*, the *calm enjoyment of one's ſelf*, which are all private goods. Another limit now reſults from the balance of affection juſt named, viz. "The ſecurity and happineſs of others;" or, to expreſs it more generally, "a *private* affection may be ſafely indulged, when, by that indulgence, we do not violate the obligations which reſult from our higher relations or public connexions." A juſt reſpect therefore being had to theſe boundaries which nature has fixed in the breaſt of every man, what ſhould limit our purſuits of private happineſs? Is nature ſullen and penurious? or, does the God of nature envy the happineſs of his offſpring?

Whether there is ever a real colliſion of intereſts between the *public* and *private* ſyſtem of affections, or the ends which each claſs has in view, will be afterwards conſidered; but where there is no colliſion, there is little or no danger of carrying either, but eſpecially the *public* affections, to exceſs, provided both kinds are kept ſubordinate to a diſcreet and cool *ſelf-love*, and to a calm and univerſal *benevolence*, which principles ſtand as guards at the head of each ſyſtem. 45 Colliſion of intereſts.

This then is the conduct of the paſſions, conſidered as *particular* and *ſeparate* forces, carrying us out to their reſpective ends; and this is their balance or economy, conſidered as *compound* powers, or powers mutually related, acting in conjunction towards a *common* end, and conſequently as forming a *ſyſtem* or *whole*. 46 Reſult.

Now, whatever adjuſts or maintains this *balance*, whatever in the human conſtitution is formed for *directing* the paſſions ſo as to keep them from defeating their own end or interfering with each other, muſt be a principle of a *ſuperior* nature to them, and *ought* to direct their meaſures and govern their proportions. But it was found that *reaſon* or reflection is ſuch a principle, which points out the tendency of our paſſions, weighs their influence upon private and public happineſs, and ſhows the beſt means of attaining either. It having been likewiſe found that there is another directing or controlling principle, which we call CONSCIENCE or the MORAL SENSE, which, by a native kind of authority, judges of affections and actions, pronouncing ſome *juſt* and *good*, and others *unjuſt* and *ill*; it follows, that the paſſions, which are mere impulſe or blind forces, are principles inferior and ſubordinate to this *judging* faculty. Therefore, if we would follow the order of nature, i. e. obſerve the mutual reſpects and the ſubordination which the different parts of the human conſtitution bear one to another, the paſſions ought to be ſubjected to the direction and authority of the *leading* or *controlling* principles. 47 Subordination of powers.

We conclude, therefore, from this *induction*, that the *conſtitution* or *juſt economy* of *human nature* conſiſts in a regular *ſubordination* of the *paſſions* and *affections* to the *authority* of *conſcience* and the *direction* of *reaſon*. 48 In what it conſiſts.

That *ſubordination* is *regular*, when the proportion formerly mentioned is maintained; that is to ſay, "when the *defenſive* paſſions are kept proportioned to our *dangers*; when the *private* paſſions are proportioned to our *wants*; and when the *public* affections are adapted to our *public connexions*, and proportioned to the wants and dangers of others." 49 Economy of nature or right temper.

But the *natural ſtate*, or the *ſound* and *vigorous conſtitution* of any creature, or the *juſt economy* of its powers, we call its *health* and *perfection*; and the acting agreeably to theſe, its *virtue* or *goodneſs*. Therefore, "the *health* and *perfection* of man muſt lie in the aforeſaid *ſupremacy* of *conſcience* and *reaſon*, and in the *ſubordination* of the paſſions to their *authority* and *direction*. And his *virtue* or *goodneſs* muſt conſiſt in acting agreeably to that *order* or *economy*." 50 Human virtue and perfection.

That ſuch an ornament of the mind, and ſuch a conduct of its powers and paſſions, will ſtand the teſt of *reaſon*, cannot admit of any diſpute. For, upon a fair 51 how conformable to reaſon.

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fair examination into the consequences of things, or the relations and aptitudes of *means* to *ends*, *reason* evidently demonstrates, and *experience* confirms it, that, "to have our *defensive passions* duly proportioned to our *dangers*, is the surest way to avoid or get clear of them, and obtain the security we seek after.—To proportion our *private passions* to' our *wants*, is the best means to supply them;—and, to adapt our *public affections* to our *social relations*, and the *good* of others, is the most effectual method of fulfilling the *one*, and procuring the *other*." In this sense, therefore, *virtue* may be said to be a "*conduct* conformable to *reason*," as reason discovers an apparent *aptitude*, in such an *order* and *economy* of powers and passions, to answer the end for which they are *naturally* formed.

52 Connexion between affections and ends, not the idea of moral obligation.

If the idea of *moral obligation* is to be deduced merely from this *aptitude* or *connexion* between certain passions, or a certain order and balance of passions, and certain ends obtained or to be obtained by them, then is *reason* or *reflection*, which perceives that aptitude or connexion, the proper judge of *moral obligation*; and on this supposition it may be defined, as hath been done by some, the connexion between the *affection* and the *end*, or, which is the same thing, between the *action* and the *motive*; for the *end* is the *motive* or the *final cause*, and the *affection* is the *action*, or its immediate natural cause. A man, from mere self-love, may be induced to fulfil that obligation which is founded on the connexion between the *defensive* passions and their *ends*, or the *private* passions and their *ends*; because in that case his own interest will prompt him to indulge them in the due proportion required. But if he has no affections which point beyond himself, no principle but *self-love*, or some subtle modification of it, what shall interest him in the happiness of others, where there is no connexion between it and his own? or what sense can he have of *moral obligation* to promote it? Upon this scheme, therefore, without public or social affection, there could be no *motive*, and consequently no moral obligation, to a beneficent disinterested conduct.

But if the mere connexion between certain passions, or a certain order of passions, and certain ends, is what constitutes or gives us the idea of *moral obligation*, then why may not the appositeness of any temper or conduct, nay, of any piece of machinery, to obtain its end, form an equally strict *moral obligation*? for the connexion and aptitude are as strong and invariable in the latter instances as in the former. But as this is confounding the most obvious differences of things, we must trace the idea of *moral obligation* to another and a more natural source.

53 Idea of it from experience.

Let us appeal, therefore, to our inmost sense and experience, "how we stand affected to those different sets of passions, in the just measure and balance of which we found a right temper to consist." For this is entirely a matter of experience, in which we must examine, as in any other natural inquiry, "what are the genuine feelings and operations of nature, and what affections or symptoms of them appear in the given instance."

54 Why the defensive passions approved.

The defensive passions, as *anger* and *fear*, give us rather pain than pleasure, yet we cannot help feeling them when provoked by injury, or exposed to harm. We account the creature imperfect that wants them, because they are necessary to his defence. Nay, we should in some measure condemn ourselves, did we want the necessary degree of *resentment* and *caution*. But if our *resentment* exceeds the wrong received, or our *caution* the evil dreaded, we then blame ourselves for having overacted our part. Therefore, while we are in danger, to be totally destitute of them we reckon a *blameable defect*, and to feel them in a just, i. e. necessary measure, we *approve*, as suited to the nature and condition of such a creature as man. But our security obtained, to continue to indulge them, we not only *disapprove* as *hurtful*, but *condemn* as *unmanly*, *unbecoming*, and *mean-spirited*: Nor will such a conduct afford any self-approving joy when we coolly reflect upon it.

55 Why the private.

With regard to the *private* passions, such as *love of life*, *pleasure*, *ease*, and the like, as these aim at private good, and are necessary to the perfection and happiness of the individual, we should reckon any creature *defective*, and even *blameable*, that was destitute of them. Thus, we condemn the man who imprudently ruins his fortune, impairs his health, or exposes his life; we not only pity him as an unfortunate creature, but feel a kind of *moral indignation* and contempt of him, for having made himself such. On the other hand, though a discreet self-regard does not attract our esteem and veneration, yet we approve of it in some degree, in a higher and different degree from what we would regard a well contrived machine, as necessary to constitute a finished creature, nay, to complete the virtuous character, as exactly suited to our present indigent state. There are some passions respecting private good, towards which we feel higher degrees of approbation, as the *love of knowledge*, of *action*, of *honour*, and the like. We esteem them as marks of an ingenious mind; and cannot help thinking the character in which they are wanting remarkably stupid, and in some degree *immoral*.

56 Why the public.

With regard to the social affections, as *compassion*, *natural affection*, *friendship*, *benevolence*, and the like, we approve, admire, and love them in ourselves, and, in all in whom we discover them, with an esteem and approbation, if not different in kind, yet surely far superior in degree, to what we feel towards the other passions. These we reckon necessary, just, and excellently fitted to our structure and state; and the creature which wants them we call defective, ill-constituted, a kind of abortion. But the *public* affections we esteem as self-worthy, originally and eternally amiable.

57 Distinction between vehement and calm affections.

But among the *social* affections we make an obvious and constant distinction, viz. between those particular passions which urge us with a sudden violence, and uneasy kind of sensation, to pursue the good of their respective objects, as *pity*, *natural affection*, and the like; and those calm dispassionate affections and desires which prompt us more steadily and uniformly to promote the happiness of others. The former we generally call *passions*, to distinguish them from the other sort, which go more commonly by the name of *affections*, or *calm desires*. The first kind we approve indeed, and delight in; but we feel still higher degrees of approbation and moral complacence towards the *last*, and towards all limitation of the particular instincts, by the principle of *universal benevolence*. The more objects the calm affections take in, and the worthier these are, their dignity

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nity rifes in proportion, and with this our approbation keeps in exact pace. A character, on the other hand, which is quite divefted of thefe public affections, which feels no love for the fpecies, but inftead of it entertains malice, rancour, and ill will, we reckon totally immoral and unnatural.

Such then are the fentiments and difpofitions we feel when thefe feveral orders of affections pafs before the mental eye.

Therefore, "that ftate in which we feel ourfelves moved, in the manner above defcribed, towards thofe affections and paffions, as they come under the mind's review, and in which we are, inftantaneoufly and independently of our choice or volition, prompted to a *correfpondent* conduct, we call a ftate of *moral obligation*." Let us fuppofe, for inftance, a parent, a friend, a benefactor, reduced to a condition of the utmoft indigence and diftrefs, and that it is in our power to give them immediate relief. To what conduct are we *obliged?* what *duty* does nature dictate and require in fuch a cafe? Attend to nature, and nature will tell, with a voice irrefiftibly audible and commanding to the *human heart*, with an authority which no man can filence without being felf-condemned, and which no man can elude but at his peril, "that immediate relief *ought* to be given." Again, Let a friend, a neighbour, or even a ftranger, have lodged a *depofite* in our hands, and after fome time reclaim it; no fooner do thefe ideas of the confidence repofed in us, and of property not *transferred*, but *depofited*, occur, than we immediately and unavoidably feel and recognize the *obligation* to reftore it. In both thefe cafes we fhould condemn and even loathe ourfelves if we acted otherwife, as having done, or omitted doing, what we *ought* not, as having acted beneath the dignity of our nature;—contrary to our moft intimate fenfe of *right* and *wrong*:—we fhould accufe ourfelves as guilty of ingratitude, injuftice, and inhumanity,—and be confcious of deferving the cenfure, and therefore dread the refentment, of all rational beings.—But in complying with the *obligation*, we feel joy and felf-approbation,—are confcious of an inviolable harmony between our nature and duty, and think ourfelves entitled to the applaufe of every impartial fpectator of our conduct.

58 Moral obligation.

To *defcribe*, therefore, what we cannot perhaps *define*, a ftate of *moral obligation* is "that ftate in which a creature, endued with fuch fenfes, powers, and affections as man, would condemn himfelf, and think he deferved the condemnation of all others, fhould he refufe to fulfil it; but would approve himfelf, and expect the approbation of all others, upon complying with it."

59 Moral agent.

And we call him a MORAL AGENT, who is in fuch a *ftate*, or is fubject to *moral obligation*. Therefore, as man's *ftructure* and *connexions* often fubject him to fuch a ftate of *moral obligation*, we conclude that *he* is a *moral agent*. But as man may fometimes act without *knowing* what he does, as in cafes of *frenzy* or *difeafe*, or in many *natural functions*; or, knowing what he does, he may act without *choice* or *affection*, as in cafes of *neceffity* or *compulfion*; therefore, to denominate an

60 Moral action good and bad.

action *moral*, i. e. *approveable*, or *blameable*, it muft be done *knowingly* and *willingly*, or *from affection* and *choice*. "A *morally good action*, then, is to fulfil a *moral obligation* knowingly and willingly." And a *morally bad action*, or an *immoral action*, is, "to violate a *moral obligation* knowingly and willingly."

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61 Moral character and temper good and bad.

As not an *action*, but a *feries of actions*, conftitute a *character*; as not an *affection*, but a *feries of affections*, conftitute a *temper*; and as we denominate things by the grofs, *à fortiori*, or by the qualities which chiefly prevail in them; therefore we call that a "*morally good character*, in which a *feries of morally good actions* prevail;" and that a "*morally good temper*, in which a *feries of morally good affections* have the afcendant." A bad character and bad temper are the reverfe. But where the above-mentioned *order* or *proportion* of paffions is maintained, there a *feries* of *morally* good *affections and actions* will prevail. *Therefore*, "to maintain that order and proportion, is to have a *morally good temper and character*." But a "morally good temper and character is *moral rectitude*, *integrity*, *virtue*, or the *completion of duty*."

62 How we come by the idea of moral obligation.

If it be afked, after all, "how we come by the idea "of *moral obligation* or *duty?*" we may anfwer, That we come by it in the fame way as by our other *original* and *primary* perceptions. We receive them all from nature, or the great Author of nature. For this idea of *moral obligation* is not a creature of the mind, or dependent on any previous act of volition; but arifes on certain occafions, or when certain other ideas are prefented to the mind, as neceffarily, inftantaneoufly, and unavoidably, as *pain* does upon too near an approach to the fire, or *pleafure* from the fruition of any good. It does not, for inftance, depend on our choice, whether we fhall feel the *obligation* to fuccour a diftreffed parent, or to reftore a depofite intrufted to us when it is recalled. We cannot call this a *compound idea* made up of one or more fimple ideas. We may indeed, nay we muft, have fome ideas antecedent to it, e. g. that of a parent—in diftrefs—of a child—able to relieve—of the relation of one to the other—of a truft—of right, &c. But none of thefe ideas conftitute the perception of *obligation*. This is an idea quite diftinct from, and fomething fuperadded to, the ideas of the correlatives, or the relation fubfifting between them. Thefe indeed, by a law of our nature, are the occafion of fuggefting it; but they are as totally different from it as colours are from founds. By fenfe of reflection we perceive the correlatives; our memory recals the favours or depofite we received; the various circumftances of the cafe are matters of fact or experience; but fome delicate inward *organ* or *power*, or call it what we pleafe, does, by a certain inftantaneous fympathy, antecedent to the cool deductions of reafon, and independent of previous inftruction, or volition, *perceive the moral harmony*, the *living*, *irrefiftible charms of moral obligation*, which immediately interefts the correfpondent paffions, and prompts us to fulfil its lawful dictates.

63 The ufe of reafon in moral cafes.

We need not apprehend any danger from the quicknefs of its decifions, nor be frightened becaufe it looks like *inftinct*, and has been called fo. Would we approve one for deliberating long, or reafoning the matter much at leifure, whether he fhould relieve a diftreffed parent, feed a ftarving neighbour, or reftore the truft committed to him? fhould we not fufpect the reafoner of knavery, or of very weak affections to virtue? We employ *reafon*, and worthily employ it, in examining the condition, relations, and other circumftances of the agent or patient, or of thofe with whom

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whom either of them are connected, or, in other words, the *ſtate of the caſe*: and in complicated caſes, where the circumſtances are many, it may require no ſmall attention to find the true ſtate of the caſe; but when the relations of the agent or patient, and the circumſtances of the action are obvious, or come out ſuch after a fair trial, we ſhould ſcarcely approve him who demurs on the obligation to that conduct which the caſe ſuggeſts.

64 Pleaſure not the idea of obligation.

From what has been ſaid, it is evident, that it is not the pleaſure or agreeable ſenſations which accompany the exerciſe of the ſeveral affections, nor thoſe conſequent to the actions, that conſtitute *moral obligation*, or excite in us the idea of it. That pleaſure is poſterior to the idea of obligation; and frequently we are obliged, and acknowledge ourſelves under an obligation, to ſuch affections and actions as are attended with pain; as in the trials of virtue, where we are obliged to ſacrifice private to public good, or a preſent pleaſure to a future intereſt. We have pleaſure in ſerving an aged parent, but it is neither the perception nor proſpect of that pleaſure which gives us the idea of obligation to that conduct.

Chap. III. *The* Final *Cauſes of our moral Faculties of* Perception *and* Affection.

65 The ſurvey propoſed.

We have now taken a *general* proſpect of man and of his *moral powers* and *connexions*, and on theſe erected a ſcheme of *duty*, or *moral obligation*, which ſeems to be confirmed by *experience*, conſonant to *reaſon*, and approved by his moſt inward and moſt ſacred *ſenſes*. It may be proper, in the next place, to take a more particular view of the *final cauſes* of thoſe delicate *ſprings* by which he is *impelled* to action, and of thoſe *clogs* by which he is reſtrained from it. By this detail we ſhall be able to judge of their aptitude to anſwer their end, in a creature endued with his *capacities*, ſubject to his *wants*, expoſed to his *dangers*, and ſuſceptible of his *enjoyments*; and from thence we ſhall be in a condition to pronounce concerning the *end* of his *whole ſtructure*, its *harmony* with its *ſtate*, and conſequently its ſubſerviency to anſwer the great and benevolent intentions of its Author.

66 Inward anatomy of the ſyſtem of the mind.

The ſupreme Being has ſeen fit to blend in the whole of things a prodigious variety of diſcordant and contrary principles, *light* and *darkneſs*, *pleaſure* and *pain*, *good* and *evil*. There are multifarious natures, *higher* and *lower*, and many intermediate ones between the wide-diſtant extremes. Theſe are differently ſituated, variouſly adjuſted, and ſubjected to each other, and all of them ſubordinate to the order and perfection of the whole. We may ſuppoſe *man* placed as in a centre amidſt thoſe innumerable orders of beings, by his *outward* frame drawing to the *material* ſyſtem, and by his *inward* connected with the intellectual or *moral*, and of courſe affected by the laws which govern both, or affected by that good and that ill which reſult from thoſe laws. In this infinite variety of *relations* with which he is ſurrounded, and of *contingencies* to which he is liable, he feels ſtrong attractions to the *good*, and violent repulſions or averſions to the *ill*. But as good and ill are often blended, and wonderfully complicated one with the other; as they ſometimes immediately produce and run up into each other, and at other times lie at great diſtances, yet by means of intervening links introduce one another; and as theſe effects are often brought about in conſequence of hidden relations and general laws, of the energy of which he is an incompetent judge; it is eaſy for him to miſtake *good* for *evil*, and *evil* for *good*, and conſequently he may be frequently attracted by ſuch things as are deſtructive or repel ſuch as are ſalutary. Thus, by the tender and complicated frame of his body, he is ſubjected to a great variety of ills, to *ſickneſs*, *cold*, *heat*, *fatigue*, and innumerable *wants*. Yet his knowledge is ſo narrow withal, and his reaſon ſo weak, that in many caſes he cannot judge, in the way of inveſtigation or reaſoning, of the connexions of thoſe effects with their reſpective cauſes, or of the various latent energies of natural things. He is therefore informed of this connexion by the experience of certain *ſenſes* or *organs* of *perception*, which by a mechanical inſtantaneous motion, feel the *good* and the *ill*, receiving pleaſure from *one*, and pain from the *other*. By theſe, without any reaſoning, he is taught to attract or chooſe what tends to his welfare, and to repel and avoid what tends to his ruin. Thus, by his ſenſes of *taſte* and *ſmell*, or by the *pleaſure* he receives from certain kinds of food, he is admoniſhed which agree with his conſtitution; and by an oppoſite ſenſe of *pain* he is informed which ſort diſagree, or are deſtructive of it; but is not by means of this inſtructed in the inward natures and conſtitutions of things.

67 Uſe of appetites and paſſions.

Some of theſe ſenſes are armed with ſtrong degrees of *uneaſineſs* or *pain*, in order to urge him to ſeek after ſuch objects as are ſuited to them. And theſe reſpect his more immediate and preſſing *wants*; as the ſenſe of *hunger*, *thirſt*, *cold*, and the like; which, by their painful importunities, compel him to provide *food*, *drink*, *raiment*, *ſhelter*. Thoſe inſtincts by which we are thus prompted with ſome kind of commotion or violence to attract and purſue *good*, or to repel and avoid *ill*, we call *appetites* and *paſſions*. By our ſenſes then we are informed of what is *good* or *ill* to the *private ſyſtem*, or the *individual*; and by our *private appetites* and *paſſions* we are impelled to one, and reſtrained from the other.

68 Man's outward ſtate.

In conſequence of this machinery, and the great train of wants to which our nature ſubjects us, we are engaged in a continued ſeries of occupations, which often require much application of thought, or great bodily labour, or both. The neceſſaries of life, food, clothes, ſhelter, and the like, muſt be provided; conveniencies muſt be acquired to render life ſtill more eaſy and comfortable. In order to obtain theſe, arts, induſtry, manufactures, and trade are neceſſary. And to ſecure to us the peaceable enjoyment of their fruits, civil government, policy, and laws, muſt be contrived, and the various buſineſs of public life carried on: thus, while man is concerned and buſied in making proviſion, or obtaining ſecurity for himſelf, he is by degrees engaged in connexions with a family, friends, neighbours, a community, or a commonwealth. Hence ariſe new wants, new intereſts, new cares, and new employments. The paſſions of one man interfere with thoſe of another. Intereſts are oppoſed. Competitions ariſe, contrary courſes are taken. Diſappointments happen, diſtinctions are made, and parties formed. This opens a vaſt ſcene of diſtraction and embarraſſment, and introduces a mighty train of good and ill, both public and private. Yet amidſt all this confuſion and hurry, plans of action muſt be laid, conſequences foreſeen or guarded againſt, inconveniences provided for; and frequently particular reſolutions muſt be taken, and ſchemes executed, without reaſoning or delay.

69 Proviſions for it. Now what proviſion has the Author of our nature made for this neceſſitous condition? how has he fitted the actor, man, for playing his part in this perplexed and buſy ſcene?

70 By public ſenſes and paſſions. Our ſupreme Parent, watchful for the whole, has not left himſelf without a witneſs here neither, and hath made nothing imperfect, but all things are double one againſt the other. He has not left man to be informed, only by the cool notices of reaſon, of the *good* or *ill*, the *happineſs* or *miſery* of his fellow creatures.—He has made him ſenſible of their good and happineſs, but eſpecially of their ill and miſery, by an immediate ſympathy, or quick *feeling* of *pleaſure* and of *pain*.

71 Pity. The latter we call PITY or COMPASSION. For the

72 Congratulation. former, though every one, who is not quite diveſted of humanity, feels it in ſome degree, we have not got a name, unleſs we call it CONGRATULATION or *joyful* SYMPATHY, or that *good humour* which ariſes on ſeeing others pleaſed or happy. Both theſe feelings have been called in general the PUBLIC OR COMMON SENSE, κοινη μνημοσυνη, by which we feel for others, and are intereſted in their concerns as really, though perhaps leſs ſenſibly, than in our own.

73 Reſentment. When we ſee our fellow creatures unhappy through the fault or injury of others, we feel *reſentment* or *indignation* againſt the *unjuſt* cauſers of that miſery.—If we are conſcious that it has happened through our fault or *injurious* conduct, we feel *ſhame*; and both theſe claſſes of *ſenſes* and *paſſions*, regarding *miſery* and *wrong*, are armed with ſuch ſharp ſenſations of *pain*, as not only prove a powerful guard and ſecurity to the *ſpecies*, or *public ſyſtem*, againſt thoſe ills it may, but ſerve alſo to leſſen or remove thoſe ills it does, ſuffer. Compaſſion draws us out of ourſelves to bear a part of the misfortunes of others, powerfully ſolicits us in their favour, melts us at the ſight of their diſtreſs, and makes us in ſome degree unhappy till they are relieved from it. It is peculiarly well adapted to the condition of human life, becauſe it is much more and oftener in our power to do miſchief than good, and to prevent or leſſen miſery than to communicate poſitive happineſs; and therefore it is an admirable reſtraint upon the more *ſelfiſh* paſſions, or thoſe violent impulſes that carry us to the hurt of others.

74 Public affections. There are other particular *inſtincts* or *paſſions* which intereſt us in the concerns of others, even while we are moſt buſy about our own, and which are ſtrongly attractive of *good*, and repulſive of *ill* to them. Such are *natural affection*, *friendſhip*, *love*, *gratitude*, *deſire of fame*, *love of ſociety*, of *one's country*, and others that might be named. Now as the *private* appetites and paſſions were found to be armed with ſtrong ſenſations of deſire and uneaſineſs, to prompt man the more effectually to ſuſtain labours, and to encounter dangers in purſuit of thoſe goods that are neceſſary to the preſervation and welfare of the individual, and to avoid thoſe ills which tend to his deſtruction; in like manner it was neceſſary, that this *other* claſs of deſires and affections ſhould be prompted with as quick ſenſations of pain, not only to counteract the ſtrength of their antagoniſts, but to engage us in a virtuous activity for our relations, families, friends, neighbours, country. Indeed our *ſenſe* of *right* and *wrong* will admoniſh us that it is our *duty*, and *reaſon* and *experience* farther aſſure us that it is both our *intereſt* and beſt *ſecurity*, to promote the happineſs of others; but that *ſenſe*, that *reaſon*, and that *experience*, would frequently prove but weak and ineffectual prompters to ſuch a conduct, eſpecially in caſes of danger and hardſhip, and amidſt all the importunities of nature, and that conſtant hurry in which the *private* paſſions involve us, without the aid of thoſe particular *kind* affections which mark out to us particular ſpheres of duty, and with an agreeable violence engage and fix us down to them.

It is evident, therefore, that thoſe two claſſes of affection, the *private* and *public*, are ſet one againſt the other, and deſigned to control and limit each other's influence, and thereby to produce a juſt balance in the whole *. In general, the violent ſenſations of pain and uneaſineſs which accompany hunger, thirſt, and the other private appetites, or too great fatigue of mind as well as of body, prevent the individual from running to great exceſſes in the exerciſe of the higher functions of the mind, as too intenſe thought in the ſearch of truth, violent application to buſineſs of any kind, and different degrees of romantic heroiſm. On the other hand, the finer ſenſes of *perception*, and thoſe *generous deſires* and *affections* which are connected with them, the *love of action*, of *imitation*, of *truth*, *honour*, *public virtue*, and the like, are wiſely placed in the oppoſite ſcale, in order to prevent us from ſinking into the dregs of the *animal* life, and debaſing the dignity of man below the condition of brutes. So that, by the mutual reaction of thoſe oppoſite powers, the bad effects are prevented that would naturally reſult from their acting ſingly and apart, and the good effects are produced which each are ſeverally formed to produce. 75 Contraſt or balance of paſſions.

* Vid. *Hutcheſon's Conduct of the Paſſions*, Treat. 1. §. 2.

The ſame wholeſome oppoſition appears likewiſe in the particular counter-workings of the *private* and *public* affections one againſt the other. Thus *compaſſion* is adapted to counterpoiſe the *love of eaſe*, of *pleaſure*, and of *life*, and to diſarm or to ſet bounds to *reſentment*; and *reſentment* of injury done to ourſelves, or to our friends who are dearer than ourſelves, prevents an effeminate *compaſſion* or *conſternation*, and gives us a noble contempt of labour, pain, and death. *Natural affection*, *friendſhip*, *love of one's country*, nay, *zeal* for any particular virtue, are frequently more than a match for the whole train of *ſelfiſh* paſſions.—On the other hand, without that intimate overruling paſſion of *ſelf-love*, and thoſe private deſires which are connected with it, the *ſocial* and *tender inſtincts* of the human heart would degenerate into the wildeſt dottage, the moſt torturing anxiety, and downright frenzy. 76 Contraſt or balance of public and private paſſions.

But not only are the different orders or claſſes of affection checks one upon another, but paſſions of the ſame claſſes are mutual clogs. Thus, how many are withheld from the violent outrages of *reſentment* by *fear*! and how eaſily is *fear* controlled in its turn, while mighty wrongs awaken a mighty *reſentment*! 77 Contraſts among thoſe of the ſame claſſes.

The

Of Perception and Affection.

The *private* paſſions often interfere, and therefore moderate the violence of each other; and a calm *ſelf-love* is placed at their head, to direct, influence, and control their particular attractions and repulſions. The *public* affections likewiſe reſtrain one another; and all of them are put under the controul of a calm diſpaſſionate *benevolence*, which ought in like manner to direct and limit their particular motions. Thus moſt part, if not all the paſſions, have a twofold aſpect, and ſerve a twofold end. In *one* view they may be conſidered as *powers*, impelling mankind to a certain courſe, with a *force* proportioned to the *apprehended moment* of the good they aim at. In *another* view they appear as *weights*, balancing the action of the *powers*, and controlling the violence of their impulſes. By means of theſe *powers* and *weights* a natural *poiſe* is ſettled in the human breaſt by its all-wiſe Author, by which the creature is kept tolerably ſteady and regular in his courſe, amidſt that variety of ſtages through which he muſt paſs.

78 Particular perceptions or inſtincts of approbation.

But this is not all the proviſion which God has made for the hurry and perplexity of the ſcene in which man is deſtined to act. Amidſt thoſe infinite attractions and repulſions towards private and public good and ill, mankind either cannot often foreſee the *conſequences* or *tendencies* of all their actions towards one or other of theſe, eſpecially where thoſe tendencies are intricate and point different ways, or thoſe conſequences remote and complicated; or though, by careful and cool inquiry, and a due improvement of their rational powers, they might find them out, yet, diſtracted as they are with buſineſs, amuſed with trifles, diſſipated by pleaſure, and diſturbed by paſſion, they either have or can find no leiſure to attend to thoſe conſequences, or to examine how far this or that conduct is productive of private or public good on the whole. Therefore, were it left entirely to the flow and ſober deductions of reaſon to trace thoſe tendencies, and make out thoſe conſequences, it is evident, that in many particular inſtances the buſineſs of life muſt ſtand ſtill, and many important occaſions of action be loſt, or perhaps the groſſeſt blunders be committed. On this account, the Deity, beſides that general approbation which we beſtow on every degree of *kind* affection, has moreover implanted in man many particular *perceptions* or *determinations* to approve of certain *qualities* or *actions*, which, in effect, tend to the advantage of ſociety, and are connected with private good, though he does not always ſee that tendency, nor mind that connexion. And theſe *perceptions* or *determinations* do, without reaſoning, point out, and, antecedent to views of intereſt, prompt to a conduct beneficial to the *public*, and uſeful to the *private* ſyſtem. Such is that *ſenſe of candour and veracity*, that *abhorrence of fraud and falſehood*, that *ſenſe of fidelity, juſtice, gratitude, greatneſs of mind, fortitude, clemency, decorum*, and that *diſapprobation of knavery, injuſtice, ingratitude, meanneſs of ſpirit, cowardice, cruelty*, and *indecorum*, which are natural to the human mind. The *former* of thoſe diſpoſitions, and the actions flowing from them, are approved, and thoſe of the latter kind diſapproved by us, even abſtracted from the view of their tendency or conduciveneſs to the happineſs or miſery of others, or of ourſelves. In one we diſcern a *beauty*, a *ſuperior excellency*, a congruity to the *dignity* of man; in the other a *deformity*, a *littleneſs*, a *debaſement*, of human nature.

79 Others of an inferior order.

There are other principles alſo connected with the good of ſociety, or the happineſs and perfection of the individual, though that connexion is not immediately apparent, which we behold with real complacency and approbation, though perhaps inferior in degree, if not in kind, ſuch as *gravity, modeſty, ſimplicity of deportment, temperance, prudent economy*; and we feel ſome degree of contempt and diſlike where they are wanting, or where the oppoſite qualities prevail. Theſe and the like *perceptions* or *feelings* are either different *modifications* of the *moral ſenſe*, or *ſubordinate* to it, and plainly ſerve the ſame important purpoſe, being expeditious *monitors*, in the ſeveral emergencies of a various and diſtracted life, of what is *right*, what is *wrong*, what is to be *purſued*, and what *avoided*; and, by the pleaſant or painful conſciouſneſs which attends them, exerting their influence as powerful *prompters* to a ſuitable conduct.

80 Their general tendencies.

From a ſlight inſpection of the above-named principles, it is evident they all carry a friendly aſpect to *ſociety* and the *individual*, and have a more immediate or a more remote tendency to promote the *perfection* or *good* of both. This tendency cannot be always foreſeen, and would be often miſtaken or ſeldom attended to by a weak, buſy, ſhort-ſighted creature like man, both raſh and variable in his opinions, a dupe to his own paſſions, or to the deſigns of others, liable to ſickneſs, to want, and to error. Principles, therefore, which are ſo nearly linked with *private ſecurity* and *public good*, by directing him, without operoſe reaſoning, where to find the *one*, and how to promote the *other*; and, by prompting him to a conduct conducive to both, are admirably adapted to the exigencies of his preſent ſtate, and wiſely calculated to obtain the ends of univerſal benevolence.

81 Paſſions fitted to a ſtate of trial;

It were eaſy, by conſidering the ſubject in another light, to ſhow, in a curious detail of particulars, how wonderfully the inſide of man, or that aſtoniſhing train of *moral powers* and *affections* with which he is endued, is fitted to the ſeveral ſtages of that *progreſſive* and *probationary* ſtate through which he is deſtined to paſs. As our faculties are narrow and limited, and riſe from very ſmall and imperfect beginnings, they muſt be improved by exerciſe, by attention, and repeated trials. And this holds true not only of our *intellectual* but of our *moral* and *active* powers. The former are liable to errors in ſpeculation, the latter to blunders in practice, and both often terminate in miſfortunes and pains. And thoſe errors and blunders are generally owing to our paſſions, or to our too forward and warm *admiration* of thoſe partial *goods* they naturally purſue, or to our fear of thoſe partial *ills* they naturally repel. Thoſe misfortunes, therefore, lead us back to conſider where our miſconduct lay, and whence our errors flowed; and conſequently are ſalutary pieces of trial, which tend to enlarge our views, to *correct* and *refine* our paſſions, and conſequently improve both our *intellectual* and *moral* powers. Our paſſions then are the rude materials of our virtue, which Heaven has given us to work up, to refine and poliſh into a harmonious and divine piece of workmanſhip. They furniſh out the whole machinery, the calms and ſtorms, the lights and ſhades of human life. They ſhow mankind in every attitude

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attitude and variety of character, and give *virtue* both its struggles and its triumphs. To conduct them well in every state, is merit; to abuse or misapply them, is demerit.

82 To a progressive state.

The different sets of *senses*, *powers*, and *passions*, which unfold themselves in those successive stages, are both necessary and adapted to that *rising* and *progressive* state. Enlarging views and growing connexions require new passions and new habits; and thus the mind, by these continually expanding and finding a progressive exercise, rises to higher improvements, and pushes forward to maturity and perfection.

83 Harmony of our structure and state.

In this beautiful economy and harmony of our structure, both outward and inward, with that state, we may at once discern the great lines of our duty traced out in the fairest and brightest characters, and contemplate with admiration a more august and marvellous scene of divine wisdom and goodness laid in the human breast, than we shall perhaps find in the whole compass of nature.

84 In what economy virtue consists.

From this detail it appears, that man, by his original frame, is made for a *temperate*, *compassionate*, *benevolent*, *active*, and *progressive* state. He is strongly *attractive* of the *good*, and *repulsive* of the *ills* which befal others as well as himself. He feels the highest *approbation* and *moral complacence* in those affections, and in those actions, which immediately and directly respect the *good* of others, and the highest *disapprobation* and *abhorrence* of the contrary. Besides these, he has many particular *perceptions* or *instincts* of *approbation*, which, though perhaps not of the same kind with the others, yet are accompanied with correspondent degrees of affection, proportioned to their respective tendencies to the *public good*. *Therefore*, by acting agreeably to these principles, *man* acts agreeably to his structure, and fulfils the benevolent intentions of its Author. But we call a thing *good* when it answers its *end*, and a creature *good*, when he acts in a *conformity* to his *constitution*. Consequently, *man* must be denominated *good* or *virtuous* when he acts suitably to the *principles* and *destination* of his nature.

PART II.

Chap. I. *The principal Distinctions of* Duty *or* Virtue.

WE have now considered the *constitution* and *connexions* of *man*, and on those erected a general system of *duty* or *moral obligation*, consonant to *reason*, approved by his most sacred and intimate *sense*, suitable to his *mixed condition*, and confirmed by the *experience* of mankind. We have also traced the *final causes* of his *moral faculties* and *affections* to those noble purposes they answer, with regard both to the *private* and the *public system*.

85 General division of duty.

From this induction it is evident, that there is one order or class of duties which *man* owes to *himself*: another to *society*: and a third to *God*.

86 Duty to one's self.

The duties he owes to *himself* are founded chiefly on the *defensive* and *private* passions, which prompt him to pursue whatever tends to *private good* or *happiness*, and to avoid or ward off whatever tends to *private ill* or *misery*. Among the various goods which allure and solicit him, and the various ills which attack or threaten him, "to be intelligent and accurate in selecting *one*, and rejecting the *other*, or in preferring the most *excellent goods*, and avoiding the most *terrible ills*, when there is a competition among either, and to be discreet in using the best means to attain the *goods* and avoid the *ills*, is what we call *prudence*." This, in our *inward* frame, corresponds to *sagacity*, or *quickness of sense*, in our *outward*.—"To proportion our *defensive passions* to our *dangers*, we call *fortitude*; which always implies "a just mixture of calm resentment or animosity, and well-governed caution." And this *firmness of mind* answers to the *strength* and *muscling* of the *body*. And "duly to adjust our *private passions* to our wants, or to the respective moment of the good we affect or pursue, we call *temperance*;" which does therefore always imply, in this large sense of the word, "a just balance or command of the passions."

87 Duties to society.

The *second class* of *duties* arises from the *public* or *social affections*, "the just harmony or proportion of which to the *dangers* and *wants* of others, and to the several *relations* we bear, commonly goes by the name of *justice*." This includes the whole of our duty to *society*, to our *parents*, and the *general polity* of *nature*; particularly *gratitude*, *friendship*, *sincerity*, *natural affection*, *benevolence*, and the other *social virtues*: This, being the *noblest temper*, and *fairest complexion* of the soul, corresponds to the *beauty* and *fine proportion* of the person. The virtues comprehended under the former class, especially *prudence* and *fortitude*, may likewise be transferred to this; and according to the various circumstances in which they are placed, and the more confined or more extensive sphere in which they operate, may be denominated *private*, *economical*, or *civil prudence*, *fortitude*, &c. These direct our conduct with regard to the *wants* and *dangers* of those lesser or greater circles with which they are connected.

88 Duties to God.

The *third* class of duties respects the Deity, and arises from the *public affections*, and the several glorious *relations*, which he sustains to us as our *Creator*, *Benefactor*, *Lawgiver*, *Judge*, *&c.*

89 Method.

We choose to consider this *set* of duties in the last place; because, though *prior* in dignity and excellency, they seem to be *last* in order of time, as thinking it the most simple and easy method to follow the gradual progress of nature, as it takes its rise from individuals, and spreads through the social system, and still ascends upwards, till at length it stretches to its almighty Parent and Head, and so terminates in those duties which are *highest* and *best*.

90 Piety

The duties resulting from these *relations* are, *reverence*, *gratitude*, *love*, *resignation*, *dependence*, *obedience*, *worship*, *praise*: which, according to the model of our finite capacities, must maintain some sort of proportion to the grandeur and perfection of the object whom we venerate, love, and obey. "This *proportion* or *harmony* is expressed by the general name of *piety* or *devotion*,"

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devotion," which is always stronger or weaker according to the greater or less apprehended excellency of its object. This sublime principle of virtue is the enlivening soul which animates the *moral system*, and that cement which binds and sustains the other duties which *man* owes to *himself* or to *society*.

91 Conscience. This then is the general temper and constitution of virtue, and these are the principal lines or divisions of duty. To those good dispositions which respect the several objects of our duty, and to all actions which flow from such dispositions, the mind gives its sanction or testimony. And this sanction or judgement concerning the moral quality, or the goodness of actions or dispositions, moralists call *conscience*. When it judges of an action that is to be performed, it is called an *antecedent conscience*; and when it passes sentence on an action which is performed, it is called a *subsequent conscience*. The tendency of an action to produce happiness, or its external conformity to a law, is termed its *material* goodness. But the good dispositions from which an action proceeds, or its conformity to law in every respect, constitutes its *formal* goodness.

92 Its divisions. When the mind is ignorant or uncertain about the moment of an action or its tendency to private or public good; or when there are several circumstances in the case, some of which, being doubtful, render the mind dubious concerning the morality of the action; that is called a *doubtful* or *scrupulous conscience*; if it mistakes concerning these, it is called an *erroneous conscience*. If the *error* or *ignorance* is *involuntary* or *invincible*, the action proceeding from that *error*, or from that *ignorance*, is reckoned *innocent*, or not imputable. If the error or ignorance is *supine* or *affected*, *i. e.* the effect of negligence, or of affectation and wilful inadvertence, the conduct flowing from such error, or such ignorance, is *criminal* and *imputable*.—Not to follow one's conscience, though erroneous and ill-informed, is *criminal*, as it is the guide of life; and to counteract it, shows a depraved and incorrigible spirit. Yet to follow an erroneous conscience is likewise criminal, if that error which misled the conscience was the effect of inattention, or any criminal passion *.

* *Hutches. Mor. Inst.* lib. ii. c. 3.

93 How conscience is to be rectified. If it be asked, "How an erroneous conscience shall be rectified, since it is supposed to be the only guide of life, and judge of morals?" we answer, In the very same way that we would rectify reason if at any time it should judge wrong, as it often does, viz. by giving it proper and sufficient materials for judging right, *i. e.* by inquiring into the whole state of the case, the relations, connexions, and several obligations of the actor, the consequences and other circumstances of the action, or the surplusage of private or public good which results, or is likely to result, from the action or from the omission of it. If those circumstances are fairly and fully stated, the conscience will be just and impartial in its decision; for, by a necessary law of our nature, it approves and is well affected to the *moral form*; and if it seems to approve of *vice* or *immorality*, it is always under the notion or mask of some *virtue*. So that, strictly speaking, it is not conscience which errs; for its sentence is always conformable to the view of the case which lies before it; and is *just*, upon the supposition that the case is truly such as it is represented to it. All the fault is to be imputed to the agent, who neglects to be better informed, or who, through weakness or wickedness, hastens to pass sentence from an imperfect evidence.

Of Man's duty to Himself.

Chap. II. *Of Man's Duty to* Himself. *Of the Nature of* Good, *and the Chief* Good.

Every creature, by the constitution of his nature, is determined to love himself; to pursue whatever tends to his preservation and happiness, and to avoid whatever tends to his hurt and misery. Being endued with sense and perception, he must necessarily receive *pleasure* from some objects, and *pain* from others. Those objects which give pleasure are called *good*; and those which give pain, *evil*. To the former he feels that attraction or motion we call *desire*, or *love*; to the latter, that impulse we call *aversion*, or *hatred*.—To objects which suggest neither pleasure nor pain, and are apprehended of no use to procure one or ward off the other, we feel neither *desire* nor *aversion*; and such objects are called *indifferent*. Those objects which do not of themselves produce pleasure or pain, but are the *means* of procuring either, we call *useful* or *noxious*. Towards them we are affected in a subordinate manner, or with an *indirect* and *reflective* rather than a *direct* and *immediate* affection. All the original and particular affections of our nature lead us out to and ultimately rest in the first kind of objects, viz. those which give immediate pleasure, and which we therefore call *good directly so*. The calm affection of *self-love* alone is conversant about such objects as are only *consequentially good*, or merely useful to ourselves. 94 Divisions of good.

But, besides those sorts of objects which we call *good*, merely and solely as they give pleasure, or are means of procuring it, there is a higher and nobler species of good, towards which we feel that peculiar movement we call *approbation* or *moral complacency*; and which we *therefore* denominate *moral good*. Such are our affections, and the consequent actions to them. The perception of this is, as has been already observed, quite distinct in kind from the perception of other species; and though it may be connected with *pleasure* or *advantage* by the benevolent constitution of nature, yet it constitutes a *good* independent of that pleasure and that advantage, and far superior not in degree only but in dignity to both. The *other*, viz. the *natural good*, consists in obtaining those pleasures which are adapted to the peculiar senses and passions susceptible of them, and is as various as are those senses and passions. This, *viz.* the *moral*, good, lies in the right conduct of the several senses and passions, or their just proportion and accommodation to their respective objects and relations, and this is of a more simple and invariable kind. 95 Moral good.

By our several senses we are capable of a great variety of pleasing sensations. These constitute distinct ends or objects ultimately pursuable for their own sake. To these ends, or ultimate objects, correspond peculiar appetites or affections, which prompt the mind to pursue them. When these ends are attained, there it rests, and looks no farther. Whatever therefore is pursuable, not on its own account, but as subservient or necessary to the attainment of something else that is intrinsically valuable for its own sake, be that value ever so great or ever so small, we call a *mean*, 96 Human happiness.

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mean, and not an *end*. So that *ends* and *means* conſtitute the *materials* or the very *eſſence* of our *happineſs*. Conſequently happineſs, *i. e. human* happineſs, cannot be one ſimple uniform thing in creatures conſtituted, as we are, with ſuch various ſenſes of pleaſure, or ſuch different capacities of enjoyment. Now the ſame principle, or law of our nature, which determines us to purſue any one end or ſpecies of good, prompts us to purſue every other end or ſpecies of good of which we are ſuſceptible, or to which our Maker has adapted an original propenſion. But amidſt the great multiplicity of *ends* or *goods* which form the various ingredients of our happineſs, we perceive an evident *gradation* or *ſubordination* ſuited to that gradation of *ſenſes*, *powers*, and *paſſions*, which prevails in our mixed and various conſtitution, and to that aſcending ſeries of connexions which open upon us in the different ſtages of our progreſſive ſtate.

97 Gradation of goods.

Thus the goods of the *body*, or of the *external ſenſes*, ſeem to hold the loweſt rank in this gradation or ſcale of goods. Theſe we have in common with the brutes; and though many men are brutiſh enough to purſue the goods of the body with a more than brutal fury, yet, when at any time they come in competition with goods of an higher order, the unanimous verdict of mankind, by giving the laſt the preference, condemns the firſt to the meaneſt place. Goods conſiſting in exterior ſocial connexions, as *fame*, *fortune*, *power*, *civil authority*, ſeem to ſucceed next, and are chiefly valuable as the means of procuring *natural* or *moral* good, but principally the latter. Goods of the *intellect* are ſtill ſuperior, as *taſte*, *knowledge*, *memory*, *judgement*, &c. The higheſt are moral goods of the mind, directly and ultimately regarding ourſelves, as *command of the appetites* and *paſſions*, *prudence*, *fortitude*, *benevolence*, &c. Theſe are the great objects of our purſuit, and the principal ingredients of our happineſs. Let us conſider each of them as they riſe one above the other in this natural ſeries or ſcale, and touch briefly on our obligations to purſue them.

98 Goods of the body.

Thoſe of the body are *health*, *ſtrength*, *agility*, *hardineſs*, and *patience of change*, *neatneſs*, and *decency*.

99 Good health;

Good health, and a regular eaſy flow of ſpirits, are in themſelves ſweet natural enjoyments, a great fund of pleaſure, and indeed the proper ſeaſoning which gives a flavour and poignancy to every other pleaſure. The want of health unfits us for moſt duties of life, and is eſpecially an enemy to the ſocial and humane affections, as it generally renders the unhappy ſufferer peeviſh and ſullen, diſguſted at the allotments of Providence, and conſequently apt to entertain ſuſpicious and gloomy ſentiments of its Author. It obſtructs the free exerciſe and full improvement of our reaſon, makes us a burden to our friends, and uſeleſs to ſociety. Whereas the uninterrupted enjoyment of good health is a conſtant ſource of good humour, and good humour is a great friend to openneſs and benignity of heart, enables us to encounter the various ills and diſappointments of life with more courage, or to ſuſtain them with more patience; and, in ſhort, conduces much, if we are otherwiſe duly qualified, to our acting our part in every exigency of life with more firmneſs, conſiſtency, and dignity. Therefore it imports us much to preſerve and improve a habit or enjoyment, without which every other external entertainment is taſteleſs, and moſt other advantages of little avail.— And this is beſt done by a ſtrict temperance in diet and regimen, by regular exerciſe, and by keeping the mind ſerene and unruffled by violent paſſions, and unſubdued by intenſe and conſtant labours, which greatly impair and gradually deſtroy the ſtrongeſt conſtitutions.

100 How preſerved.

101 Strength, agility, &c.

Strength, *agility*, *hardineſs*, and *patience of change*, ſuppoſe health, and are unattainable without it; but they imply ſomething more, and are neceſſary to guard it, to give us the perfect uſe of life and limbs, and to ſecure us againſt many otherwiſe unavoidable ills.— The exerciſe of the neceſſary manual, and of moſt of the elegant arts of life, depends on ſtrength and agility of body; perſonal dangers, private and public dangers, the demands of our friends, our families, and country, require them; they are neceſſary in war, and ornamental in peace; fit for the employment of a country and a town life, and they exalt the entertainments and diverſions of both. They are chiefly obtained by moderate and regular exerciſe.

102 How attained.

103 Patience of change;

Few are ſo much raiſed above want and dependence, or ſo exempted from buſineſs and care, as not to be often expoſed to inequalities and changes of diet, exerciſe, air, climate, and other irregularities. Now, what can be ſo effectual to ſecure one againſt the miſchiefs ariſing from ſuch unavoidable alterations, as hardineſs, and a certain verſatility of conſtitution which can bear extraordinary labours, and ſubmit to great changes, without any ſenſible uneaſineſs or bad conſequences. This is beſt attained, not by an over great delicacy and minute attention to forms, or by an invariable regularity in diet, hours, and way of living, but rather by a bold and diſcreet latitude of regimen. Beſides, deviations from eſtabliſhed rules and forms of living, if kept within the bounds of ſobriety and reaſon, are friendly to thought and original ſentiments, animate the dull ſcene of ordinary life and buſineſs, and agreeably ſtir the paſſions, which ſtagnate or breed ill humour in the calms of life.

104 How attained.

105 Neatneſs, decency, &c.

Neatneſs, *cleanlineſs*, and *decency*, to which we may add *dignity* of *countenance*, and *demeanour*, ſeem to have ſomething refined and moral in them: at leaſt we generally eſteem them indications of an orderly, genteel, and well governed mind, conſcious of an inward worth, or the reſpect due to one's nature. Whereas *naſtineſs*, *ſlovenlineſs*, *awkwardneſs*, and *indecency*, are ſhrewd ſymptoms of ſomething mean, careleſs, and deficient, and betray a mind of untaught, illiberal, unconſcious of what is due to one's ſelf or to others. How much cleanlineſs conduces to health, needs hardly to be mentioned; and how neceſſary it is to maintain one's character and rank in life, and to render us agreeable to others as well as to ourſelves, is as evident.—There are certain motions, airs, and geſtures, which become the human countenance and form, in which we perceive a *comelineſs*, *openneſs*, *ſimplicity*, *gracefulneſs*; and there are others, which to our ſenſe of decorum appear *uncomely*, *affected*, *diſingenuous*, and *awkward*, quite unſuitable to the native dignity of our face and form. The *firſt* are in themſelves the moſt eaſy, natural and commodious, give one boldneſs and preſence of mind, a modeſt aſſurance, an addreſs both awful and alluring; they beſpeak candour and greatneſs

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nefs of mind, raife the moft agreeable prejudices in one's favour, render fociety engaging, command refpect, and often love, and give weight and authority both in converfation and bufinefs; in fine, they are the colouring of virtue, which fhow it to the greateft advantage in whomfoever it is; and not only imitate, but in fome meafure fupply it where it is wanting. Whereas the laft, *viz. rudenefs*, *affectation*, *indecorum*, and the like, have all the contrary effects; they are burdenfome to one's felf, a difhonour to our nature, and a nuifance in fociety. The former qualities or goods are beft attained by a liberal education, by preferving a juft fenfe of the dignity of our nature, by keeping the beft and politeft company, but, above all, by acquiring thofe virtuous and ennobling habits of mind which are decency in perfection, which will give an air of unaffected grandeur, and fpread a luftre truly engaging over the whole form and deportment.

106 How attained.

107 Goods of exterior focial connections.

We are next to confider thofe goods which confift in exterior focial connexions, as *fame*, *fortune*, *civil authority*, *power*.

108 Fame.

The firft has a twofold afpect, as a good pleafant in itfelf, or gratifying to an original paffion, and then as expedient or ufeful towards a farther end. Honour from the wife and good, on the account of a virtuous conduct, is regaling to a good man; for then his heart re-echoes to the grateful found. There are few quite indifferent even to the commendation of the vulgar. Though we cannot approve that conduct which proceeds entirely from this principle, and not from good affection or love of the conduct itfelf, yet, as it is often a guard and additional motive to virtue in creatures imperfect as we are, and often diftracted by interfering paffions, it might be dangerous to fupprefs it altogether, however wife it may be to reftrain it within due bounds, and however laudable to ufe it only as a fcaffolding to our virtue, which may be taken down when that glorious ftructure is finifhed, but hardly till then. To purfue fame for itfelf, is innocent; to regard it only as an auxiliary to virtue, is noble; to feek it chiefly as an engine of public ufefulnefs, is ftill more noble, and highly praife-worthy. For though the opinion and breath of men are tranfient and fading things, often obtained without merit, and loft without caufe; yet as our bufinefs is with men, and as our capacity of ferving them is generally increafed in proportion to their efteem of us, therefore found and well eftablifhed *moral* applaufe may and will be modeftly, not oftentatioufly, fought after by the *good;* not indeed as a folitary refined fort of luxury, but as a public and proper inftrument to ferve and blefs mankind. At the fame time they will learn to defpife that reputation which is founded on rank, fortune, and any other circumftances or accomplifhments that are foreign to real merit, or to ufeful fervices done to others, and think that praife of little avail which is purchafed without defert, and beftowed without judgement.

109 Fortune, power, &c.

Fortune, *power*, and *civil authority*, or whatever is called influence and weight among mankind, are *goods* of the *fecond* divifion, that is, valuable and purfuable only as they are *ufeful*, or as means to a farther end, viz. procuring or preferving the immediate objects of enjoyment or happinefs to ourfelves or others. Therefore to love fuch goods on their own account, and to purfue them as ends, not the means of enjoyment, muft be highly prepofterous and abfurd. There can be no meafure, no limit, to fuch purfuit; all muft be whim, caprice, extravagance. Accordingly fuch appetites, unlike all the *natural* ones, are increafed by poffeffion, and whetted by enjoyment. They are always precarious, and never without fears, becaufe the objects lie without one's felf; they are feldom without forrow and vexation, becaufe no acceffion of wealth or power can fatisfy them. But if thofe goods are confidered only as the materials or means of private or public happinefs, then the fame obligations which bind us to purfue the latter, bind us likewife to purfue the former. We may, and no doubt we ought, to feek fuch a meafure of wealth as is neceffary to fupply all our real wants, to raife us above fervile dependence, and provide us with fuch conveniences as are fuited to our rank and condition in life. To be regardlefs of this meafure of wealth, is to expofe ourfelves to all the temptations of poverty and corruption: to forfeit our natural independency and freedom; to degrade, and confequently to render the rank we hold, and the character we fuftain in fociety, ufelefs, if not contemptible. When thefe important ends are fecured, we ought not to murmur or repine that we poffefs no more; yet we are not fecluded by any obligation, moral or divine, from feeking more, in order to give us that happieft and moft godlike of all powers, the *power* of *doing good.* A fupine indolence in this refpect is both abfurd and criminal; *abfurd*, as it robs us of an inexhaufted fund of the moft refined and durable enjoyments; and *criminal*, as it renders us fo far ufelefs to the fociety to which we belong. "That purfuit of wealth which goes beyond the former end, viz. the obtaining the neceffaries, or fuch conveniencies of life, as, in the eftimation of reafon, not of vanity or paffion, are fuited to our rank and condition, and yet is not directed to the latter, viz. the doing good, is what we call *avarice.*" And "that purfuit of *power*, which, after fecuring one's felf, i. e. having attained the proper independence and liberty of a rational focial creature, is not directed to the good of others, is what we call *ambition*, or the *luft of power.*" To what extent the ftrict meafures of virtue will allow us to purfue either wealth or power, and civil authority, is not perhaps poffible precifely to determine. That muft be left to prudence, and the peculiar character, condition, and other circumftances of each man. Only thus far a limit may be fet, that the purfuit of either muft encroach upon no other duty or obligation which we owe to ourfelves, to fociety, or to its parent and head. The fame reafoning is to be applied to *power* as to *wealth.* It is only valuable as an inftrument of our own fecurity, and of the free enjoyment of thofe original goods it may, and often does, adminifter to us, and as an engine of more extenfive happinefs to our friends, our country, and mankind.

110 How far purfuable.

111 Avarice.

112 Ambition.

113 How fame and power are attained.

Now the beft, and indeed the only way to obtain a folid and lafting fame, is an uniform inflexible courfe of virtue, the employing one's ability and wealth in fupplying the wants, and ufing one's power in promoting or fecuring the happinefs, the rights and liberties of mankind, joined to an univerfal affability and politenefs of manners. And furely one will not miftake the matter much, who thinks the fame courfe conducive to the acquiring greater acceffions both of wealth and

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and power; especially if he adds to those qualifications a vigorous industry, a constant attention to the characters and wants of men, to the conjunctures of times, and continually varying genius of affairs; and a steady intrepid honesty, that will neither yield to the allurements, nor be overawed with the terrors, of that corrupt and corrupting scene in which we live. We have sometimes heard indeed of other ways and means, as fraud, dissimulation, servility, and prostitution, and the like ignoble arts, by which the men of the world (as they are called, shrewd politicians, and men of address!) amass wealth, and procure power; but as we want rather to form a man of virtue, an honest, contented, happy man, we leave to the men of the world their own ways, and permit them, unenvied and unimitated by us, to reap the fruit of their doings.

114 Goods of the intellect.

The next species of objects in the scale of good, are the goods of the *intellect*, as *knowledge*, *memory*, *judgement*, *taste*, *sagacity*, *docility*, and whatever else we call intellectual virtues. Let us consider them a little, and the means as well as obligations to improve them.

115 Their moment.

As *man* is a *rational* creature, capable of knowing the differences of things and actions;—as he not only sees and feels what is present, but remembers what is past, and often foresees what is future;—as he advances from small beginnings by slow degrees, and with much labour and difficulty, to knowledge and experience;—as his opinions sway his passions,—as his passions influence his conduct,—and as his conduct draws consequences after it, which extend not only to the present but to the future time, and therefore is the principal source of his happiness or misery; it is evident, that he is formed for intellectual improvements, and that it must be of the utmost consequence for him to improve and cultivate his intellectual powers, on which these opinions, those passions, and that conduct depend *.

* *Philos. Sinic. Confuc.* lib. 1. § 3, 4, &c.

116 The pleasures they give.

But besides the future consequences and moment of improving our intellectual powers, their immediate exercise on their proper objects yields the most rational and refined pleasures. Knowledge, and a right taste in the arts of *imitation* and *design*, as *poetry*, *painting*, *sculpture*, *music*, *architecture*, afford not only an innocent, but a most sensible and sublime entertainment. By

117 Knowledge and taste;

these the understanding is instructed in ancient and modern life, the history of men and things, the energies and effects of the passions, the consequences of virtue and vice; by these the imagination is at once entertained and nourished with the beauties of nature and art, lighted up and spread out with the novelty, grandeur, and harmony of the universe; and, in fine, the passions are agreeably roused, and suitably engaged, by the greatest and most interesting objects that can fill the human mind. He who has a taste formed to those ingenious delights, and plenty of materials to gratify it, can never want the most agreeable exercise and entertainment, nor once have reason to make that fashionable complaint of the tediousness of time. Nor can he want a proper subject for the discipline and improvement of his heart. For, being daily conversant with *beauty*, *order*, and *design*, in inferior subjects, he bids fair for growing in due time an admirer of what is fair and well-proportioned in the conduct of life and the order of society, which is only order and design exerted in their highest subject. He will learn to transfer the numbers of poetry to the harmony of the mind and of well-governed passions; and, from admiring the virtues of others in moral paintings, come to approve and imitate them himself. Therefore, to cultivate a *true* and *correct taste* must be both our interest and our duty, when the circumstances of our station give leisure and opportunity for it, and when the doing it is not inconsistent with our higher obligations or engagements to society and mankind.

118 How attained.

It is best attained by reading the best books, where *good sense* has more the ascendant than *learning*, and which pertain more to *practice* than to *speculation*; by studying the best models, i. e. those which profess to imitate nature most, and approach the nearest to it, and by conversing with men of the most refined taste, and the greatest experience in life.

119 Other intellectual goods;

As to the other intellectual goods, what a fund of entertainment must it be to investigate the truth and various relations of things, to trace the operations of nature to general laws, to explain by these its manifold phenomena, to understand that order by which the universe is upheld, and that economy by which it is governed! to be acquainted with the human mind, the connexions, subordinations, and uses of its powers, and to mark their energy in life! how agreeable to the ingenious inquirer, to observe the manifold relations and combinations of individual minds in society, to discern the causes why they flourish or decay, and from thence to ascend, through the vast scale of beings, to that general Mind which presides over all; and operates unseen in every system and in every age, through the whole compass and progression of nature! Devoted to such entertainments as these, the contemplative have abandoned every other pleasure, retired from the body, so to speak, and sequestered themselves from social intercourse: for these, the *busy* have often preferred to the hurry and din of life the calm retreats of contemplation; for these, when once they came to taste them, even the *gay* and *voluptuous* have thrown up the lawless pursuits of sense and appetite, and acknowledged these mental enjoyments to be the most *refined*, and indeed the *only* luxury. Besides, by a just and large knowledge of nature, we recognize the perfections of its Author; and thus piety, and all those pious affections which depend on just sentiments of his character, are awakened and confirmed; and a thousand superstitious fears, that arise from partial views of his nature and works, will of course be excluded. An extensive prospect of human life, and of the periods and revolutions of human things, will conduce much to the giving a certain greatness of mind, and a noble contempt to those little competitions about power, honour, and wealth, which disturb and divide the bulk of mankind; and promote a calm endurance of those inconveniencies and ills that are the common appendages of humanity. Add to all, that a just knowledge of human nature, and of those hinges upon which the business and fortunes of men turn, will prevent our thinking either too highly or too meanly of our fellow creatures, give no small scope to the exercise of friendship, confidence, and good will, and at the same time brace the mind with a proper caution and distrust (those nerves of prudence), and give a greater mastery in the conduct of private as well as public life. Therefore, by cultivating our intellectual abilities, we shall best

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beft promote and fecure our intereft, and be qualified for acting our part in fociety with more honour to ourfelves, as well as advantage to mankind. Confequently, to improve them to the utmoft of our power is our duty; they are talents committed to us by the Almighty Head of fociety, and we are accountable to him for the ufe of them.

120 How attained.

The intellectual virtues are beft improved by accurate and impartial obfervation, extenfive reading, and unconfined converfe with men of all characters, efpecially with thofe who, to private ftudy, have joined the wideft acquaintance with the world, and greateft practice in affairs; but, above all, by being much in the world, and having large dealings with mankind. Such opportunities contribute much to diveft one of prejudices and a fervile attachment to crude fyftems, to open one's views, and to give that experience on which the moft ufeful becaufe the moft practical knowledge is built, and from which the fureft maxims for the conduct of life are deduced.

121 Moral goods.

The higheft goods which enter into the compofition of human happinefs are *moral* goods of the mind, directly and ultimately regarding ourfelves; as *command of the appetites and paffions, prudence and caution, magnanimity, fortitude, humility, love of virtue, love of God, refignation*, and the like. Thefe fublime goods are goods by way of eminence, goods recommended and enforced by the moft intimate and awful fenfe and confcioufnefs of our nature; goods that conftitute the quinteffence, the very temper of happinefs, and form that complexion of foul which renders us approveable and lovely in the fight of God; goods, in fine, which are the elements of all our future perfection and felicity.

122 Their moment.

Moft of the other goods we have confidered depend partly on ourfelves, and partly on accidents which we can neither forefee nor prevent, and refult from caufes which we cannot influence or alter. They are fuch goods as we may poffefs to-day and lofe to-morrow, and which require a felicity of conftitution and talents to attain them in full vigour and perfection, and a felicity of conjunctures to fecure the poffeffion of them. Therefore, did our happinefs depend altogether or chiefly on fuch tranfitory and precarious poffeffions, it were itfelf moft precarious, and the higheft folly to be anxious about it. But though creatures, conftituted as we are, cannot be indifferent about fuch goods, and muft fuffer in fome degree, and confequently have our happpinefs incomplete without them, yet they weigh but little in the fcale when compared with moral goods. By the benevolent conftitution of our nature, thefe are placed within the fphere of our activity, fo that no man can be deftitute of them unlefs he is firft wanting to himfelf. Some of the wifeft and beft of mankind have wanted moft of the former goods, and all the external kind, and felt moft of the oppofite ills, fuch at leaft as arife from without; yet by poffeffing the latter, viz. the moral goods, have declared they were happy; and to the conviction of the moft impartial obfervers have appeared happy. The worft of men have been furrounded with every outward good and advantage of fortune, and have poffeffed great parts; yet for want of moral rectitude, have been, and have confeffed themfelves, notorioufly and exquifitely miferable. The exercife of virtue has fupported its votaries, and made them exult in the midft of tortures almoft intolerable; nay, how often has fome falfe form or fhadow of it fuftained even the greateft (E) villains and bigots under the fame preffures! But no external goods, no goods of fortune, have been able to alleviate the agonies or expel the fears of a guilty mind, confcious of the deferved hatred and reproach of mankind, and the juft difpleafure of Almighty God.

123 The mixed condition of human life requires particular virtues.

As the prefent condition of human life is wonderfully chequered with good and ill, and as no height of ftation, no affluence of fortune, can abfolutely enfure the good, or fecure againft the ill, it is evident that a great part of the comfort and ferenity of life muft lie in having our minds duly affected with regard to both, i. e. rightly attempered to the lofs of one and the fufferance of the other. For it is certain that outward calamities derive their chief malignity and preffure from the inward difpofitions with which we receive them. By managing thefe right, we may greatly abate that malignity and preffure, and confequently diminifh the number, and weaken the force, of the ills of life, if we fhould not have it in our power to obtain a large fhare of its goods. There are particularly three virtues which go to the forming this right temper towards ill, and which are of fingular efficacy, if not totally to remove, yet wonderfully to alleviate, the calamities of life. Thefe are *fortitude* or *patience*, *humility*, and *refignation*.

124 Fortitude.

Fortitude is that calm and fteady habit of mind which either moderates our fears, and enables us bravely to encounter the profpect of ill, or renders the mind ferene and invincible under its immediate preffure. It lies equally diftant from rafhnefs and cowardice: and though it does not hinder us from feeling, yet prevents our complaining or fhrinking under the ftroke. It always includes a generous contempt of, or at leaft a noble fuperiority to, thofe precarious goods of which we can enfure neither the poffeffion nor continuance. The man therefore who poffeffes this virtue in this ample fenfe of it, ftands upon an eminence, and fees human things below him; the tempeft indeed may reach him, but he ftands fecure and collected againft it upon the bafis of confcious virtue, which the fevereft ftorms can feldom fhake, and never overthrow.

125 Humility.

Humility is another virtue of high rank and dignity, though often miftaken by proud mortals for meannefs and pufillanimity. It is oppofed to *pride*, which commonly includes in it a falfe or overrated eftimation of our own merit, an afcription of it to ourfelves as its only and original caufe, an undue comparifon of ourfelves with others, and in confequence of that fuppofed fuperiority, an arrogant preference of ourfelves, and a fupercilious contempt of them. *Humility*, on the other hand, feems to denote that modeft and ingenuous temper of mind, which arifes from a juft and equal eftimate

(E) As Ravaillac, who affaffinated Henry IV. of France; and Balthafar Geraerd, who murdered William I. prince of Orange.

Of Man's duty to Himself. estimate of our own advantages compared with those of others, and from a sense of our deriving all originally from the Author of our being. Its ordinary attendants are mildness, a gentle forbearance, and an easy unassuming humanity with regard to the imperfections and faults of others; virtues rare indeed, but of the fairest complexion, the proper offspring of so lovely a parent, the best ornaments of such imperfect creatures as we are, precious in the sight of God, and which sweetly allure the hearts of men.

126 Resignation. *Resignation* is that mild and heroic temper of mind which arises from a sense of an infinitely wise and good providence, and enables one to acquiesce with a cordial affection in its just appointments. This virtue has something very particular in its nature, and sublime in its efficacy. For it teaches us to bear ill, not only with patience, and as being unavoidable, but it transforms, as it were, ill into good, by leading us to consider it, and every event that has the least appearance of ill, as a divine dispensation, a wise and benevolent temperament of things, subservient to universal good, and of course including that of every individual, especially of such as calmly stoop to it. In this light, the administration itself, nay every act of it, becomes an object of affection, the evil disappears, or is converted into a balm which both heals and nourisheth the mind. For though the first unexpected access of ill may surprise the soul into grief, yet that grief, when the mind calmly reviews its object, changes into contentment, and is by degrees exalted into veneration and a divine composure. Our private will is lost in that of the Almighty, and our security against every real ill rests on the same bottom as the throne of him who lives and reigns for ever.

127 Chief good, *objective* and *formal*. Before we finish this section, it may be fit to observe, that as the Deity is the supreme and inexhausted source of good, on whom the happiness of the whole creation depends; as he is the highest object in nature, and the only object who is fully proportioned to the intellectual and moral powers of the mind, in whom they ultimately rest, and find their most perfect exercise and completion; he is therefore termed the *Chief good of man*, objectively considered. And *virtue*, or the proportioned and vigorous exercise of the several powers and affections on their respective objects, as above described, is, in the schools, termed the *chief good*, formally considered, or its formal idea, being the inward temper and native constitution of human happiness.

From the detail we have gone through, the following corollaries may be deduced.

128 Corollaries. 1. It is evident, that the happiness of such a *progressive* creature as man can never be at a stand, or continue a fixed invariable thing. His finite nature, let it rise ever so high, admits still higher degrees of improvement and perfection. And his progression in improvement or virtue always makes way for a progression in happiness. So that no possible point can be assigned in any period of his existence in which he is perfectly happy, that is, so happy as to exclude higher degrees of happiness. All his perfection is only comparative. 2. It appears that many things must conspire to complete the happiness of so *various* a creature as man, subject to so many wants, and susceptible of such different pleasures. 3. As his capacities of pleasure cannot be all gratified at the same time, and must often interfere with each other in such a precarious and fleeting state as human life, or be frequently disappointed, perfect happiness, i. e. the undisturbed enjoyment of the several pleasures of which we are capable, is unattainable in our present state. 4. That state is most to be sought after, in which the fewest competitions and disappointments can happen, which least of all impairs any sense of pleasure, and opens an inexhausted source of the most refined and lasting enjoyments. 5. That state which is attended with all those advantages, is a state or course of virtue. 6. *Therefore*, a state of *virtue*, in which the moral goods of the mind are attained, is the *happiest state*.

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Chap. III. *Duties of* Society.

Sect. I. *Filial and Fraternal Duty.*

As we have followed the order of nature in tracing the history of man, and those duties which he owes to himself, it seems reasonable to take the same method with those he owes to society, which constitute the *second* class of his *obligations*.

His parents are among the earliest objects of his attention; he becomes soonest acquainted with them, repose a peculiar confidence in them, and seems to regard them with a fond affection, the early prognostics of his future *piety* and *gratitude*. Thus does nature dictate the first lines of filial duty, even before a just sense of the connexion is formed. But when the child is grown up, and has attained to such a degree of understanding, as to comprehend the *moral tie*, and be sensible of the obligations he is under to his parents; when he looks back on their tender and disinterested affection, their incessant cares and labours in nursing, educating, and providing for him, during that state in which he had neither prudence nor strength to care and provide for himself, he must be conscious that he owes to them these peculiar duties. 129 Connection of parents.

1. To reverence and honour them, as the instruments of nature in introducing him to life, and to that state of comfort and happiness which he enjoys; and therefore to esteem and imitate their good qualities, to alleviate and bear with, and spread, as much as possible, a decent veil over their faults and weaknesses. 130 Duties to parents.

2. To be highly grateful to them, for those favours which it can hardly ever be in his power fully to repay; to show this gratitude by a strict attention to their wants, and a solicitous care to supply them; by a submissive deference to their authority and advice, especially by paying great regard to it in the choice of a wife, and of an occupation; by yielding to, rather than peevishly contending with, their humours, as remembering how oft they have been persecuted by his; and, in fine, by soothing their cares, lightening their sorrows, supporting the infirmities of age, and making the remainder of their life as comfortable and joyful as possible.

As his brethren and sisters are the next with whom the creature forms a *social* and *moral* connexion, to them he owes a *fraternal* regard; and with them ought he to enter into a strict league of friendship, mutual sympathy, advice, assistance, and a generous intercourse of kind offices, remembering their relation to 131 Duties to brethren and sisters.

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to common parents, and that brotherhood of nature which unites them into a closer community of interest and affection.

SECT. II. *Concerning Marriage.*

132 Connection with the other sex.

When man arrives to a certain age, he becomes sensible of a peculiar sympathy and tenderness towards the other sex; the charms of beauty engage his attention, and call forth new and softer dispositions than he has yet felt. The many amiable qualities exhibited by a fair outside, or by the mild allurement of female manners, or which the prejudiced spectator without much reasoning supposes those to include, with several other circumstances both natural and accidental, point his view and affection to a particular object, and of course contract that general rambling regard, which was lost and useless among the undistinguished crowd, into a peculiar and permanent attachment to one woman, which ordinarily terminates in the most important, venerable, and delightful connection in life.

133 The grounds of this connection.

The state of the brute creation is very different from that of human creatures. The former are clothed and generally armed by their structure, easily find what is necessary to their subsistance, and soon attain their vigour and maturity; so that they need the care and aid of their parents but for a short while; and therefore we see that nature has assigned to them vagrant and transient amours. The connexion being purely *natural*, and merely for propagating and rearing their offspring, no sooner is that end answered, than the connexion dissolves of course. But the human race are of a more tender and defenceless constitution; their infancy and non-age continue longer; they advance slowly to strength of body and maturity of reason; they need constant attention, and a long series of cares and labours, to train them up to decency, virtue, and the various arts of life. Nature has therefore, provided them with the most affectionate and anxious tutors, to aid their weakness, to supply their wants, and to accomplish them in those necessary arts, even their own parents, on whom she has devolved this mighty charge, rendered agreeable by the most alluring and powerful of all ties, parental affection. But unless both concur in this grateful task, and continue their joint labours, till they have reared up and planted out their young colony, it must become a prey to every rude invader, and the purpose of nature in the original union of the human pair be defeated. Therefore our structure as well as condition is an evident indication, that the human sexes are destined for a more intimate, for a moral and lasting union. It appears likewise, that the principal end of marriage is not to propagate and nurse up an offspring, but to educate and form minds for the great duties and extensive destinations of life. Society must be supplied from this original nursery with useful members, and its fairest ornaments and supports.

134 Moral ends of marriage.

The mind is apt to be dissipated in its views and acts of friendship and humanity; unless the *former* be directed to a particular object, and the *latter* employed in a particular province. When men once indulge in this dissipation, there is no stopping their career; they grow insensible to moral attractions; and, by obstructing or impairing the decent and regular exercise of the tender and generous feelings of the human heart, they in time become unqualified for, or averse to, the forming a moral union of souls, which is the cement of society, and the source of the purest domestic joys. Whereas a rational, undepraved *love*, and its fair companion, *marriage*, collect a man's views, guide his heart to its proper object, and, by confining his affection to that object, do really enlarge its influence and use. Besides, it is but too evident from the conduct of mankind, that the common ties of humanity are too feeble to engage and interest the passions of the generality in the affairs of society. The connexions of neighbourhood, acquaintance, and general intercourse, are too wide a field of action for many, and those of a *public* or *community* are so for more; and in which they *either care not or know not how* to exert themselves. Therefore nature, ever wise and benevolent, by implanting that strong sympathy which reigns between the individuals of each sex, and by urging them to form a particular moral connexion, the spring of many domestic endearments, has measured out to each pair a particular *sphere of action*, proportioned to their views, and adapted to their respective capacities. Besides, by interesting them deeply in the concerns of their own little circle, she has connected them more closely with society, which is composed of particular families, and bound them down to their good behaviour in that particular community to which they belong. This *moral connexion* is *marriage*, and this *sphere of action* is a *family*.

Of the *conjugal* alliance the following are the *natural laws*. First, Mutual fidelity to the marriage bed. 135 Duties of marriage.
Disloyalty defeats the very end of marriage; dissolves the natural cement of the relation; weakens the moral tie, the chief strength of which lies in the reciprocation of affection; and by making the offspring uncertain, diminishes the care and attachment necessary to their education.

2. A conspiration of counsels and endeavours to promote the common interest of the family, and to educate their common offspring. In order to observe these laws, it is necessary to cultivate, both before and during the married state, the strictest decency and chastity of manners, and a just sense of what becomes their respective characters.

3. The union must be inviolable, and for life. The nature of friendship, and particularly of this species of it, the education of their offspring, and the order of society and of successions, which would otherwise be extremely perplexed, do all seem to require it. To preserve this union, and render the matrimonial state more harmonious and comfortable, a mutual esteem and tenderness, a mutual deference and forbearance, a communication of advice, and assistance and authority, are absolutely necessary. If either party keep within their proper departments, there need be no disputes about power or superiority, and there will be none. They have no *opposite* no *separate* interests, and therefore there can be no just ground for opposition of conduct.

From this detail, and the present state of things, in which there is pretty near a parity of numbers of both sexes, it is evident that *polygamy* is an *unnatural* state; and though it should be granted to be more fruitful of 136 Polygamy.

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of children, which however it is not found to be, yet it is by no means so fit for rearing minds, which seems to be as much, if not more, the intention of nature than the propagation of bodies.

Sect. III. *Of Parental Duty.*

137 Connection of parents and children.

The connexion of parents with their children is a natural consequence of the matrimonial connexion; and the duties which they owe them result as naturally from that connexion. The feeble state of children, subject to so many wants and dangers, requires their incessant care and attention; their ignorant and uncultivated minds demand their continual instruction and culture. Had human creatures come into the world with the full strength of *men*, and the weakness of reason and vehemence of passions which prevail in *children*, they would have been too strong or too stubborn to have submitted to the government and instruction of their parents. But as they were designed for a progression in knowledge and virtue, it was proper that the growth of their bodies should keep pace with that of their minds, lest the purposes of that progression should have been defeated. Among other admirable purposes which this gradual expansion of their outward as well as inward structure serves, this is one, that it affords ample scope to the exercise of many tender and generous affections, which fill up the domestic life with a beautiful variety of duties and enjoyments; and are of course a noble discipline for the heart, and a hardy kind of education for the more honourable and important duties of *public* life.

138 The authority founded on that connection.

The above mentioned weak and ignorant state of children seems plainly to invest their parents with such authority and power as is necessary to their support, protection, and education; but that authority and power can be construed to extend no farther than is necessary to answer those ends, and to last no longer than that weakness and ignorance continue; wherefore, the foundation or reason of the authority and power ceasing, they cease of course. Whatever power or authority then it may be necessary or lawful for parents to exercise during the non-age of their children, to assume or usurp the same when they have attained the maturity or full exercise of their strength and reason would be tyrannical and unjust. From hence it is evident, that parents have no right to punish the persons of their children more severely than the nature of their wardship requires, much less to invade their lives, to encroach upon their liberty, or transfer them as their property to any master whatsoever.

139 Duties of parents.

The first class of duties which parents owe their children respect their natural life; and these comprehend protection, nurture, provision, introducing them into the world in a manner suitable to their rank and fortune, and the like.

140 Education.

The second order of duties regards the *intellectual* and *moral* life of their children, or their education in such arts and accomplishments as are necessary to qualify them for performing the duties they owe to themselves and to others. As this was found to be the principal design of the matrimonial alliance, so the fulfilling that design is the most important and dignified of all the parental duties. In order therefore to fit the child for acting his part wisely and worthily as a *man*, as a *citizen*, and a *creature of God*, both parents ought to combine their joint wisdom, authority, and power, and each apart to employ those talents which are the peculiar excellency and ornament of their respective sex. The father ought to *lay out* and *superintend* their education, the mother to execute and manage the detail of which she is capable. The *former* should direct the manly exertion of the intellectual and moral powers of his child. His imagination, and the manner of those exertions, are the peculiar province of the *latter*. The *former* should advise, protect, command, and, by his experience, masculine vigour, and that superior authority which is commonly ascribed to his sex, brace and strengthen his pupil for *active* life, for gravity, integrity, and firmness in suffering. The business of the *latter* is to bend and soften her *male* pupil, by the charms of her conversation, and the softness and decency of her manners, for *social* life, for politeness of taste, and the elegant decorums and enjoyments of humanity; and to improve and refine the tenderness and modesty of her *female* pupil, and form her to all those mild domestic virtues which are the peculiar characteristics and ornaments of her sex: To conduct the opening minds of their sweet charge through the several periods of their progress, to assist them in each period, in throwing out the latent seeds of reason and ingenuity, and in gaining fresh accessions of light and virtue; and at length, with all these advantages, to produce the young adventurers upon the great theatre of human life, to play their several parts in the sight of their friends, of society, and mankind.

Sect. IV. *Herile and Servile Duty.*

141 The ground of this connection.

In the natural course of human affairs, it must necessarily happen that some of mankind will live in plenty and opulence, and others be reduced to a state of indigence and poverty. The former need the labours of the latter, and the latter provision and support of the former. This mutual necessity is the foundation of that connexion, whether we call it *moral* or *civil*, which subsists between masters and servants. He who feeds another has a right to some equivalent, the labour of him whom he maintains, and the fruits of it. And he who labours for another has a right to expect that he should support him. But as the labours of a man of ordinary strength are certainly of greater value than mere food and clothing; because they would actually produce more, even the maintenance of a family, were the labourer to employ them in his own behalf; therefore he has an undoubted right to rate and dispose of his service for certain wages above mere maintenance; and if he has incautiously disposed of it for the latter only, yet the contract being of the *onerous* kind, he may equitably claim a supply of that deficiency. If the service be specified, the servant is bound to that only; if not, then he is to be construed as bound only to such services as are consistent with the laws of justice and humanity. By the voluntary servitude to which he subjects himself, he forfeits no rights but such as are necessarily included in that servitude, and is obnoxious to no punishment but such as a voluntary failure in the service may be supposed reasonably to require. *The offspring of such servants* have a right to that

142 The conditions of service.

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that liberty which neither they nor their parents have forfeited.

143 The case of great offenders.

As to those who, because of some heinous offence, or for some notorious damage, for which they cannot otherwise compensate, are condemned to perpetual service, they do not, on that account, forfeit all the rights of men; but those, the loss of which is necessary to secure society against the like offences for the future, or to repair the damage they have done.

144 The case of captives.

With regard to captives taken in war, it is barbarous and inhuman to make perpetual slaves of them, unless some peculiar and aggravated circumstances of guilt have attended their hostility. The bulk of the subjects of any government engaged in war may be fairly esteemed innocent enemies; and therefore they have a right to that clemency which is consistent with the common safety of mankind, and the particular security of that society against which they are engaged. Though ordinary captives have a grant of their lives, yet to pay their liberty as an equivalent is much too high a price. There are other ways of acknowledging or returning the favour, than by surrendering what is far dearer than life itself*. To those who, under pretext of the necessities of commerce, drive the unnatural trade of bargaining for human flesh, and consigning their innocent but unfortunate fellow creatures to eternal servitude and misery, we may address the words of a fine writer; "Let avarice defend it as it will, there is an honest reluctance in humanity against buying and selling, and regarding those of our own species as our wealth and possessions."

* *Hutches Mor. Inst. Phil.* lib. iii. c. 3.

SECT. V. *Social Duties of the private Kind.*

Hitherto we have considered only the *domestic economical* duties, because these are first in the progress of nature. But as man passes beyond the little circle of a family, he forms connexions with relations, friends, neighbours, and others; from whence results a new train of duties of the more private social kind, as "friendship, chastity, courtesy, good neighbourhood, charity, forgiveness, hospitality."

145 Man's aptitude for society.

Man is admirably formed for particular social attachments and duties. There is a peculiar and strong propensity in his nature to be affected with the sentiments and dispositions of others. Men, like certain musical instruments, are set to each other, so that the vibrations or notes excited in one raise correspondent notes and vibrations in the others. The impulses of *pleasure* or *pain*, *joy* or *sorrow*, made on one mind, are by an instantaneous sympathy of nature communicated in some degree to all; especially when hearts are (as a humane writer expresses it) in *unison* of kindness; the joy that vibrates in one communicates to the other also. We may add, that though joy thus imparted swells the harmony, yet grief vibrated to the heart of a friend, and rebounding from thence in sympathetic notes, melts as it were, and almost dies away. All the passions, but especially those of the social kind, are contagious; and when the passions of one man mingle with those of another, they increase and multiply prodigiously. There is a most moving eloquence in the human countenance, air, voice, and gesture, wonderfully expressive of the most latent feelings and passions of the soul, which darts them like a subtle flame into the hearts of others, and raises correspondent feelings there: friendship, love, good humour, joy, spread through every feature, and particularly shoot from the eyes their softer and fiercer fires with an irresistible energy. And in like manner the opposite passions of hatred, enmity, ill humour, melancholy, diffuse a sullen and saddening air over the face, and, flashing from eye to eye, kindle a train of similar passions. By these, and other admirable pieces of machinery, men are formed for society and the delightful interchange of friendly sentiments and duties, to increase the happiness of others by participation, and their own by rebound; and to diminish, by dividing, the common stock of their misery.

146 Duties arising from private relation.

The first emanations of the *social* principle beyond the bounds of a family lead us to form a nearer conjunction of friendship or good will with those who are anywise connected with us by *blood* or *domestic alliance*. To them our affection does commonly exert itself in a greater or less degree, according to the nearness or distance of the relation. And this proportion is admirably suited to the extent of our powers and the indigence of our state; for it is only within those lesser circles of consanguinity or alliance that the generality of mankind are able to display their abilities or benevolence, and consequently to uphold their connexion with society, and subserviency to a public interest. Therefore it is our duty to regard these closer connexions as the next department to that of a family, in which nature has marked out for us a sphere of activity and usefulness; and to cultivate the kind affections which are the cement of these endearing alliances.

147 Ingredients of friendship.

Frequently the view of distinguishing moral qualities in some of our acquaintance may give birth to that more noble connexion we call FRIENDSHIP, which is far superior to the alliances of consanguinity. For these are of a superficial, and often of a transitory nature, of which as they hold more of *instinct* than of *reason*, we cannot give such a rational account. But *friendship* derives all its strength and beauty, and the only existence which is durable, from the qualities of the heart, or from virtuous and lovely dispositions. Or, should these be wanting, they or some shadow of them must be supposed present.—Therefore *friendship* may be described to be, "The union of two souls by means of *virtue*, the common object and cement of their mutual affection." Without virtue, or the supposition of it, friendship is only a *mercenary* league, an alliance of interest, which must dissolve of course when that interest decays or subsists no longer. It is not so much any particular passion, as a composition of some of the noblest feelings and passions of the mind. *Good sense*, a *just taste* and *love of virtue*, a *thorough candour and benignity of heart*, or what we usually call a *good temper*, and a generous sympathy of sentiments and affections, are the necessary ingredients of this virtuous connection. When it is grafted on esteem, strengthened by habit, and mellowed by time, it yields infinite pleasure, ever new and ever growing; is a noble support amidst the various trials and vicissitudes of life, and a high seasoning to most of our other enjoyments.—To form and cultivate virtuous friendship, must be very improving to the temper, as its principal *object* is *virtue*, set off with all the allurement of countenance, air,

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air, and manners, ſhining forth in the native graces of manly honeſt ſentiments and affections, and rendered *viſible* as it were to the friendly ſpectator in a conduct unaffectedly great and good; and as its principal exerciſes are the very energies of virtue, or its effect and emanations. So that wherever this amiable attachment prevails, it will exalt our admiration and attachment to virtue, and unleſs impeded in its courſe by unnatural prejudices, run out into a friendſhip to the human race. For as no one can merit, and none ought to uſurp, the ſacred name of friend, who hates mankind; ſo whoever truly loves *them*, poſſeſſes the moſt eſſential quality of a true friend.

148 Its duties.

The duties of friendſhip are a mutual eſteem of each other, unbribed by intereſt, and independent of it; a generous confidence, as far diſtant from ſuſpicion as from reſerve; an inviolable harmony of ſentiments and diſpoſitions, of deſigns and intereſts; a fidelity unſhaken by the changes of fortune; a conſtancy unalterable by diſtance of time or place; a reſignation of one's perſonal intereſt to thoſe of one's friend, and a reciprocal, unenvious, unreſerved exchange of kind offices.—But, amidſt all the exertions of this moral connexion, humane and generous as it is, we muſt remember that it operates within a narrow ſphere, and its immediate operations reſpect only the individual; and therefore its particular impulſes muſt ſtill be ſubordinate to a more public intereſt, or be always directed and controlled by the more extenſive connexions of our nature.

149 Love and chaſtity.

When our friendſhip terminates on any of the other ſex, in whom beauty or agreeableneſs of perſon and external gracefulneſs of manners conſpire to expreſs and heighten the moral charm of a tender honeſt heart, and ſweet, ingenuous, modeſt temper, lighted up by good ſenſe; it generally grows into a more ſoft and endearing attachment. When this attachment is improved by a growing acquaintance with the worth of its object, is conducted by diſcretion, and iſſues at length, as it ought to do, in the moral connexion formerly mentioned †, it becomes the ſource of many amiable duties, of a communication of paſſions and intereſts, of the moſt refined decencies, and of a thouſand nameleſs deep-felt joys of reciprocal tenderneſs and love, flowing from every look, word, and action. Here friendſhip acts with double energy, and the *natural* conſpires with the *moral* charms to ſtrengthen and ſecure the love of virtue. As the delicate nature of female honour and decorum, and the inexpreſſible grace of a chaſte and modeſt behaviour, are the ſureſt and indeed the only means of kindling at firſt, and ever after of keeping alive, this tender and elegant flame, and of accompliſhing the excellent ends deſigned by it; to attempt by fraud to violate one, or, under pretence of paſſion, to ſully and corrupt the other, and, by ſo doing, to expoſe the too often credulous and unguarded object, with a wanton cruelty, to the hatred of her own ſex and the ſcorn of ours, and to the loweſt infamy of both, is a conduct not only baſe and criminal, but inconſiſtent with that truly rational and refined enjoyment, the ſpirit and quinteſſence of which are derived from the baſhful and ſacred charms of virtue kept untainted and therefore ever alluring to the lover's heart.

† See Sect. ii. of this chapter.

150 Courteſy, good neighbourhood, &c.

Courteſy, good neighbourhood, affability, and the like duties, which are founded on our private ſocial connexions, are no leſs neceſſary and obligatory to creatures united to ſociety, and ſupporting and ſupported by each other in a chain of mutual want and dependence. They do not conſiſt in a ſmooth addreſs, an artificial or obſequious air, fawning adulations, or a polite ſervility of manners; but in a juſt and modeſt ſenſe of our own dignity and that of others, and of the reverence due to mankind, eſpecially to thoſe who hold the higher links of the ſocial chain; in a diſcreet and manly accommodation of ourſelves to the foibles and humours of others; in a ſtrict obſervance of the rules of decorum and civility; but, above all, in a frank obliging carriage, and generous interchange of good deeds rather than words. Such a conduct is of great uſe and advantage, as it is an excellent ſecurity againſt injury, and the beſt claim and recommendation to the eſteem, civility, and univerſal reſpect of mankind. This inferior order of virtues unites the particular members of ſociety more cloſely, and forms the leſſer pillars of the civil fabric; which, in many inſtances, ſupply the unavoidable defects of laws, and maintain the harmony and decorum of ſocial intercourſe, where the more important and eſſential lines of virtue are wanting.

151 Charity, forgiveneſs.

Charity and *forgiveneſs* are truly amiable and uſeful duties of the ſocial kind. There is a twofold diſtinction of rights commonly taken notice of by moral writers, viz. *perfect* and *imperfect*. To fulfil the former, is neceſſary to the being and ſupport of ſociety; to fulfil the latter, is a duty equally ſacred and obligatory, and tends to the improvement and proſperity of ſociety; but as the violation of them is not equally prejudicial to the public good, the fulfilling them is not ſubjected to the cognizance of law, but left to the candour, humanity, and gratitude of individuals. And by this means ample ſcope is given to exerciſe all the generoſity, and diſplay the genuine merit and luſtre, of virtue. Thus the wants and misfortunes of others call for our charitable aſſiſtance and ſeaſonable ſupplies. And the good man, unconſtrained by law, and uncontrolled by human authority, will cheerfully acknowledge and generouſly ſatisfy this mournful and moving claim; a claim ſupported by the ſanction of heaven, of whoſe bounties he is honoured to be the grateful truſtee. If his own *perfect* rights are invaded by the injuſtice of others, he will not therefore reject their *imperfect* right to pity and forgiveneſs, unleſs his grant of theſe ſhould be inconſiſtent with the more extenſive rights of ſociety, or the public good. In that caſe he will have recourſe to public juſtice and the laws, and even then he will proſecute the injury with no unneceſſary ſeverity, but rather with mildneſs and humanity. When the injury is merely perſonal, and of ſuch a nature as to admit of alleviations, and the forgiveneſs of which would be attended with no worſe conſequences, eſpecially of a public kind, the good man will generouſly forgive his offending brother. And it is his duty to do ſo, and not to take private revenge, or retaliate evil for evil. For though reſentment of injury is a natural paſſion, and implanted, as was obſerved * above, for wiſe and good ends; yet, conſidering the manifold partialities which moſt men have for themſelves, was every one to act as judge in

* See Part I. chap. ii. and iv.

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in his own cause, and to execute the sentence dictated by his own resentment, it is but too evident that mankind would pass all bounds in their fury, and the last sufferer be provoked in his turn to make full reprisals. So that evil, thus encountering with evil, would produce one continued series of violence and misery, and render society intolerable, if not impracticable. Therefore, where the security of the individual, or the good of the public, does not require a proportionable retaliation, it is agreeable to the general law of benevolence, and to the particular end of the passion (which is to prevent injury and the misery occasioned by it), to forgive personal injuries, or not to return evil for evil. This duty is one of the noble refinements which *Christianity* has made upon the general maxims and practice of mankind, and enforced, with a peculiar strength and beauty, by sanctions no less alluring than awful. And indeed the practice of it is generally its own reward; by expelling from the mind the most dreadful intruders upon its repose, those rancorous passions which are begot and nursed by resentment, and by disarming and even subduing every enemy one has, except such as have nothing left of men but the outward form.

152 Hospitality.

The most enlarged and humane connexion of the private kind seems to be the hospitable alliance, from which flow the amiable and disinterested duties we owe to strangers. If the exercise of passions of the most private and instinctive kind is beheld with moral approbation and delight, how lovely and venerable must those appear which result from a calm philanthropy, are founded in the common rights and connexions of society, and embrace men, not of a particular sect, party, or nation, but all in general without distinction, and without any of the little partialities of self-love.

Sect. VI. *Social Duties of the* Commercial *Kind.*

153 Commercial duties.

The next order of connexions are those which arise from the wants and weakness of mankind, and from the various circumstances in which their different situations place them. These we may call *commercial* connections, and the duties which result from them *commercial* duties, as *justice, fair-dealing, sincerity, fidelity to compacts*, and the like.

154 Their foundation.

Though nature is perfect in all her works, yet she has observed a manifest and eminent distinction among them. To all such as lie beyond the reach of human skill and power, and are properly of her own department, she has given the finishing hand. These man may design after and imitate, but he can never rival them, nor add to their beauty or perfection. Such are the forms and structure of vegetables, animals, and many of their productions, as the honey comb, the spider's web, and the like. There are others of her works which she has of design left unfinished, as it were, in order to exercise the ingenuity and power of man. She has presented to him a rich profusion of materials of every kind for his conveniency and use; but they are rude and unpolished, or not to be come at without art and labour. These therefore he must apply, in order to adapt them to his use, and to enjoy them in perfection. Thus nature hath given him an infinite variety of herbs, grains, fossils, minerals, woods, water, earth, air, and a thousand other crude materials, to supply his numerous wants. But he must sow, plant, dig, refine, polish, build, and, in short, manufacture the various produce of nature, in order to obtain even the necessaries, and much more the conveniencies and elegancies of life. These then are the price of his labour and industry, and, without that, nature will sell him nothing. But as the wants of mankind are many, and the single strength of individuals small, they could hardly find the necessaries, and much less the conveniences of life, without uniting their ingenuity and strength in acquiring these, and without a mutual intercourse of good offices. Some men are better formed for some kinds of ingenuity and labour, and others for other kinds; and different soils and climates are enriched with different productions; so that men, by exchanging the produce of their respective labours, and supplying the wants of one country with the superfluities of another, do in effect diminish the labours of each, and increase the abundance of all. This is the foundation of all commerce, or exchange of commodities and goods, one with another; in order to facilitate which, men have contrived different species of coin, or money, as a common standard by which to estimate the comparative values of their respective goods. But to render commerce sure and effectual, *justice, fair-dealing, sincerity*, and *fidelity to compacts*, are absolutely necessary.

155 Justice;

Justice or *fair-dealing*, or, in other words, a disposition to treat others as we would be treated by them, is a virtue of the first importance, and inseparable from the virtuous character. It is the cement of society, or that pervading spirit which connects its members, inspires its various relations, and maintains the order and subordination of each part of the whole. Without it, society would become a den of thieves and banditti, hating and hated, devouring and devoured, by one another.

And here it may be proper to take a view of Mr Hume's supposed case of the sensible knave and the worthless miser (N° 16), and consider what would be the duty of the former according to the theory of those moralists who hold the *will of God* to be the *criterion* or *rule*, and *everlasting happiness* the *motive* of human virtue.

156 universally a duty on the principles of those who hold the will of God to be the criterion of virtue.

It has been already observed, and the truth of the observation cannot be controverted, that, by secretly purloining from the coffers of a miser, part of that gold which there lies useless, a man might in particular circumstances promote the good of society, without doing any injury to a single individual: and it was hence inferred, that, in such circumstances, it would be no duty to abstain from theft, were *local utility* arising from *particular consequences* the real criterion or standard of justice. Very different, however, is the conclusion which must be drawn by those who consider the natural tendency of actions, if universally performed, as the criterion of their merit or demerit, in the sight of God. Such philosophers attend, not to the particular consequences of a single action in any given case, but to the general consequences of the principle from which it flows, if that principle were universally adopted. You cannot (say they) permit one action and forbid another, without showing a difference

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ference between them. The ſame ſort of actions, therefore, muſt be generally permitted or generally forbidden. But were every man allowed to aſcertain for himſelf the circumſtances in which the good of ſociety would be promoted, by ſecretly abſtracting the ſuperfluous wealth of a worthleſs miſer, it is plain that no property could be ſecure; that all incitements to induſtry would be at once removed; and that, whatever might be the *immediate* conſequences of any particular *theft*, the *general* and *neceſſary* conſequences of the *principle* by which it was authorized muſt ſoon prove fatal. Were one man to purloin part of the riches of a real miſer, and to conſider his conduct as vindicated by his intention to employ thoſe riches in acts of generoſity, another might by the ſame ſort of caſuiſtry think himſelf authorized to appropriate to himſelf part of his wealth; and thus theft would ſpread through all orders of men, till ſociety were diſſolved into ſeparate, hoſtile, and ſavage families, mutually dreading and ſhunning each other. The general conſequences, therefore, of encroaching upon private property tend evidently and violently to univerſal miſery.

On the other hand, indeed, the particular and immediate conſequences of that principle which conſiders every man's property as ſacred, may in ſome caſes, ſuch as that ſuppoſed, be in a ſmall degree injurious to a few families in the neighbourhood of the miſer and the knave. But that injury can never be of long duration; and it is infinitely more than counterbalanced by the general good conſequences of the principle from which it accidentally reſults; for theſe conſequences extend to all nations and to all ages. Without a ſacred regard to property, there could neither be arts nor induſtry nor confidence among men, and happineſs would be for ever baniſhed from this world. But the communication of happineſs being the end which God had in view when he created the world, and all men ſtanding in the ſame relation to him, it is impoſſible to ſuppoſe that he does not approve, and will not ultimately reward, thoſe voluntary actions of which the natural tendency is to increaſe the ſum of human happineſs; or that he does not diſapprove, and will not ultimately puniſh, thoſe which naturally tend to aggravate human miſery. The concluſion is, that a ſtrict adherence to the principle of juſtice is univerſally, and in all poſſible circumſtances, a duty from which we cannot deviate without offending our Creator, and ultimately bringing miſery upon ourſelves.

157 Sincerity.

Sincerity, or *veracity*, in our words and actions, is another virtue or duty of great importance to ſociety, being one of the great bands of mutual intercourſe, and the foundation of mutual truſt. Without it, ſociety would be the dominion of miſtruſt, jealouſy, and fraud, and converſation a traffic of lies and diſſimulation. It includes in it a conformity of our words with our ſentiments, a correſpondence between our actions and diſpoſitions, a ſtrict regard to truth, and an irreconcilable abhorrence of falſehood. It does not indeed require, that we expoſe our ſentiments indiſcreetly, or tell all the truth in every caſe; but certainly it does not and cannot admit the leaſt violation of truth or contradiction to our ſentiments. For if theſe bounds are once paſſed, no poſſible limit can be aſſigned where the violation ſhall ſtop, and no pretence of private or public good can poſſibly counterbalance the ill conſequences of ſuch a violation.

158 Fidelity to promiſes, compacts, &c.

Fidelity to promiſes, *compacts*, and *engagements*, is likewiſe a duty of ſuch importance to the ſecurity of commerce and interchange of benevolence among mankind, that ſociety would ſoon grow intolerable without the ſtrict obſervance of it. Hobbes, and others who follow the ſame track, have taken a wonderful deal of pains to puzzle this ſubject, and to make all the virtues of this ſort merely *artificial*, and not at all *obligatory*, antecedent to human conventions. No doubt compacts ſuppoſe people who make them; and promiſes perſons to whom they are made; and therefore both ſuppoſe ſome ſociety, more or leſs, between thoſe who enter into theſe mutual engagements. But is not a compact or promiſe binding, till men have agreed that they ſhall be binding? or are they only binding, becauſe it is our intereſt to be bound by them, or to fulfil them? Do not we highly approve the man who fulfils them, even though they ſhould prove to be againſt his intereſt? and do not we condemn him as a knave who violates them on that account? A promiſe is a voluntary declaration by words, or by an action equally ſignificant, of our reſolution to do ſomething in behalf of another, or for his ſervice. When it is made, the perſon who makes it is by all ſuppoſed under an obligation to perform it. And he to whom it is made may demand the performance as his right. That perception of *obligation* is a ſimple idea, and is on the ſame footing as our other moral perceptions, which may be deſcribed by inſtances, but cannot be defined. Whether we have a perception of ſuch obligation quite diſtinct from the intereſt, either public or private, that may accompany the fulfilment of it, muſt be referred to the conſcience of every individual. And whether the mere ſenſe of that obligation, apart from its concomitants, is not a ſufficient inducement or motive to keep one's promiſe, without having recourſe to any ſelfiſh principle of our nature, muſt be likewiſe appealed to the conſcience of every honeſt man.

159 Shown to be duties independent of the authority of the moral ſenſe.

It may, however, be not improper to remark, that in this, as in all other inſtances, our chief good is combined with our duty. "Men act from expectation. Expectation is in moſt caſes determined by the aſſurances and engagements which we receive from others. If no dependence could be placed upon theſe aſſurances, it would be impoſſible to know what judgement to form of many future events, or how to regulate our conduct with reſpect to them. Confidence, therefore, in promiſes, is eſſential to the intercourſe of human life, becauſe without it the greateſt part of our conduct would proceed upon chance. But there could be no confidence in promiſes, if men were not obliged to perform them. Thoſe, therefore, who allow not to the perceptions of the moral ſenſe all that authority which we attribute to them, muſt ſtill admit the obligation to perform promiſes; becauſe ſuch performance may be ſhown to be agreeable to the will of God, in the very ſame manner in which, upon their principles, we have ſhown the uniform practice of juſtice to be ſo.

160 What thoſe duties require.

Fair dealing and *fidelity* to *compacts* require that we take no advantage of the ignorance, paſſion, or incapacity of others, from whatever cauſe that incapacity ariſes;

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arises;—that we be explicit and candid in making bargains, just and faithful in fulfilling our part of them. And if the other party violates his engagements, redress is to be sought from the laws, or from those who are intrusted with the execution of them. In fine, the *commercial* virtues and duties require that we not only do not invade, but maintain the rights of others;—that we be fair and impartial in transferring, bartering, or exchanging property, whether in goods or service; and be inviolably faithful to our word and our engagements, where the matter of them is not criminal, and where they are not extorted by force. See PROMISE.

SECT. VII. *Social Duties of the* POLITICAL *Kind.*

We are now arrived at the last and highest order of duties respecting society, which result from the exercise of the most generous and heroic affections, and are founded on our most enlarged connexions.

161 Political connections.

The *social* principle in man is of such an expansive nature, that it cannot be confined within the circuit of a family, of friends, or a neighbourhood; it spreads into wider systems, and draws men into larger confederacies, communities, and commonwealths. It is in those only that the higher powers of our nature attain the highest improvement and perfection of which they are capable. These principles hardly find objects in the solitary state of nature. *There* the principle of action rises no higher at farthest than *natural affection* towards one's offspring. There personal or family wants entirely engross the creature's attention and labour, and allow no leisure, or, if they did, no exercise for views and affections of a more enlarged kind. In *solitude* all are employed in the same way, in providing for the *animal* life. And even after their utmost labour and care, single and unaided by the industry of others, they find but a sorry supply of their wants, and a feeble precarious security against dangers from wild beasts; from inclement skies and seasons; from the mistakes or petulant passions of their fellow creatures; from their preference of themselves to their neighbours; and from all the little exorbitancies of self-love. But in *society*, the mutual aids which men give and receive shorten the labours of each, and the combined strength and reason of individuals give security and protection to the whole body. There is both a variety and subordination of genius among mankind. Some are formed to lead and direct others, to contrive plans of happiness for individuals and of government for communities, to take in a public interest, invent laws and arts, and superintend their execution, and, in short, to refine and civilize human life. Others, who have not such good heads, may have as honest hearts, a truly public spirit, love of liberty, hatred of corruption and tyranny, a generous submission to laws, order, and public institutions, and an extensive philanthropy. And others, who have none of those capacities either of heart or head, may be well formed for manual exercises and bodily labour. The former of these principles have no scope in solitude, where a man's thoughts and concerns do all either centre in himself or extend no farther than a family; into which little circle all the duty and virtue of the solitary mortal is crowded. But society finds proper objects and exercises for every genius, and the noblest objects and exercises for the noblest geniuses, and for the highest principles in the human constitution; particularly for that warmest and most divine passion which God hath kindled in our bosoms, the inclination of doing good, and reverencing our nature; which may find here both employment and the most exquisite satisfaction. In society, a man has not only more leisure, but better opportunities, of applying his talents with much greater perfection and success, especially as he is furnished with the joint advice and assistance of his fellow creatures, who are now more closely united one with the other, and sustain a common relation to the same moral system or community. This then is an object proportioned to his most enlarged social affections; and in serving it he finds scope for the exercise and refinement of his highest intellectual and moral powers. *Therefore society*, or *a state of civil government*, rests on these two principal pillars, "That in it we find security against those evils which are unavoidable in solitude,—and obtain those goods, some of which cannot be obtained at all, and others not so well, in that state where men depend solely on their individual sagacity and industry."

From this short detail it appears, that *man* is a *social* creature, and formed for a *social* state; and that *society*, being adapted to the higher principles and destinations of his nature, must of necessity be his *natural* state.

162 Political duties.

The duties suited to that state, and resulting from those principles and destinations, or, in other words, from our social passions and social connexions, or relation to a public system, are, *love of our country, resignation, and obedience to the laws, public spirit, love of liberty, sacrifice of life and all to the public, and the like.*

163 Love of one's country.

Love of our country, is one of the noblest passions that can warm and animate the human breast. It includes all the limited and particular affections to our parents, friends, neighbours, fellow citizens, countrymen. It ought to direct and limit their more confined and partial actions within their proper and natural bounds, and never let them encroach on those sacred and first regards we owe to the great public to which we belong. Were we solitary creatures, detached from the rest of mankind, and without any capacity of comprehending a *public interest*, or without affections leading us to desire and pursue it, it would not be our duty to mind it, nor criminal to neglect it. But as we are PARTS of the *public system*, and are not only capable of taking in large views of its interests, but by the strongest affections connected with it, and prompted to take a share of its concerns, we are under the most sacred ties to prosecute its security and welfare with the utmost ardour, especially in times of public trial. This *love of our country* does not import an attachment to any particular soil, climate, or spot of earth, where perhaps we first drew our breath, though those *natural* ideas are often associated with the *moral* ones, and, like external signs or symbols, help to ascertain and bind them; but it imports an affection to that *moral system*, or *community*, which is governed by the same laws and magistrates, and whose several parts are variously connected one with the other, and all

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all united upon the bottom of a common intereſt. Perhaps indeed every member of the community cannot comprehend ſo large an object, eſpecially if it extends through large provinces, and over vaſt tracts of land; and ſtill leſs can he form ſuch an idea, if there is no *public*, i. e. if all are ſubject to the caprice and unlimited will of one man; but the preference the generality ſhow to their native country, the concern and longing after it which they expreſs when they have been long abſent from it; the labours they undertake and ſufferings they endure to ſave or ſerve it, and the peculiar attachment they have to their countrymen, evidently demonſtrate that the paſſion is *natural*, and never fails to exert itſelf when it is fairly diſengaged from foreign clogs, and is directed to its proper object. Wherever it prevails in its genuine vigour and extent, it ſwallows up all ſordid and ſelfiſh regards; it conquers the love of *eaſe*, *power*, *pleaſure*, and *wealth*; nay, when the amiable partialities of *friendſhip*, *gratitude*, *private affection*, or *regards to a family*, come in competition with it, it will teach us bravely to ſacrifice all, in order to maintain the rights, and *promote* or *defend* the honour and happineſs, of our country.

164 Reſignation and obedience to the laws, &c.

Reſignation and *obedience to the laws* and *orders* of the ſociety to which we belong, are *political* duties neceſſary to its very being and ſecurity, without which it muſt ſoon degenerate into a ſtate of licentiouſneſs and anarchy. The welfare, nay, the nature of civil ſociety, requires, that there ſhould be a ſubordination of orders, or diverſity of ranks and conditions in it;—that certain men, or orders of men, be appointed to ſuperintend and manage ſuch affairs as concern the public ſafety and happineſs;—that all have their particular provinces aſſigned them;—that ſuch a ſubordination be ſettled among them as none of them may interfere with another; and finally, that certain *rules* or *common meaſures of action* be agreed on, by which each is to diſcharge his reſpective duty to govern or be governed, and all may concur in ſecuring the order, and promoting the felicity, of the whole political body. Thoſe *rules of action* are the *laws* of the community; and thoſe different *orders* are the ſeveral officers or magiſtrates appointed by the public to explain them, and ſuperintend or aſſiſt in their execution. In conſequence of this ſettlement of things, it is the duty of each individual to obey the laws enacted; to ſubmit to the executors of them with all due deference and homage, according to their reſpective ranks and dignity, as to the keepers of the public peace, and the guardians of public liberty; to maintain his own rank, and perform the functions of his own ſtation, with diligence, fidelity, and incorruption. The ſuperiority of the *higher* orders, or the authority with which the ſtate has inveſted them, entitle them, eſpecially if they employ their authority well, to the obedience and ſubmiſſion of the *lower*, and to a proportionable honour and reſpect from all. The ſubordination of the lower ranks claims protection, defence, and ſecurity from the higher. And the laws, being ſuperior to all, require the obedience and ſubmiſſion of all, being the laſt reſort, beyond which there is no deciſion or appeal.

Public ſpirit, *heroic zeal*, *love of liberty*, and the other *political* duties, do, above all others, recommend thoſe who practiſe them to the admiration and homage of mankind; becauſe, as they are the offspring of the nobleſt minds, ſo *are they* the parents of the greateſt bleſſing to ſociety. Yet, exalted as they are, it is only in equal and free governments where they can be exerciſed and have their due effect; for there only does a true *public ſpirit* prevail, and there only is the *public good* made the ſtandard of the civil conſtitution. As the end of ſociety is the *common intereſt* and *welfare* of the people aſſociated, this end muſt of neceſſity be the *ſupreme law*, or *common ſtandard*, by which the particular rules of action of the ſeveral members of the ſociety towards each other are to be regulated. But a *common intereſt* can be no other than that which is the reſult of the *common reaſon* or *common feelings* of all. Private men, or a particular order of men, have intereſts and feelings peculiar to themſelves, and of which they may be good judges; but theſe may be ſeparate from, and often contrary to, the intereſts and feelings of the reſt of the ſociety; and therefore they can have no right to make, and much leſs to impoſe, laws on their fellow citizens, inconſiſtent with, and oppoſite to, thoſe intereſts and thoſe feelings. Therefore, a *ſociety*, *a government*, or *real public*, truly worthy the name, and not a confederacy of banditti, a clan of lawleſs ſavages, or a band of ſlaves under the whip of a maſter, muſt be ſuch a one as conſiſts of freemen, chooſing or conſenting to laws themſelves; or, ſince it often happens that they cannot aſſemble and act in a *collective body*, delegating a ſufficient number of *repreſentatives*, i. e. ſuch a number as ſhall moſt fully comprehend, and moſt equally repreſent, their *common feelings* and *common intereſts*, to digeſt and vote laws for the conduct and controul of the whole body, the moſt agreeable to thoſe common feelings and common intereſts.

Duties of Society.

165 Foundation of public ſpirit, love of liberty, &c.

166 Political duties of every citizen.

A ſociety thus conſtituted by *common reaſon*, and formed on the plan of a *common intereſt*, becomes immediately an object of public attention, public veneration, public obedience, a public and inviolable attachment, which ought neither to be ſeduced by bribes, nor awed by terrors; an object, in fine, of all thoſe extenſive and important duties which ariſe from ſo glorious a confederacy. To watch over ſuch a ſyſtem; to contribute all he can to promote its good by his reaſon, his ingenuity, his ſtrength, and every other ability, whether natural or acquired; to reſiſt, and, to the utmoſt of his power, defeat every encroachment upon it, whether carried on by a ſecret corruption or open violence; and to ſacrifice his eaſe, his wealth, his power, nay life itſelf, and, what is dearer ſtill, his family and friends, to defend or ſave it, is the duty, the honour, the intereſt, and the happineſs of every citizen; it will make him venerable and beloved while he lives, be lamented and honoured if he falls in ſo glorious a cauſe, and tranſmit his name with immortal renown to the lateſt poſterity.

167 Of the people.

As the PEOPLE are the fountain of power and authority, the original ſeat of majeſty, the authors of laws, and the creators of officers to execute them; if they ſhall find the power they have conferred abuſed by their truſtees, their majeſty violated by tyranny or by uſurpation, their authority proſtituted to ſupport violence or ſcreen corruption, the laws grown pernicious through accidents unforeſeen or unavoidable, or rendered

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rendered ineffectual through the infidelity and corruption of the executors of them; then it is their right, and what is their right is their duty, to resume that delegated power, and call their trustees to an account; to resist the usurpation, and extirpate the tyranny; to restore their sullied majesty and prostituted authority; to suspend, alter, or abrogate those laws, and punish their unfaithful and corrupt officers. Nor is it the duty only of the united body; but every member of it ought, according to his respective rank, power, and weight in the community, to concur in advancing and supporting these glorious designs.

Resistance, therefore, being undoubtedly lawful in extraordinary emergencies, the question, among good reasoners, can only be with regard to the degree of necessity which can justify resistance, and render it expedient or commendable. And here we must acknowledge, that, with Mr Hume *, "we shall always incline to their side that draw the bond of allegiance very close, and who consider an infringement of it as the last refuge in desperate cases, when the public is in the highest danger from violence and tyranny. For besides the mischiefs of a civil war, which commonly attends insurrection, it is certain, that where a disposition to rebellion appears among any people, it is one chief cause of tyranny in the rulers, and forces them into many violent measures, which, had every one been inclined to submission and obedience, they would never have embraced. Thus the *tyrannicide*, or assassination approved of by ancient maxims, instead of keeping tyrants and usurpers in awe, made them ten times more fierce and unrelenting; and is now justly abolished on that account by the laws of nations, and universally condemned, as a base and treacherous method of bringing to justice those disturbers of society."

* *Essays*, vol. i.

Chap. IV. *Duty to* God.

168 Divine connexions.

Of all the *relations* which the human mind sustains, that which subsists between the *Creator* and his *creatures*, the supreme *Lawgiver* and his *subjects*, is the highest and the best. This relation arises from the *nature* of a *creature* in general, and the *constitution* of the *human mind* in particular; the noblest powers and affections of which point to an *universal* Mind, and would be imperfect and abortive without such a direction. How lame then must that system of morals be, which leaves a *Deity* out of the question! How disconsolate, and how destitute of its firmest support!

169 Existence of God.

It does not appear, from any true history or experience of the mind's progress, that any man, by any formal deduction of his discursive power, ever reasoned himself into the belief of a God. Whether such a belief is only some *natural anticipation* of soul, or is derived from father to son, and from one man to another, in the way of *tradition*, or is suggested to us in consequence of an *immutable law of our nature*, on beholding the august aspect and beautiful order of the universe, we will not pretend to determine. What seems most agreeable to experience is, that a *sense* of its *beauty* and *grandeur*, and the *admirable fitness* of one thing to another in its vast apparatus, leads the mind *necessarily* and *unavoidably* to a perception of a *design*, or of a *designing cause*, the origin of all, by a progress as simple and natural as that by which a *beautiful picture* or a *fine building* suggests to us the idea of an *excellent artist*. For it seems to hold universally true, that wherever we discern a *tendency* or *co-operation of things towards a certain end*, or producing a common effect, there, by a necessary *law of association*, we apprehend *design*, a *designing energy* or *cause*. No matter whether the objects are *natural* or *artificial*, still that suggestion is unavoidable, and the *connexion* between the *effect* and its *adequate cause* obtrudes itself on the mind, and it requires no nice search or elaborate deduction of reason to trace or prove that connexion. We are particularly satisfied of its truth in the subject before us by a kind of direct intuition; and we do not seem to attend to the maxim we learn in schools, "That there cannot be an *infinite series* of *causes* and *effects* producing and produced by one another." That maxim is familiar only to metaphysicians; but all men of sound understanding are led to believe the existence of a God. We are conscious of our *existence*, of *thought*, *sentiment*, and *passion*, and sensible withal that these came not of ourselves; therefore we immediately recognize a *parent mind*, an *original intelligence*, from whom we borrowed those little portions of thought and activity. And while we not only feel *kind* affections in ourselves, and discover them in others, but likewise behold round us such a number and variety of creatures, endued with natures nicely adjusted to their several stations and economies, supporting and supported by each other, and all sustained by a *common order* of things, and sharing different degrees of happiness according to their respective capacities, we are naturally and necessarily led up to the Father of such a numerous offspring, the fountain of such wide-spread happiness. As we conceive this Being before all, above all, and greater than all, we naturally, and without reasoning, ascribe to him every kind of perfection, wisdom, power, and goodness without bounds, existing through all time, 170

His relation to the human mind.

and pervading all space. We apply to him those glorious epithets of our *Creator*, *Preserver*, *Benefactor*, the *supreme Lord* and *Lawgiver* of the whole society of rational and intelligent creatures. Not only the imperfections and wants of our being and condition, but some of the noblest instincts and affections of our minds, connect us with this great and universal nature. The mind, in its progress from object to object, from one character and prospect of beauty to another, finds some blemish or deficiency in each, and soon exhausts or grows weary and dissatisfied with its subject; it sees no character of excellency among men equal to that pitch of esteem which it is capable of exerting; no object within the compass of human things adequate to the strength of its affection: nor can it stay anywhere in this self expansive progress, or find repose after its highest flights, till it arrives at a Being of unbounded greatness and worth, on whom it may employ its sublimest powers without exhausting the subject, and give scope to the utmost force and fulness of its love without satiety or disgust. So that the nature of this Being corresponds to the nature of man; nor can his intelligent and moral powers obtain their entire end, but on the supposition of such a Being, and without a real sympathy and communication with him. The native propensity of the mind to reverence whatever is *great* and *wonderful* in nature, finds a proper object of homage in him who spread out the heavens and

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and the earth, and who sustains and governs the whole of things. The *admiration* of beauty, the *love* of order, and the *complacency* we feel in goodness, must rise to the highest pitch, and attain the full vigour and joy of their operations, when they unite in him who is the sum and source of all perfection.

171 Immorality of impiety. It is evident from the slightest survey of morals, that how punctual soever one may be in performing the duties which result from our relations to mankind, yet to be quite deficient in performing those which arise from our *relation* to the *Almighty*, must argue a strange perversion of *reason* or depravity of *heart*. If imperfect degrees of worth attract our veneration, and if the want of it would imply an insensibility, or, which is worse, an aversion to merit, what lameness of affection or immorality of character must it be to be unaffected with, and much more to be ill-affected to, a Being of superlative worth! To love society, or particular members of it, and yet to have no sense of our connexion with its Head, no affection to our common Parent and Benefactor; to be concerned about the approbation or censure of our fellow creatures, and yet to feel nothing of this kind towards him who sees and weighs our actions with unerring wisdom and justice, and can fully reward or punish them, betrays equal madness and partiality of mind. It is plain, therefore, beyond all doubt, that some regards are due to the great Father of all, in whom every lovely and adorable quality combines to inspire veneration and homage.

172 Right opinions of God. As it has been observed already, that our *affections* depend on our *opinions* of their objects, and generally keep pace with them, it must be of the highest importance, and seems to be among the first duties we owe to the Author of our being, "to form the least imperfect, since we cannot form perfect, conceptions of his *character* and *administration*." For such *conceptions*, thoroughly imbibed, will render our *religion* rational, and our *dispositions* refined. If our *opinions* are diminutive and distorted, our religion will be superstitious, and our temper abject. Thus, if we ascribe to the Deity that false majesty which consists in the unbenevolent and sullen exercise of mere *will* or *power*, or suppose him to delight in the prostrations of servile fear, or as servile praise, he will be worshipped with mean adulation and a profusion of compliments. Farther, If he be looked upon as a stern and implacable Being, delighting in vengeance, he will be adored with pompous offerings, sacrifices, or whatever else may be thought proper to soothe and mollify him. But if we believe *perfect goodness* to be the character of the supreme Being, and that he loves those most who resemble him most, the worship paid him will be rational and sublime, and his worshippers will seek to please him by imitating that goodness which they adore.

173 Rational faith. The foundation then of all true religion is a *rational faith*. And of a rational faith these seem to be the chief articles, to believe, "that an infinite all-perfect Mind exists, who has no opposite nor any separate interest from that of his creatures: that he superintends and governs all creatures, and things;—that his goodness extends to all his creatures, in different degrees indeed, according to their respective natures, but without any partiality or envy:—that he does every thing for the best, or in a subserviency to the perfection and happiness of the whole; particularly that he directs and governs the affairs of men, inspects their actions, distinguishes the *good* from the *bad*, loves and befriends the former, is displeased with and pities the latter in *this* world, and will according to their respective deserts reward one and punish the other in the next;—that, in fine, he is always carrying on a scheme of virtue and happiness through an unlimited duration; and is ever guiding the universe, through its successive stages and periods, to higher degrees of perfection and felicity." This is true *Theism*, the glorious scheme of divine faith; a scheme exhibited in all the works of God, and executed through his whole administration.

This faith, well founded and deeply felt, is nearly connected with a *true moral taste*, and hath a powerful efficacy on the temper and manners of the theist. He who admires goodness in others, and delights in the practice of it, must be conscious of a reigning order within, a rectitude and candour of heart, which disposes him to entertain favourable apprehensions of men, and, from an impartial survey of things, to presume that *good order* and *good meaning* prevail in the universe; and if good meaning and good order, then an *ordering*, an *intending mind*, who is no enemy, no tyrant to his creatures, but a *friend*, a *benefactor*, an *indulgent sovereign*. 174 Morality of theism.

On the other hand, a bad man, having nothing goodly or generous *to contemplate within*, no right intentions, nor honesty of heart, suspects every person and every thing; and, beholding nature through the gloom of a selfish and guilty mind, is either averse to the belief of a reigning order, or, if he cannot suppress the unconquerable anticipations of a governing mind, he is prone to tarnish the beauty of nature, and to impute malevolence, or blindness and impotence at least, to the Sovereign Ruler. He turns the universe into a forlorn and horrid waste, and transfers his own character to the Deity, by ascribing to him that uncommunicative grandeur, that arbitrary or revengeful spirit, which he affects or admires in himself. As such a temper of mind naturally leads to *atheism*, or to a *superstition* fully as bad; therefore, as far as that temper depends on the unhappy creature on whom it prevails, the propensity to atheism or superstition consequent thereto must be *immoral*. Farther, If it be true that the belief or sense of a Deity is natural to the mind, and the evidence of his existence reflected from his works so full as to strike even the most superficial observer with conviction, then the supplanting or corrupting that sense, or the want of due attention to that evidence, and, in consequence of both, a supine ignorance or affected unbelief of a Deity, must argue a bad temper or an immoral turn of mind. In the case of invincible ignorance, or a very bad education, though nothing can be concluded directly against the character; yet whenever ill passions and habits pervert the judgement, and by perverting the judgement terminate in atheism, then the case becomes plainly criminal. 175 Immorality of atheism.

But let casuists determine this as they will, a true faith in the divine character and administration is generally the consequence of a virtuous state of mind. The man who is truly and habitually good, feels the *love of order*, of *beauty*, and *goodness*, in the strongest degree; and therefore cannot be insensible to those emanations of them which appear in all the works of God, nor 176 The connection of theism and virtue.

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nor help loving their ſupreme ſource and model. He cannot but think, that he who has poured ſuch beauty and goodneſs over all his works, muſt himſelf delight in beauty and goodneſs, and what he delights in muſt be both amiable and happy. Some indeed there are, and it is pity there ſhould be any ſuch, who, through the unhappy influence of a wrong education, have entertained dark and unfriendly thoughts of the Deity and his adminiſtration, though otherwiſe of a virtuous temper themſelves. However, it muſt be acknowledged, that ſuch ſentiments have, for the moſt part, a bad effect on the temper; and when they have not, it is becauſe the undepraved affections of an honeſt *heart* are more powerful in their operation than the ſpeculative opinions of an ill-informed *head*.

177 Duties of gratitude, love, &c.

But wherever right conceptions of the Deity and his providence prevail, when he is conſidered as the inexhauſted ſource of light, and love, and joy, as acting in the joint character of a *Father* and *Governor*, imparting an endleſs variety of capacities to his creatures, and ſupplying them with every thing neceſſary to their full completion and happineſs; what veneration and gratitude muſt ſuch conceptions, thoroughly believed, excite in the mind? How natural and delightful muſt it be to one whoſe heart is open to the perception of truth, and of every thing *fair*, *great*, and *wonderful* in nature, to contemplate and adore him who is the firſt *fair*, the firſt *great*, and firſt *wonderful*; in whom *wiſdom*, *power*, and *goodneſs*, dwell vitally, eſſentially, originally, and act in perfect concert? What *grandeur* is here to fill the moſt enlarged capacity, what *beauty* to engage the moſt ardent love, what a maſs of *wonders* in ſuch exuberance of perfection to aſtoniſh and delight the human mind through an unfailing duration!

178 Other affections.

If the *Deity* is conſidered as our ſupreme *Guardian* and *Benefactor*, as the *Father of Mercies*, who loves his creatures with infinite tenderneſs, and, in a particular manner all good men, nay all who delight in goodneſs, even in its moſt imperfect degrees; what reſignation, what dependence, what generous confidence, what hope in God and his all-wiſe providence, muſt ariſe in the ſoul that is poſſeſſed of ſuch amiable views of him! All thoſe exerciſes of piety, and above all a ſuperlative eſteem and love, are directed to God as to their *natural*, their *ultimate*, and indeed their only *adequate* object; and though the immenſe obligations we have received from him may excite in us more lively feelings of divine goodneſs than a general and abſtracted contemplation of it, yet the affections of *gratitude* and *love* are of themſelves of the generous diſintereſted kind, not the reſult of ſelf-intereſt, or views of reward. A perfect character, in which we always ſuppoſe infinite goodneſs, guided by unerring wiſdom, and ſupported by almighty power, is the proper object of perfect love; which, as ſuch, we are forcibly drawn to purſue and to aſpire after. In the contemplation of the divine nature and attributes, we find at laſt what the ancient philoſophers ſought in vain, the SUPREME AND SOVEREIGN GOOD; from which all other goods ariſe, and in which they are all contained. The Deity therefore challenges our ſupreme and ſovereign love, a ſentiment which, whoſoever indulges, muſt be confirmed in the love of virtue, in a deſire to imitate its all-perfect pattern, and in a cheerful ſecurity that all his great concerns, thoſe of his friends and of the univerſe, ſhall be abſolutely ſafe under the conduct of unerring wiſdom and unbounded goodneſs. It is in his care and providence alone that the good man, who is anxious for the happineſs of all, finds perfect ſerenity; a ſerenity neither ruffled by partial ill nor ſoured by private diſappointment.

179 Repentance, &c.

When we conſider the unſtained purity and abſolute perfection of the *divine* nature, and reflect withal on the imperfection and various blemiſhes of our own, we muſt ſink, or be convinced we ought to ſink, into the deepeſt humility and proſtration of ſoul before him who is ſo wonderfully great and holy. When, further, we call to mind what low and languid feelings we have of the divine preſence and majeſty, what inſenſibility of his fatherly and univerſal goodneſs, nay, what ungrateful returns we have made to it, how far we come ſhort of the perfection of his law and the dignity of our own nature, how much we have indulged the ſelfiſh paſſions, and how little we have cheriſhed the benevolent ones; we muſt be conſcious that it is our duty to repent of a temper and conduct ſo unworthy our nature and unbecoming our obligations to its Author, and to reſolve and endeavour to act a wiſer and better part for the future.

180 Hopes of pardon.

Nevertheleſs, from the character which his works exhibit of him, from thoſe delays or alleviations of puniſhment which offenders often experience, and from the merciful tenor of his adminiſtration in many other inſtances, the ſincere penitent may entertain good hopes that his Parent and Judge will not be ſtrict to mark iniquity, but will be propitious and favourable to him, if he honeſtly endeavours to avoid his former practices, and ſubdue his former habits, and to live in a greater conformity to the divine will for the future. If any doubts or fears ſhould ſtill remain, how far it may be conſiſtent with the rectitude and equity of the divine government to let his iniquities paſs unpuniſhed, yet he cannot think it unſuitable to his paternal clemency and wiſdom to contrive a method of retrieving the penitent offender, that ſhall unite and reconcile the majeſty and mercy of his government. If reaſon cannot of itſelf ſuggeſt ſuch a ſcheme, it gives at leaſt ſome ground to expect it. But though *natural religion* cannot let in moral light and aſſurance on ſo intereſting a ſubject, yet it will teach the humble theiſt to wait with great ſubmiſſion for any farther intimations it may pleaſe the ſupreme Governor to give of his will; to examine with candour and impartiality whatever evidence ſhall be propoſed to him of a *divine revelation*, whether that evidence is *natural* or *ſupernatural*; to embrace it with veneration and cheerfulneſs, if the evidence is clear and convincing; and, finally, if it bring to light any *new relations* or *connexions*, *natural religion* will perſuade its ſincere votary faithfully to comply with the *obligations*, and perform the *duties* which reſult from thoſe relations and connexions. This is *theiſm*, *piety*, the *completion of morality*!

181 Worſhip, praiſe, thankſgiving.

We muſt farther obſerve, that all thoſe affections which we ſuppoſed to regard the Deity as their *immediate* and *primary* object, are vital energies of the ſoul, and conſequently exert themſelves into act, and, like all other energies, gain ſtrength or greater activity by that exertion. It is therefore our *duty* as well as higheſt *intereſt*, often at ſtated times, and by decent and ſolemn

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lemn acts, to contemplate and adore the great Original of our existence, the Parent of all beauty and of all good; to express our veneration and love by an awful and devout recognition of his perfections; and to evidence our gratitude by celebrating his goodness, and thankfully acknowledging all his benefits. It is likewise our duty, by proper exercises of sorrow and humiliation, to confess our ingratitude and folly; to signify our dependence on God, and our confidence in his goodness, by imploring his blessing and gracious concurrence in assisting the weakness and curing the corruptions of our nature; and, finally, to testify our sense of his authority, and our faith in his government, by devoting ourselves to do his will, and resigning ourselves to his disposal. These duties are not therefore obligatory, because the Deity needs or can be profited by them; but as they are apparently *decent* and *moral*, suitable to the relations he sustains of our *Creator*, *Benefactor*, *Lawgiver*, and *Judge;* expressive of our state and obligations; and improving to our tempers, by making us more rational, social, god-like, and consequently more happy.

182 External worship.

We have now considered INTERNAL piety, or the *worship of the mind*, that which is in spirit and in truth; we shall conclude the section with a short account of that which is EXTERNAL. *External* worship is founded on the same principles as *internal*, and of as strict moral obligation. It is either *private* or *public*. *Devotion* that is *inward*, or *purely intellectual*, is too spiritual and abstracted an operation for the bulk of mankind. The operations of their minds, such especially as are employed on the most sublime, immaterial objects, must be assisted by their outward organs, or by some help from the imagination; otherwise they will soon be dissipated by sensible impressions, or grow tiresome if too long continued. Ideas are such fleeting things, that they must be fixed; and so subtle, that they must be expressed and delineated, as it were, by sensible marks and images; otherwise we cannot attend to them, nor be much affected by them. *Therefore, verbal adoration*, *prayer*, *praise*, *thanksgiving*, and *confession*, are admirable aids to *inward* devotion, fix our attention, compose and enliven our thoughts, impress us more deeply with a sense of the awful presence in which we are, and, by a natural and mechanical sort of influence, tend to heighten those devout feelings and affections which we ought to entertain, and after this manner reduce into formal and explicit act.

183 Public worship.

This holds true in a higher degree in the case of *public* worship, where the presence of our fellow-creatures, and the powerful contagion of the *social* affections, conspire to kindle and spread the devout flame with greater warmth and energy. To conclude: As *God* is the *parent* and *head* of the *social system*, as he has formed us for a *social state*, as by *one* we find the best security against the ills of life, and in the *other* enjoy its greatest comforts, and as, by means of *both*, our nature attains its highest improvement and perfection; and moreover, as there are *public blessings* and *crimes* in which we all share in some degree, and *public wants* and *dangers* to which all are exposed—it is therefore evident, that the various and solemn offices of *public religion* are duties of indispensable moral obligation, among the best cements of society, the firmest prop of government, and the fairest ornament of both.

PART III.

CHAP. I. *Of* PRACTICAL ETHICS, *or the* CULTURE *of the* MIND.

184 Dignity and importance of the subject.

WE have now gone through a particular detail of the several duties we owe to OURSELVES, to SOCIETY, and to GOD. In considering the *first order* of duties, we just touched on the methods of acquiring the different kinds of goods which we are led by nature to pursue; only we left the consideration of the method of acquiring the *moral* goods of the mind to a chapter by itself, because of its singular importance. This chapter then will contain a brief enumeration of the arts of acquiring *virtuous habits*, and of eradicating *vicious ones*, as far as is consistent with the brevity of such a work: a subject of the utmost difficulty as well as importance in morals; to which, nevertheless, the least attention has been generally given by *moral* writers. This will properly follow a detail of duty, as it will direct us to such *means* or *helps* as are most necessary and conducive to the practice of it.

185 Sensible ideas and sensible taste.

In the first part of this inquiry we traced the order in which the passions shoot up in the different periods of human life. That order is not accidental, or dependent on the caprice of men, or the influence of custom and education, but arises from the original constitution and laws of our nature; of which this is one, viz. "That sensible objects make the first and strongest impressions on the mind." These, by means of our outward organs, being conveyed to the mind, become objects of its attention, on which it reflects when the outward objects are no longer present, or, in other words when the impressions upon the outward organs cease These objects of the mind's reflection are called *ideas* or *notions*. Towards these, by another law of our nature, we are not altogether indifferent; but correspondent movements of *desire* or *aversion*, *love* or *hatred*, arise, according as the objects which they denote made an agreeable or disagreeable impression on our organs. Those *ideas* and *affections* which we experience in the *first* period of life, we refer to the *body*, or to *sense;* and the *taste*, which is formed towards them, we call a *sensible*, or a merely *natural taste;* and the objects corresponding to them we in general call *good* or *pleasant*.

186 Ideas of beauty and a fine taste.

But as the mind moves forward in its course, it extends its views, and receives a new and more *complex* set of ideas, in which it observes *uniformity*, *variety*, *similitude*, *symmetry of parts*, *reference to an end*, *novelty*, *grandeur*. These compose a vast train and diversity of *imagery*, which the mind compounds, divides, and moulds into a thousand forms, in the absence of those objects which first introduced it. And this more complicated imagery suggests a new train of *desires* and

affections,

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affections, full as sprightly and engaging as any which have yet appeared. This whole class of *perceptions* or *impressions* is referred to the *imagination*, and forms a higher taste than the *sensible*, and which has an immediate and mighty influence on the *finer* passions of our nature, and is commonly termed a *fine taste*.

The objects which correspond to this taste we use to call *beautiful*, *great*, *harmonious*, or *wonderful*, or in general by the name of *beauty*.

187 Moral ideas and a moral taste.

The mind, still pushing onwards and increasing its stock of ideas, ascends from those to a higher species of objects, viz. the *order* and *mutual relations* of *minds* to each other, their reciprocal *affections*, *characters*, *actions*, and various *aspects*. In these it discovers a *beauty*, a *grandeur*, a *decorum*, more interesting and alluring than in any of the former kinds. These objects, or the notions of them, passing in review before the mind, do, by a necessary law of our nature, call forth another and nobler set of affections, as *admiration*, *esteem*, *love*, *honour*, *gratitude*, *benevolence*, and others of the like tribe. This class of *perfections*, and their correspondent *affections*, we refer, because of their objects (*manners*), to a *moral* sense, and call the *taste* or *temper* they excite, *moral*. And the objects which are agreeable to this *taste* or *temper* we denominate by the general name of *moral beauty*, in order to distinguish it from the other, which is termed *natural*.

188 Sources of association.

These different sets of *ideas* or *notions* are the materials about which the mind employs itself, which it blends, ranges, and diversifies ten thousand different ways. It feels a strong propension to connect and associate those ideas among which it observes any *similitude* or any *aptitude*, whether *original* and *natural*, or *customary* and *artificial*, to suggest each other. See METAPHYSICS.

189 Laws of association.

But whatever the reasons are, whether *similitude*, *coexistence*, *causality*, or any other *aptitude* or *relation*, why any two or more ideas are connected by the mind at first, it is an established law of our nature, "that when two or more ideas have often started in company, they form so strong an union, that it is very difficult ever after to separate them." Thus the *lover* cannot separate the idea of *merit* from his *mistress*; the *courtier* that of *dignity* from his *title* or *ribbon*; the *miser* that of *happiness* from his *bags*. It is these associations of *worth* or *happiness* with any of the different sets of *objects* or *images* before specified that form our *taste* or *complex idea* of *good*. By another law of our nature, "our *affections* follow and are governed by this *taste*. And to these *affections* our *character* and *conduct* are similar and proportioned on the general tenor of which our *happiness* principally depends."

190 Leading passions follow taste.

As all our *leading* passions then depend on the direction which our *taste* takes, and as it is always of the same strain with our *leading* associations, it is worth while to inquire a little more particularly how these are formed, in order to detect the secret sources from whence our passions derive their principal strength, their various rises and falls. For this will give us the true key to their management, and let us into the right method of correcting the *bad* and improving the *good*.

191 The importance and use of the imagination.

No kind of objects make so powerful an impression on us as those which are immediately impressed on our *senses*, or strongly painted on our *imaginations*. Whatever is purely *intellectual*, as abstracted or scientific truths, the subtle relations and differences of things, has a fainter sort of existence in the mind; and though it may exercise and whet the *memory*, the *judgement*, or the *reasoning power*, gives hardly any impulse at all to the *active* powers, the *passions*, which are the main springs of motion. On the other hand, were the mind entirely under the direction of *sense*, and impressible only by such objects as are present, and strike some of the outward organs, we should then be precisely in the state of the brute creation, and be governed solely by *instinct* or *appetite*, and have no power to control whatever impressions are made upon us: Nature has therefore endued us with a *middle faculty*, wonderfully adapted to our *mixed* state, which holds partly of *sense* and partly of *reason*, being strongly allied to the *former*, and the common receptacle in which all the notices that come from that quarter are treasured up; and yet greatly subservient and ministerial to the *latter*, by giving a body, a coherence, and beauty to its conceptions. This *middle* faculty is called the *imagination*, one of the most busy and fruitful powers of the mind. Into this common storehouse are likewise carried all those *moral forms* which are derived from our *moral faculties* of perception; and there they often undergo new changes and appearances, by being mixed and wrought up with the ideas and forms of *sensible* or *natural* things. By this coalition of imagery, *natural beauty* is dignified and heightened by *moral qualities* and *perfections*, and *moral qualities* are at once exhibited and set off by *natural beauty*. The *sensible* beauty, or good, is refined from its dross by partaking of the *moral*; and the *moral* receives a stamp, a visible character and currency, from the *sensible*.

192 Its energy in various instances in heightening sensible pleasures;

As we are first of all accustomed to *sensible* impressions and *sensible* enjoyments, we contract early a *sensual relish* or *love of pleasure*, in the lower sense of the word. In order, however, to justify this relish, the mind, as it becomes open to *higher* perceptions of *beauty* and *good*, borrows from thence a noble set of *images*, as *fine taste*, *generosity*, *social affections*, *friendship*, *good fellowship*, and the like; and, by dressing out the old pursuits with these new ornaments, gives them an additional dignity and lustre. By these ways the *desire of a table*, *love of finery*, *intrigue* and *pleasure*, are vastly increased beyond their natural pitch, having an impulse combined of the force of the *natural* appetites, and of the superadded strength of those *passions* which tend to the *moral species*.

193 in heightening the pleasures of beauty, harmony, &c.

When the mind becomes more sensible to those objects or appearances in which it perceives *beauty*, *uniformity*, *grandeur*, and *harmony*, as fine clothes, elegant furniture, plate, pictures, gardens, houses, equipage, the beauty of animals, and particularly the attractions of the sex; to these objects the mind is led by *nature* or taught by *custom*, the *opinion* and example of others, to annex certain ideas of *moral character*, *dignity*, *decorum*, *honour*, *liberality*, *tenderness*, and *active* or *social enjoyment*. The consequence of this association is, that the objects to which these are annexed must rise in their value, and be pursued with proportionable ardour. The *enjoyment* of them is often attended with *pleasure*; and the mere *possession* of them, where that is wanting, frequently draws respect from one's fellow-creatures: This *respect* is, by many, thought equivalent to the pleasure of *enjoyment*. Hence it it happens that the idea of *happineſs* is connected with the mere *poſſeſſion*, which is therefore eagerly ſought after without any regard to the *generous uſe* or *honourable enjoyment*. Thus the paſſion, reſting on the *means*, not the end, i. e. loſing ſight of its *natural* object, becomes wild and extravagant.

194 in raiſing the value of external ſymbols, &c.

In fine, any *object*, or *external denomination*, a *ſtaff*, a *garter*, a *cup*, a *crown*, a *title*, may become a *moral* badge or emblem of *merit*, *magnificence*, or *honour*, according as theſe have been found or thought, by the poſſeſſors or admirers of them, to accompany them; yet, by the deception formerly mentioned, the *merit* or the *conduct* which entitled, or ſhould entitle, to thoſe marks of diſtinction, ſhall be forgot or neglected, and the *badges* themſelves be paſſionately affected or purſued, as including every excellency. If theſe are attained by any means, all the concomitants which *nature*, *cuſtom*, or *accidents* have joined to them, will be ſuppoſed to follow of courſe. Thus, *moral ends* with which the unhappy admirer is apt to colour over his paſſion and views will, in his opinion, juſtify the moſt *immoral means*, as *proſtitution*, *adulation*, *fraud*, *treachery*, and every ſpecies of *knavery*, whether more open or more diſguiſed.

195 in heightening the value of wealth, power, &c.

When men are once engaged in *active* life, and find that *wealth* and *power*, generally called INTEREST, are the great avenues to every kind of enjoyment, they are apt to throw in many engaging *moral forms* to the object of their purſuit, in order to juſtify their paſſion, and varniſh over the meaſures they take to gratify it, as *independency on the vices* or *paſſions* of others, *proviſion* and *ſecurity to themſelves* and *friends*, *prudent economy* or *well-placed charity*, *ſocial communication*, *ſuperiority to their enemies*, who are all villains, *honourable ſervice*, and many other ingredients of *merit*. To attain ſuch capacities of *uſefulneſs* or *enjoyment*, what arts, nay what meanneſſes, can be thought blameable by thoſe cool purſuers of intereſt?—Nor have they whom the gay world is pleaſed to indulge with the title of *men of pleaſure*, their imaginations leſs pregnant with *moral images*, with which they never fail to ennoble, or, if they cannot do that, to palliate their groſs purſuits. Thus *admiration of wit*, of *ſentiments* and *merit*, *friendſhip*, *love*, *generous ſympathy*, *mutual confidence*, *giving* and *receiving pleaſure*, are the ordinary ingredients with which they ſeaſon their gallantry and pleaſurable entertainments; and by which they impoſe on themſelves, and endeavour to impoſe on others, that *their amours* are the joint iſſue of good ſenſe and virtue.

196 Its influence on all the paſſions.

Theſe *aſſociations*, variouſly combined and proportioned by the *imagination*, form the chief *private* paſſions, which govern the lives of the generality, as the *love of action*, of *pleaſure*, *power*, *wealth*, and *fame*; they influence the *defenſive*, and affect the *public paſſions*, and raiſe *joy* or *ſorrow* as they are gratified or diſappointed. So that in effect theſe aſſociations of *good* and *evil*, *beauty* and *deformity*, and the paſſions they raiſe, are the main *hinges of life* and *manners*, and the great *ſources* of our *happineſs* or *miſery*. It is evident, therefore, that the whole of *moral culture* muſt depend on giving a right direction to the *leading paſſions*, and duly proportioning them to the *value* of the *objects* or *goods* purſued, under what name ſoever they may appear.

Now, in order to give them this *right direction* and *due proportion*, it appears, from the foregoing detail, that thoſe *aſſociations* of ideas, upon which the paſſions depend, muſt be *duly* regulated; that is to ſay, as an exorbitant paſſion for *wealth*, *pleaſure*, or *power*, flows from an *aſſociation* or *opinion*, that more *beauty* and *good*, whether *natural* or *moral*, enters into the enjoyment or poſſeſſion of them, than really belongs to either; *therefore*, in reſtoring thoſe paſſions to their juſt proportion, we muſt begin with correcting the *opinion*, or breaking the *falſe aſſociation*, or, in other words, we muſt decompound the *complex phantom* of *happineſs* or *good*, which we fondly admire; diſunite thoſe ideas that have no natural alliance; and ſeparate the *original* idea of *wealth*, *power*, or *pleaſure*, from the foreign mixtures incorporated with it, which enhance its value, or give it its chief power to enchant and ſeduce the mind. For inſtance, let it be conſidered how poor and inconſiderable a thing *wealth* is, if it be disjoined from *real uſe*, or from ideas of *capacity* in the poſſeſſor to *do good*, from *independence*, *generoſity*, *proviſion for a family* or *friends*, and *ſocial communication* with others. By this *ſtandard* let its true value be fixed; let its miſapplication, or unbenevolent enjoyment, be accounted ſordid and infamous; and nothing worthy or eſtimable be aſcribed to the *mere poſſeſſion* of it, which is not borrowed from its *generous uſe*.

197 Moral culture, by correcting our taſte or imaginations;

198 by ſelf denial, and a counter-proceſs;

If that *complex* form of *good* which is called *pleaſure* engage us, let it be analyzed into its conſtituent principles, or thoſe allurements it draws from the *heart* and *imagination*, in order to heighten the low part of the indulgence; let the *ſeparate* and *comparative* moment of each be diſtinctly aſcertained and deduced from that groſs part, and this remainder of the accumulated enjoyment will dwindle down into a poor, inſipid, tranſitory thing. In proportion as the *opinion* of the *good* purſued abates, the *admiration* muſt decay, and the *paſſions* loſe ſtrength of courſe. One effectual way to lower the *opinion*, and conſequently to weaken the habit founded upon it, is to practiſe leſſer pieces of ſelf-denial, or to abſtain, to a certain pitch, from the purſuit or enjoyment of the favourite object; and, that this may be the more eaſily accompliſhed, one muſt avoid thoſe occaſions, that company, thoſe places, and the other circumſtances, that inflamed *one* and endeared the *other*. And, as a *counter-proceſs*, let *higher* or even *different* enjoyments be brought in view, other paſſions played upon the former, different places frequented, other exerciſes tried, company kept with perſons of a different or more correct way of thinking both in *natural* and *moral* ſubjects.

199 by a ſound and natural education.

As much depends on our ſetting out well in life, let the *youthful* fancy, which is apt to be very florid and luxuriant, be early accuſtomed by *inſtruction*, *example*, and ſignificant *moral exerciſes*, nay, by looks, geſtures, and every other teſtimony of juſt approbation or blame, to annex ideas of *merit*, *honour*, and *happineſs*, not to *birth*, *dreſs*, *rank*, *beauty*, *fortune*, *power*, *popularity*, and the like *outward* things, but to *moral* and *truly virtuous qualities*, and to thoſe *enjoyments* which ſpring from a well-informed judgement and a regular conduct of the affections, eſpecially thoſe of the *ſocial* and *diſintereſted* kind. Such dignified forms of *beauty* and *good*, often ſuggeſted, and, by moving pictures and examples warmly recommended to the *imagination*, enforced by the authority of *conſcience*, and demonſtrated by *reaſon* to be the

the ſureſt means of enjoyment, and the only independent, undeprivable, and durable goods, will be the beſt counterbalance to meaner paſſions, and the firmeſt foundation and ſecurity of virtue.

200 by rightly ſtudying human nature;

It is of great importance to the forming a *juſt taſte*, or pure and large conceptions of happineſs, to ſtudy and underſtand *human nature* well, to remember what a complicated ſyſtem it is, particularly to have deeply imprinted on our mind that GRADATION of *ſenſes*, *faculties*, and *powers of enjoyment* formerly mentioned, and the *ſubordination* of *goods* reſulting from thence, which nature points out, and the experience of mankind confirms. Who, when they think ſeriouſly, and are not under the immediate influence of ſome violent prejudice or paſſion, prefer not the pleaſures of *action*, *contemplation*, *ſociety*, and moſt *exerciſes* and *joys* of the *moral* kind, as *friendſhip*, *natural affection*, and the like, to all *ſenſual* gratifications whatſoever? Where the different ſpecies of pleaſure are blended into *one complex form*, let them be accurately diſtinguiſhed, and be referred each to its proper *faculty* and *ſenſe*, and examined apart what they have peculiar, what common with others, and what foreign and adventitious.

201 by comparing the moment and abatements of different goods;

Let *wealth*, *grandeur*, *luxury*, *love*, *fame*, and the like, be tried by this teſt, and their true alloy will be found out. Let it be further conſidered, whether the mind may not be eaſy and enjoy itſelf greatly, though it want many of thoſe elegancies and ſuperfluities of life which ſome poſſeſs, or that load of wealth and power which others eagerly purſue, and under which they groan. Let the difficulty of attaining, the precariouſneſs of poſſeſſing, and the many abatements in enjoying overgrown wealth and envied greatneſs, of which the weary poſſeſſors ſo frequently complain, as the hurry of buſineſs, the burden of company, of paying attendance to the *few*, and giving it to *many*, the cares of keeping, the fears of loſing, and the deſires of increaſing what they have, and the other troubles which accompany this pitiful drudgery and pompous ſervitude; let theſe and the like circumſtances be often conſidered, that are conducive to the removing or leſſening the *opinion* of ſuch goods, and the attendant *paſſion* or *ſet* of *paſſions* will decay of courſe.

202 by obſerving our own bent and character, &c.

Let the peculiar bent of our nature and character be obſerved, whether we are moſt inclined to form aſſociations and reliſh objects of the *ſenſible*, *intellectual*, or *moral* kind. Let that which has the aſcendant be particularly watched; let it be directed to right objects, be improved by proportioned exerciſes, and guarded by proper checks from an oppoſite quarter. Thus the *ſenſible* turn may be exalted by the *intellectual*, and a taſte for the beauty of the *fine arts*, and both may be made ſubſervient to convey and rivet ſentiments highly *moral* and *public ſpirited*. This inward ſurvey muſt extend to the *ſtrength* and *weakneſſes* of one's *nature*, one's *conditions*, *connexions*, *habitudes*, *fortunes*, *ſtudies*, *acquaintance*, and the other circumſtances of one's life, from which every man will form the juſteſt eſtimate of his own diſpoſitions and character, and the beſt rules for correcting and improving them. And in order to do this with more advantage, let thoſe *times* or *critical ſeaſons* be watched when the mind is beſt diſpoſed towards a change; and let them be improved by rigorous *reſolutions*, *promiſes*, or whatever elſe will engage the mind to perſevere in virtue. Let the *conduct*, in fine, be often reviewed, and the *cauſes* of its *corruption* or *improvement* be carefully obſerved.

203 by frequent moral exerciſes.

It will greatly conduce to refine the *moral taſte* and ſtrengthen the *virtuous temper*, to accuſtom the mind to the frequent exerciſe of *moral ſentiments* and *determinations*, by reading *hiſtory*, *poetry*, particularly of the *pictureſque* and *dramatic* kind, the ſtudy of the *fine arts*; by converſing with the moſt eminent for good ſenſe and virtue; but above all, by frequent and repeated acts of *humanity*, *compaſſion*, *friendſhip*, *politeneſs*, and *hoſpitality*. It is exerciſe that gives health and ſtrength. He that reaſons moſt frequently becomes the wiſeſt, and moſt enjoys the pleaſures of wiſdom. He who is moſt often affected by objects of compaſſion in poetry, hiſtory, or real life, will have his ſoul moſt open to pity, and its delightful pains and duties. So he alſo who practiſes moſt diligently the offices of kindneſs and charity, will by it cultivate that diſpoſition from whence all his pretenſions to perſonal merit muſt ariſe, his preſent and his future happineſs.

204 by an honeſt employment;

An uſeful and honourable employment in life will adminiſter a thouſand opportunities of this kind, and greatly ſtrengthen a ſenſe of virtue and good affections, which muſt be nouriſhed by right training, as well as our underſtandings. For ſuch an employment, by enlarging one's experience, giving a habit of attention and caution, or obliging one, from neceſſity or intereſt, to keep a guard over the paſſions, and ſtudy the outward decencies and appearances of virtue, will by degrees produce good habit, and at length inſinuate the love of virtue and honeſty for its own ſake.

205 by viewing men and manners in a fair light;

It is a great inducement to the exerciſe of benevolence to view *human nature* in a favourable light, to obſerve the characters and circumſtances of mankind on the *faireſt* ſides, to put the beſt conſtructions on their actions they will bear, and to conſider them as the reſult of *partial* and *miſtaken* rather than *ill* affections, or, at worſt, as the exceſſes of a pardonable ſelf-love, ſeldom or never the effect of pure malice.

206 by conſideration and pious exerciſes.

Above all, the *nature* and *conſequences* of *virtue* and *vice*, their conſequences being the law of our nature and will of heaven; the light in which they appear to our ſupreme *Parent* and *Lawgiver*, and the reception they will meet with from him, muſt be often attended to. The exerciſes of *piety*, as *adoration* and *praiſe* of the *divine* excellency, *invocation* of and *dependence* on his aid, *confeſſion*, *thankſgiving*, and *reſignation*, are habitually to be indulged, and frequently performed, not only as *medicinal*, but highly *improving* to the temper.

207 by juſt views of human life, and its connection with a future.

To conclude: It will be of admirable efficacy towards eradicating *bad* habits, and implanting *good* ones, frequently to contemplate *human life* as the great *nurſery* of our *future* and *immortal exiſtence*, as that *ſtate* of *probation* in which we are to be *educated* for a *divine life*; to remember, that our *virtues* or *vices* will be *immortal* as ourſelves, and influence our *future* as well as our *preſent* happineſs—and therefore, that every diſpoſition and action is to be regarded as pointing beyond the *preſent* to an *immortal* duration.—An habitual attention to this wide and important *connexion* will give a vaſt compaſs and dignity to our ſentiments and actions, a no-

Motives to Virtue. ble ſuperiority to the pleaſures and pains of life, and a generous ambition to make our *virtue* as *immortal* as our *being*.

Chap. II. *Motives to* Virtue *from Perſonal* Happiness.

208 Motives from perſonal happineſs.

We have already conſidered our *obligations* to the practice of *virtue*, ariſing from the *conſtitution* of our nature, by which we are led to *approve* a certain *order* and *economy* of *affections*, and a certain *courſe of action* correſpondent to it *. But, beſides this, there are ſeveral motives which ſtrengthen and ſecure virtue, though not themſelves of a *moral* kind. Theſe are, its *tendency to perſonal happineſs*, and the *contrary tendency of vice*. "Perſonal happineſs ariſes either from the ſtate of a man's own mind, or from the ſtate and diſpoſition of external cauſes towards him."

* *Vide* Part I. chap. i. ii. &c.

209 Happineſs of virtue from within.

We ſhall firſt examine the "tendency of virtue to happineſs with reſpect to the ſtate of a man's own mind." This is a point of the utmoſt conſequence in morals, becauſe, unleſs we can convince ourſelves, or ſhow to others, that, by doing our *duty*, or fulfilling our *moral obligations*, we conſult the greateſt ſatisfaction of our own mind, or our higheſt intereſt on the whole, it will raiſe ſtrong and often unſurmountable prejudices againſt the practice of virtue, eſpecially whenever there ariſe any appearances of *oppoſition* between our *duty* and our *ſatisfaction* or *intereſt*. To creatures ſo deſirous of happineſs, and averſe to miſery, as we are, and often ſo oddly ſituated amidſt contending paſſions and intereſts, it is neceſſary that virtue appear not only an *honourable* but a *pleaſing* and *beneficent* form. And in order to juſtify our choice to ourſelves as well as before others, we muſt ourſelves feel and be able to avow in the face of the whole world, that her ways are ways of pleaſantneſs, and her paths the paths of peace. This will ſhow, beyond all contradiction, that we not only approve, but can give a ſufficient reaſon for what we do.

210 Influence of vice on the temper of the mind.

Let any man in a cool hour, when he is diſengaged from buſineſs, and undiſturbed by paſſion (as ſuch cool hours will ſometimes happen), ſit down, and ſeriouſly reflect with himſelf what ſtate or temper of mind he would chooſe to feel and indulge, in order to be eaſy and to enjoy himſelf. Would he chooſe, for that purpoſe, to be in a conſtant diſſipation and hurry of thought; to be diſturbed in the exerciſe of his reaſon; to have various and often interfering phantoms of good playing before his imagination, ſoliciting and diſtracting him by turns, now ſoothing him with amuſing hopes, then torturing him with anxious fears; and to approve this minute what he ſhall condemn the next? Would he chooſe to have a ſtrong and painful ſenſe of every petty injury; quick apprehenſions of every impending evil; inceſſant and inſatiable deſires of power, wealth, honour, pleaſure; an irreconcilable antipathy againſt all competitors and rivals; inſolent and tyrannical diſpoſitions to all below him; fawning, and at the ſame time envious, diſpoſitions to all above him; with dark ſuſpicions and jealouſies of every mortal? Would he chooſe neither to love nor be beloved of any; to have no friend in whom to confide, or with whom to interchange his ſentiments or deſigns; no favourite, on whom to beſtow his kindneſs, or vent his paſſions; in fine, to be conſcious of no merit with mankind, no eſteem from any creature, no good affection to his Maker, no concern for, nor hopes of, his approbation; but, inſtead of all theſe, to hate, and know that he is hated, to condemn, and know that he is condemned by all; by the good, becauſe he is ſo unlike; and by the bad becauſe he is ſo like themſelves; to hate or to dread the very Being that made him; and, in ſhort, to have his breaſt the ſeat of pride and paſſion, petulance and revenge, deep melancholy, cool malignity, and all the other furies that ever poſſeſſed and tortured mankind?—Would our calm inquirer after happineſs pitch on ſuch a ſtate, and ſuch a temper of mind, as the moſt likely means to put him in poſſeſſion of his deſired eaſe and ſelf-enjoyment?

From Happineſs.

211 Influence of virtue on the temper.

Or would he rather chooſe a ſerene and eaſy flow of thought; a reaſon clear and compoſed; a judgement unbiaſſed by prejudice, and undiſtracted by paſſion; a ſober and well-governed fancy, which preſents the images of things true, and unmixed with deluſive and unnatural charms, and therefore adminiſters no improper or dangerous fuel to the paſſions, but leaves the mind free to chooſe or reject, as becomes a reaſonable creature; a ſweet and ſedate temper, not eaſily ruffled by hopes or fears, prone neither to ſuſpicion nor revenge, apt to view men and things in the faireſt lights, and to bend gently to the humours of others rather than obſtinately to contend with them? Would he chooſe ſuch moderation and continence of mind, as neither to be ambitious of *power*, fond of *honours*, covetous of *wealth*, nor a ſlave to *pleaſure;* a mind of courſe neither elated with ſucceſs, nor dejected with diſappointment; ſuch a modeſt and noble ſpirit as ſupports power without inſolence, wears honour without pride, uſes wealth without profuſion or parſimony; and rejoices more in giving than in receiving pleaſure; ſuch fortitude and equanimity as riſes above misfortunes, or turns them into bleſſings; ſuch integrity and greatneſs of mind, as neither flatters the vices, nor triumphs over the follies of men; as equally ſpurns ſervitude and tyranny, and will neither engage in low deſigns, nor abet them in others? Would he chooſe, in fine, ſuch mildneſs and benignity of heart as takes part in all the joys, and refuſes none of the ſorrows, of others; ſtands well affected to all mankind; is conſcious of meriting the eſteem of all, and of being beloved by the beſt; a mind which delights in doing good without any ſhow, and yet arrogates nothing on that account; rejoices in loving and being beloved by its Maker, acts ever under his eye, reſigns itſelf to his providence, and triumphs in his approbation? Which of theſe diſpoſitions would be his choice in order to be contented, ſerene, and happy? The *former* temper is vice, the *latter* virtue. Where *one* prevails, there misery prevails, and by the generality is acknowledged to prevail. Where the *other* reigns, there happiness reigns, and by the confeſſion of mankind is acknowledged to reign. The *perfection* of either temper is *miſery* or *happineſs in perfection*.—Therefore, every *approach* to *either extreme* is an *approach to miſery* or to *happineſs;* i. e. every *degree* of *vice* or *virtue* is accompanied with a *proportionable degree* of *miſery* or *happineſs*.

212 The alleviations of his ills.

The principal alleviations of a virtuous man's calamities are theſe;—That though ſome of them may have

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have been the effect of his imprudence or weakness, yet few of them are sharpened by a sense of guilt, and none of them by a consciousness of wickedness, which surely is their keenest sting;—that they are common to him with the best of men;—that they seldom or never attack him quite unprepared, but rather guarded with a consciousness of his own sincerity and virtue, with a faith and trust in Providence, and a firm resignation to its perfect orders;—that they may be improved as means of correction, or materials to give scope and stability to his virtues;—and, to name no more, they are considerably lessened, and often sweetened to him, by the general sympathy of the wise and good.

213 His enjoyments.

His enjoyments are more numerous, or, if less numerous, yet more intense than those of the bad man: for he shares in the joys of others by rebound; and every increase of *general* or *particular* happiness is a real addition to his own. It is true, his friendly *sympathy* with others subjects him to some pains which the hard-hearted wretch does not feel; yet to give a loose to it, is a kind of agreeable discharge. It is such a sorrow as he loves to indulge; a sort of pleasing anguish that sweetly melts the mind, and terminates in a self-approving joy. Though the good man may want means to execute, or be disappointed in the success of, his benevolent purposes; yet, as was formerly † observed, he is still conscious of good affection, and that consciousness is an enjoyment of a more delightful savour than the greatest triumphs of successful vice. If the *ambitious*, *covetous*, or *voluptuous*, are disappointed, their passions recoil upon them with a fury proportioned to their opinion of the value of what they pursue, and their hope of success; while they have nothing within to balance the disappointment, unless it is an useless fund of pride, which, however, *frequently* turns mere accidents into mortifying affronts, and exalts grief into rage and frenzy. Whereas the meek, humble, and benevolent temper, is its own reward, is satisfied from within; and, as it magnifies greatly the pleasure of success, so it wonderfully alleviates, and in a manner annihilates, all pain for the want of it.

† *See* Part II. chap. ii.

214 From merited esteem and sympathy.

As the good man is conscious of loving and wishing well to all mankind, he must be sensible of his deserving the esteem and good-will of all; and this supposed reciprocation of social feelings is, by the very frame of our nature, made a source of very intense and enlivening joys. By this sympathy of affections and interests, he feels himself intimately united with the human race; and, being sensibly *alive* over the whole system, his heart receives and becomes responsive to every touch given to any part. So that, as an eminent *philosopher* * finely expresses it, he gathers contentment and delight from the pleased and happy states of those around him, from accounts and relations of such happiness, from the very countenances, gestures, voices, and sounds, even of creatures foreign to our kind, whose signs of joy and contentment he can any way discern.

* *Vide* Shaftesb. *Inq. into Virtue*, Book II.

215 Do not interfere with other joys.

Nor do those generous affections stop any other natural source of joy whatever, or deaden his sense of any innocent gratification. They rather keep the several *senses* and *powers of enjoyment* open and disengaged, intense and uncorrupted by riot or abuse; as is evident to any one who considers the dissipated, unfeeling state of men of *pleasure*, *ambition*, or *interest*, and compares it with the serene and gentle state of a mind at peace with itself, and friendly to all mankind, unruffled by any violent emotion, and sensible to every good-natured and alluring joy.

From Happiness.

216 The misery of excess in the private passions.

It were easy, by going through the different sets of affections mentioned formerly †, to show, that it is only by maintaining the proportion settled there, that the mind arrives at true repose and satisfaction. If *fear* exceeds that proportion, it sinks into melancholy and dejection. If *anger* passes just bounds, it ferments into rage and revenge, or subsides into a sullen corroding gloom, which embitters every good, and renders one exquisitely sensible to every ill. The *private* passions, the *love of honour* especially, whose impulses are more generous, as its effects are more diffusive, are instruments of private pleasure; but if they are disproportioned to our *wants*, or to the *value* of their several objects, or to the *balance* of other passions equally necessary and more amiable, they become instruments of intense pain and misery. For, being now destitute of that counterpoise which held them at a due pitch, they grow turbulent, peevish, and revengeful, the cause of constant restlessness and torment, sometimes flying out into a wild delirious joy, at other times settling in a deep splenetic grief. The concert between reason and passion is then broke: all is dissonance and distraction within. The mind is out of frame, and feels an agony proportioned to the violence of the reigning passion.

† *See* Part I. chap. i ii.

217 In the public affection.

The case is much the same, or rather worse, when any of the particular *kind* affections are out of their natural order and proportion; as happens in the case of *effeminate pity*, *exorbitant love*, *parental dotage*, or any *party passion*, where the just regards to society are supplanted. The more *social* and *disinterested* the passion is, it breaks out into the wilder excesses, and makes the more dreadful havock both within and abroad; as is but too apparent in those cases where a false species of *religion*, *honour*, *zeal*, or *party-rage*, has seized on the natural enthusiasm of the mind, and worked it up to madness. It breaks through all ties *natural* and *civil*, disregards the most sacred and solemn obligations, silences every other affection whether *public* or *private*, and transforms the most gentle natures into the most savage and inhuman.

218 Happiness of well proportioned passions.

Whereas, the man who keeps the *balance* of *affection* even, is easy and serene in his motions; mild, and yet affectionate; uniform and consistent with himself: is not liable to disagreeable collisions of interests and passions; gives always place to the most friendly and humane affections, and never to dispositions or acts of resentment, but on high occasions, when the *security* of the *private*, or *welfare* of the *public* system, or the *great interests* of mankind, necessarily require a noble indignation; and even then he observes a just measure in wrath; and last of all, he proportions every passion to the value of the object he affects, or to the importance of the end he pursues.

219 Sum of the argument.

To sum up this part of the argument, the *honest* and *good* man has eminently the advantage of the *knavish* and *selfish* wretch in every respect. The pleasures which the *last* enjoys flow chiefly from external advantages and gratifications; are superficial and transitory; dashed with long intervals of satiety, and fre-

quent

quent returns of remorſe and fear; dependent on favourable accidents and conjunctures; and ſubjected to the humours of men. But the *good* man is ſatisfied from himſelf; his principal poſſeſſions lie within, and therefore beyond the reach of the caprice of men or fortune; his enjoyments are exquiſite and permanent; accompanied with no inward checks to damp them, and always with ideas of dignity and ſelf-approbation; may be taſted at any time, and in any place. The gratifications of *vice* are turbulent and unnatural, generally ariſing from the relief of paſſions in themſelves intolerable, and iſſuing in tormenting reflection; often irritated by diſappointment, always inflamed by enjoyment, and yet ever cloyed with repetition. The pleaſures of *virtue* are calm and natural; flowing from the exerciſe of kind affections, or delightful reflections in conſequence of them; not only agreeable in the proſpect, but in the preſent feeling; they never ſatiate nor loſe their reliſh; nay, rather the admiration of virtue grows ſtronger every day; and not only is the deſire but the enjoyment heightened by every new gratification; and, unlike to moſt others, it is increaſed, not diminiſhed, by ſympathy and communication.—In fine, the ſatisfactions of *virtue* may be purchaſed without a bribe, and poſſeſſed in the humbleſt as well as the moſt triumphant fortune; they can bear the ſtricteſt review, do not change with circumſtances, nor grow old with time. Force cannot rob, nor fraud cheat us of them; and, to crown all, inſtead of abating, they enhance every other pleaſure.

220 External effects of virtue.

But the happy conſequences of *virtue* are ſeen not only in the internal enjoyments it affords a man, but "in the favourable diſpoſition of external cauſes towards him, to which it contributes."

221 On the body.

As *virtue* gives the ſober poſſeſſion of one's ſelf, and the command of one's paſſions, the conſequence muſt be heart's eaſe, and a fine natural flow of ſpirits, which conduce more than any thing elſe to health and long life. Violent paſſions, and the exceſſes they occaſion, gradually impair and wear down the machine. But the calm placid ſtate of a temperate mind, and the healthful exerciſes in which *virtue* engages her faithful votaries, preſerve the natural functions in full vigour and harmony, and exhilerate the ſpirits, which are the chief inſtruments of action.

222 On one's fortune, intereſt, &c.

It may by ſome be thought odd to aſſert, that *virtue* is no enemy to a man's *fortune* in the preſent ſtate of things.—But if by *fortune* be meant a moderate or competent ſhare of *wealth*, *power*, or *credit*, not overgrown degrees of them; what ſhould hinder the virtuous man from obtaining that? He cannot cringe or fawn, it is true, but he can be civil and obliging as well as the knave; and ſurely his civility is more alluring, becauſe it has more manlineſs and grace in it than the mean adulation of the other: he cannot cheat or undermine; but he may be cautious, provident, watchful of occaſions, and equally prompt with the rogue in improving them: he ſcorns to proſtitute himſelf as a pander to the paſſions, or as a tool to the vices, of mankind; but he may have as ſound an underſtanding and as good capacities for promoting their real intereſts as the verieſt court ſlave: and then he is more faithful and true to thoſe who employ him. In the common courſe of buſineſs, he has the ſame chances with the knave of acquiring a fortune, and riſing in the world. He may have equal abilities, equal induſtry, equal attention to buſineſs; and in other reſpects he has greatly the advantage of him. People love better to deal with him; they can truſt him more; they know he will not impoſe on them, nor take advantage of them, and can depend more on his word than on the oath or ſtrongeſt ſecurities of others. Whereas what is commonly called *cunning*, which is the *offſpring of ignorance*, and conſtant *companion* of *knavery*, is not only a mean-ſpirited, but a very ſhort-ſighted talent, and a fundamental obſtacle in the road of buſineſs. It may indeed procure immediate and petty gains; but it is attended with dreadful abatements, which do more than overbalance them, both as it ſinks a man's credit when diſcovered, and cramps that largeneſs of mind which extends to the remoteſt as well as the neareſt intereſt, and takes in the moſt durable equally with the moſt tranſient gains. It is therefore eaſy to ſee how much a man's *credit* and *reputation*, and conſequently his ſucceſs, depend on his honeſty and virtue.

223 On one's peace and ſecurity.

With regard to *ſecurity* and *peace* with his neighbours, it may be thought, perhaps, that the man of a quiet forgiving temper, and a flowing benevolence and courteſy, is much expoſed to injury and affronts from every proud or peeviſh mortal, who has the power or will to do miſchief. If we ſuppoſe, indeed, this *quietneſs* and *gentleneſs* of nature accompanied with *cowardice* and *puſillanimity*, this may often be the caſe; but in reality the good man is bold as a lion, and ſo much the bolder for being the calmer. Such a perſon will hardly be a butt to mankind. The ill natured will be afraid to provoke him, and the good natured will not incline to do it. Beſides, *true virtue*, which is conducted by reaſon, and exerted gracefully and without parade, is a moſt inſinuating and commanding thing; if it cannot diſarm malice and reſentment at once, it will wear them out by degrees, and ſubdue them at length. How many have, by favours and prudently yielding, triumphed over an enemy, who would have been inflamed into tenfold rage by the fierceſt oppoſition! In fine, *goodneſs* is the moſt univerſally popular thing that can be.

224 On one's family.

To conclude; the good man may have ſome enemies, but he will have more friends; and, having given ſo many marks of private friendſhip or public virtue, he can hardly be deſtitute of a patron to protect, or a ſanctuary to entertain him, or to protect or entertain his children when he is gone. Though he ſhould have little elſe to leave them, he bequeaths them the faireſt, and generally the moſt unenvied, inheritance of a *good name*, which, like good ſeed ſown in the field of futurity, will often raiſe up unſolicited friends, and yield a benevolent harveſt of unexpected charities. But ſhould the fragrance of the parent's virtue prove offenſive to a perverſe or envious age, or even draw perſecution on the friendleſs orphans, there is *one* in heaven who will be more than a father to them, and recompenſe their parent's virtues by ſhowering down bleſſings on them.

CHAP. III. *Motives to* VIRTUE *from the* BEING *and* PROVIDENCE *of* GOD.

225 Two external motives to virtue.

BESIDES the intereſting motive mentioned in the laſt Chapter, there are two great motives of *virtue*, ſtrictly

Motives to Virtue. ſtrictly connected with *human life*, and reſulting from the very *conſtitution* of the *human mind.* The firſt is the BEING and PROVIDENCE of GOD; the ſecond is the IMMORTALITY of the SOUL, with *future rewards* and *puniſhments.*

226 Their importance. It appears from Chap IV. of Part II. that *man*, by the *conſtitution* of his nature, is deſigned to be a RELIGIOUS CREATURE. He is intimately connected with the *Deity*, and neceſſarily dependent on him. From that *connexion* and neceſſary *dependence* reſult various *obligations* and *duties*, without fulfilling which, ſome of his ſublimeſt powers and affections would be incomplete and abortive. If he be likewiſe an IMMORTAL creature, and if his *preſent conduct* ſhall affect his *future happineſs* in *another* ſtate as well as in the *preſent*, it is evident that we take only a *partial view* of the *creature*, if we leave out this important property of his nature; and make a *partial eſtimate of human life*, if we ſtrike out of the account, or overlook, that part of his duration which runs out into eternity.

227 Piety, It is evident from the above-mentioned Chapter, that "to have a reſpect to the *Deity* in our temper and conduct, to *venerate* and *love* his *character*, to *adore* his *goodneſs*, to *depend upon* and *reſign* ourſelves to his *providence*, to *ſeek* his *approbation*, and *act* under a *ſenſe* of his *authority*, is a *fundamental part* of *moral virtue*, and the *completion* of the *higheſt deſtination* of *our nature*."

228 a ſupport to virtue; But as *piety* is an eſſential part of virtue, ſo likewiſe it is a *great ſupport* and *enforcement* to the practice of it. To contemplate and admire a Being of ſuch tranſcendent dignity and perfection as GOD, muſt naturally and neceſſarily open and enlarge the mind, give a freedom and ampleneſs to its powers, and a grandeur and elevation to its aims. For, as an excellent *divine* obſerves, "the greatneſs of an object, and the excellency of the act of any AGENT about a tranſcendent object, doth mightily tend to the enlargement and improvement of his faculties." Little objects, mean company, mean cares, and mean buſineſs, cramp the mind, contract its views, and give it a creeping air and deportment. But when it ſoars above mortal cares and mortal purſuits into the regions of divinity, and converſes with the greateſt and beſt of Beings, it ſpreads itſelf into a wider compaſs, takes higher flights in reaſon and goodneſs, becomes godlike in its air and manners. *Virtue* is, if one may ſay ſo, both the *effect* and *cauſe* of largeneſs of mind. It requires that one think freely, and act nobly. Now what can conduce more to freedom of thought and dignity of action, than to conceive worthily of GOD, to reverence and adore his unrivalled excellency, to imitate and tranſcribe that excellency into our own nature, to remember our relation to him, and that we are the images and repreſentatives of his glory to the reſt of the creation? Such feelings and exerciſes muſt and will make us ſcorn all actions that are baſe, unhandſome, or unworthy our ſtate; and the relation we ſtand in to GOD will irradiate the mind with the light of wiſdom, and ennoble it with the liberty and dominion of virtue.

229 a guard and enforcement to virtue. The influence and efficacy of *religion* may be conſidered in another light. We all know that the preſence of a friend, a neighbour, or any number of ſpectators, but eſpecially an auguſt aſſembly of them, uſes to be a conſiderable check upon the conduct of one who is not loſt to all ſenſe of honour and ſhame, and contributes to reſtrain many irregular ſallies of paſſion. In the ſame manner we may imagine, that the awe of ſome ſuperior mind, who is ſuppoſed privy to our ſecret conduct, and armed with full power to reward or puniſh it, will impoſe a reſtraint on us in ſuch actions as fall not under the controul or animadverſion of others. If we go ſtill higher, and ſuppoſe our inmoſt thoughts and darkeſt deſigns, as well as our moſt ſecret actions, to lie open to the notice of the ſupreme and univerſal Mind, who is both the *ſpectator* and *judge* of human actions, it is evident that the belief of ſo auguſt a preſence, and ſuch awful inſpection, muſt carry a reſtraint and weight with it proportioned to the ſtrength of that belief, and be an additional motive to the practice of many duties which would not have been performed without it. From the Immortality of the Soul.

It may be obſerved farther, that "to live under an habitual ſenſe of the *Deity* and his great *adminiſtration*, is to be converſant with *wiſdom*, *order*, and *beauty*, in the higheſt ſubjects, and to receive the delightful reflexions and benign feelings which theſe excite while they irradiate upon him from every ſcene of nature and providence." How improving muſt ſuch views be to the mind, in dilating and exalting it above thoſe puny intereſts and competitions which agitate and inflame the bulk of mankind againſt each other! 230 Exerciſes of piety improving to virtue.

CHAP. IV. *Motive to* VIRTUE *from the* IMMORTALITY *of the* SOUL, &c.

THE other motive mentioned was the *immortality* of the ſoul, with *future rewards* and *puniſhments.* The *metaphyſical* proofs of the ſoul's immortality are commonly drawn from—its *ſimple*, *uncompounded*, and *indiviſible* nature; from whence it is concluded, that it cannot be corrupted or extinguiſhed by a diſſolution or deſtruction of its parts:—from its having a *beginning* of *motion* within itſelf; whence it is inferred, that it cannot diſcontinue and loſe its motion:—from the different properties of *matter* and *mind*, the *ſluggiſhneſs* and *inactivity* of the *one*, and the immenſe *activity* of the *other*; its prodigious flight of *thought* and *imagination*; its *penetration*, *memory*, *foreſight*, and *anticipations* of *futurity*; from whence it is concluded, that a being of ſo divine a nature cannot be extinguiſhed. But as theſe metaphyſical proofs depend on intricate reaſonings concerning the *nature*, *properties*, and *diſtinctions* of *body* and *mind*, with which we are not very well acquainted, they are not obvious to ordinary underſtandings, and are ſeldom ſo convincing even to thoſe of higher reach, as not to leave ſome doubts behind them. Therefore perhaps it is not ſo ſafe to reſt the proof of ſuch an important article on what many may call the ſubtilities of ſchool learning. Thoſe proofs which are brought from *analogy*, from the *moral conſtitution* and *phenomena* of the *human mind*, the *moral attributes* of God, and the *preſent courſe of things*, and which therefore are called the *moral* arguments, are the plaineſt and generally the moſt ſatisfying. We ſhall ſelect only one or two from the reſt. 231 Metaphyſical arguments for its immortality.

In tracing the *nature* and *deſtination* of any being, we form the ſureſt judgement from his *powers* of *action*, and the ſcope and *limits* of theſe, compared with his *ſtate*, 232 Moral proof from analogy.

Motives to Virtue.

ſtate, or with that *field* in which they are exerciſed. If this being paſſes through different ſtates, or fields of action, and we find a *ſucceſſion* of powers adapted to the different periods of his progreſs, we conclude that he was deſtined for thoſe ſucceſſive ſtates, and reckon his nature *progreſſive*. If, beſides the immediate ſet of powers which fit him for action in his preſent ſtate, we obſerve another ſet which appear ſuperfluous if he were to be confined to it, and which point to another or higher one, we naturally conclude, that he is not deſigned to remain in his preſent ſtate, but to advance to that for which thoſe ſupernumerary powers are adapted. Thus we argue, that the *inſect*, which has wings forming or formed, and all the apparatus proper for flight, is not deſtined always to creep on the ground, or to continue in the torpid ſtate of adhering to a wall, but is deſigned in its ſeaſon to take its flight in air. Without this farther deſtination, the admirable mechaniſm of wings and the other apparatus would be uſeleſs and abſurd. The ſame kind of reaſoning may be applied to man, while he lives only a ſort of *vegetative* life in the womb. He is furniſhed even there with a beautiful apparatus of organs, eyes, ears, and other delicate ſenſes, which receive nouriſhment indeed, but are in a manner folded up, and have no proper exerciſe or uſe in their preſent confinement *. Let us ſuppoſe ſome intelligent ſpectator, who never had any connexion with man, nor the leaſt acquaintance with human affairs, to ſee this odd phenomenon, a creature formed after ſuch a manner, and placed in a ſituation apparently unſuitable to ſuch various machinery: muſt he not be ſtrangely puzzled about the uſe of his complicated ſtructure, and reckon ſuch a profuſion of art and admirable workmanſhip loſt on the ſubject; or reaſon by way of anticipation, that a creature endued with ſuch various yet unexerted capacities, was deſtined for a more enlarged ſphere of action, in which thoſe latent capacities ſhall have full play? The vaſt variety and yet beautiful ſymmetry and proportions of the ſeveral parts and organs with which the creature is endued, and their apt coheſion with, and dependence on, the curious receptacle of their life and nouriſhment, would forbid his concluding the whole to be the birth of chance, or the bungling effort of an unſkilful artiſt; at leaſt would make him demur a while at ſo harſh a ſentence. But if, while he is in this ſtate of uncertainty, we ſuppoſe him to ſee the babe, after a few ſucceſsful ſtruggles, throwing off his fetters, breaking looſe from his little dark priſon, and emerging into open day, then unfolding his recluſe and dormant powers, breathing in air, gazing at light, admiring colours, ſounds, and all the *fair variety* of nature, immediately his doubts clear up, the propriety and excellency of the workmanſhip dawn upon him with full luſtre, and the whole myſtery of the firſt period is unravelled by the opening of this new ſcene. Though in this *ſecond* period the creature lives chiefly a kind of *animal life*, i. e. of *ſenſe* and *appetite*, yet by various trials and obſervations he gains experience, and by the gradual evolution of the powers of *imagination* he ripens apace for a *higher* life, for exerciſing the arts of *deſign* and *imitation*, and of thoſe in which ſtrength or dexterity are more requiſite than acuteneſs or reach of judgement. In the ſucceeding *rational* or *intellectual* period, his *underſtanding*, which formerly crept in a lower, mounts into a higher ſphere, canvaſſes the natures, judges of the relations of things, forms ſchemes, deduces conſequences from what is paſt, and from preſent as well as paſt collects future events. By this ſucceſſion of ſtates, and of correſpondent culture, he grows up at length into a *moral*, a *ſocial*, and a *political* creature. This is the laſt period at which we perceive him to arrive in this his mortal career. Each *period* is introductory to the next ſucceeding one; each *life* is a field of exerciſe and improvement for the next higher one; the life of the *fœtus* for that of the *infant*, the life of the *infant* for that of the *child*, and all the lower for the higheſt and beſt §.—But is this the laſt period of nature's progreſſion? Is this the utmoſt extent of her plot, where ſhe winds up the drama, and diſmiſſes the actor into eternal oblivion? Or does he appear to be inveſted with ſupernumerary powers, which have not full exerciſe and ſcope even in the laſt ſcene, and reach not that maturity or perfection of which they are capable; and therefore point to ſome higher ſcene where he is to ſuſtain another and more important character than he has yet ſuſtained? If any ſuch there are, may we not conclude by analogy, or in the ſame way of anticipation as before, that he is deſtined for that after part, and is to be produced upon a more auguſt and ſolemn ſtage, where his ſublimer powers ſhall have proportioned action, and his nature attain its completion.

From the Immortality of the Soul.

* *Vide* Ludov. Viv. *de Relig. Chriſt.* Lib. II. *de vita Uteri, &c.*

§ *See* Butler's *Analogy*, Part I.

233 Powers in man which point to an after-life.

If we attend to that *curioſity*, or prodigious *thirſt* of *knowledge*, which is natural to the mind in every period of its progreſs, and conſider withal the endleſs round of buſineſs and care, and the various hardſhips to which the bulk of mankind are chained down; it is evident, that in this preſent ſtate it is impoſſible to expect the gratification of an appetite at once ſo inſatiable and ſo noble. Our *ſenſes*, the ordinary organs by which knowledge is let into the mind, are always imperfect, and often fallacious; the advantages of aſſiſting or correcting them are poſſeſſed by few; the difficulties of finding out truth amidſt the various and contradictory opinions, intereſts, and paſſions of mankind, are many; and the wants of the creature, and of thoſe with whom he is connected, numerous and urgent: ſo that it may be ſaid of moſt men, that their *intellectual* organs are as much ſhut up and ſecluded from proper nouriſhment and exerciſe in that little circle to which they are confined, as the bodily organs are in the womb. Nay, thoſe who to an aſpiring genius have added all the aſſiſtances of art, leiſure, and the moſt liberal education, what narrow proſpects can even they take of this unbounded ſcene of things from that little eminence on which they ſtand? and how eagerly do they ſtill graſp at new diſcoveries, without any ſatisfaction or limit to their ambition?

234 Intellectual.

235 Moral powers.

But ſhould it be ſaid, that man is made for *action*, and not for *ſpeculation*, or fruitleſs ſearches after knowledge, we aſk, For what kind of action? Is it only for bodily exerciſes, or for *moral*, *political*, and *religious* ones? Of all theſe he is capable; yet, by the unavoidable circumſtances of his lot, he is tied down to the *former*, and has hardly any leiſure to think of the *latter*, or, if he has, wants the proper inſtruments of exerting them. The *love of virtue*, *of one's friends* and *country*, the *generous ſympathy with mankind*, and *heroic zeal of doing good*, which are all ſo *natural* to great and good

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