A

MANUAL

OF

MINERALOGY,

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The following work includes the substance of some Lectures delivered during the last winter before the Members of the Geological Society: to whom it is most respectfully dedicated by

THE AUTHOR.

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INTRODUCTION.

THE first object of the mineralogical student is, or ought to be, the acquisition of a facility in identifying every mineral substance that presents itself to his notice. The absolute necessity of extreme accuracy in discriminating one species from another, is indeed too obvious to require any further remark, if examples were not perpetually presenting themselves of persons very slenderly provided with these rudiments of the science, who yet undertake geological investigations, and, with a peremptoriness generally in proportion to their ignorance, challenge the credit of new discoveries, or call in question the observations of their predecessors. It is indeed very true, that geological speculations are as fascinating to the student as the discrimination of species is generally repulsive; yet it ought to be borne in mind, that as all sound scholarship is founded upon grammar, so all sound geology depends primarily on a familiar acquaintance with the distinctive characters of simple minerals. Nor is this elementary part of the study, by any means, of necessity, so dry and devoid of interest as it is usually found to be: as the grammar of language has its philosophy, so has the grammar of mineralogy, and the attentive student will soon perceive the connection and mutual relation between the several classes of external characters, and will catch some glimpses that may probably hereafter be expanded into an arrangement of minerals at once natural and precise, and worthy of being compared with those that have been discovered for the kindred sciences of Botany and Zoology.

The characters of minerals are taken either from those properties that are immediately obvious to the senses, or from those which require for their manifestation the assistance of apparatus and of reagents, for the most part very simple and of easy application. These I shall proceed to treat of in order, beginning with the former.

1. *Solidity and Hardness.*

These two characters have a reference to the mode or degree in which the integrant molecules of bodies mutually cohere. In some aggregates, though the contact of the particles appears to be perfect, yet the general cohesive force is very feeble, in consequence of the easy mobility of the particles upon and among each other. Such substances are in common language called *liquid*. The number of liquid minerals is very small, not exceeding two or three, yet each of them differing remarkably from the other in the kind and degree of liquidity.

Solids are the only bodies concerning which the terms hard and soft can be used with any propriety; for these expressions imply the greater or less degree of force required to effect a permanent separation, from the mass, of those integrant molecules to which the external impulse is immediately applied. In common language hardness and refractoriness are often confounded. A stone that endures many heavy blows before it gives way is considered as harder than another which requires fewer blows for its fracture. The most unexceptionable method of ascertaining the hardness of a mineral is the greater or less ease with which it yields to the point or edge of a knife of hardened steel. The whole range of hardness obtained by the use of this instrument may be conveniently divided into three portions; the first of which will comprehend the higher degrees, and may be called *hard*, of which common Felspar is an example: the next includes the middling degrees, and may be called *moderately hard*, of which common Hornblende, Apatite, and Fluor are examples: a lower degree includes such as yield with ease to the knife, and may therefore be called *soft*, of which Calcareous Spar, Heavy Spar, and Witherite, are examples. Two other degrees of hardness however, the highest and the lowest, yet remain, for the determination of which the knife cannot conveniently be applied. The lowest or the *very soft*, are such as yield not only to the knife but to the nail, of which Chalk and common Steatite are examples. The highest or the *very hard*, are those upon which the knife makes no impression, but on the contrary, when drawn strongly over their surface leaves a greyish black line of its own substance in the same manner as plumbago does on paper.

Most writers mention the comparative ease and vivacity with which a mineral gives sparks with steel, as a good indication of the superior degrees of hardness: to this however there are several objections. In the first place the bulk of the harder minerals is often scarcely sufficient to allow of their being conveniently subjected to this trial; in the next place the specimens can scarcely fail of being materially injured by such rough treatment; and thirdly, which is perhaps the most important of any, the proposed test is itself very equivocal. In order to produce a spark, a minute thin piece of steel must be shivered from the mass, at the same time that it is inflamed by the violence of the concussion; hence it is obvious that among minerals of the same degree of hardness, that will afford the largest and most plentiful sparks, which breaks readily so as to present a number of fresh sharp edges at every blow. Neither Corundum nor Topaz (nor probably any of the gems, even Diamond) are at all comparable in this respect to Flint, though so greatly exceeding it in hardness. Another circumstance which renders this character very ambiguous, is, that even soft minerals, when amorphous, not unfrequently contain invisible or very minute grains of Pyrites, of Sand, of Garnet, and of other hard substances, which, though not affecting the hardness of the mass as deduced from the knife, will yet give sparks with steel in considerable abundance;

this is particularly the case with certain varieties of Limestone, which yield at the same time with great ease to the knife.

Some precautions in the use of the knife are requisite, the neglect of which may lead the mineralogical student into errors of considerable importance. In fibrous minerals a scratch directed across the fibres will always indicate a lower degree of hardness than the true one: for, the fibrous structure presenting an alternation of ridges and furrows, the knife glances across the intervals, thus interrupting the uniformity of the stroke into a succession of small blows, which rather break down than divide the summits of the ridges. The hardness should therefore be tried by a scratch parallel to the direction of the fibres, or still better, on the surface of the transverse fracture. Another precaution is, always to select a sound undecomposed specimen on which to make trial of the hardness, this character being affected, perhaps sooner than any other, by the spontaneous alteration of a mineral. In examining the relative degree of hardness of two minerals, by trying which will scratch the other, it is necessary to be aware that in crystallized minerals the solid angles and edges of the primitive forms are very sensibly harder than the angles and edges of the derivative forms, or than the angles and edges produced by casual fracture, either of crystals or of massive varieties of the same species. This fact has long been well known to the diamond cutters, who always carefully distinguish between the *hard* and *soft points* of this gem, that is, between the solid angles belonging to the primitive octohedron and those belonging to any of the modifications, the latter being easily worn down by cutting and rubbing them with the former.

2. *Frangibility.*

Frangibility is that quality in minerals which disposes them to separate into pieces or fragments on the application of a blow. Both frangibility and hardness are measured by the resistance which they oppose to disintegration by external force; they differ however in this circumstance, that the resistance by which hardness is estimated takes place at the point where the force is applied; whereas that which measures frangibility takes place at a distance from the same point, and this distance generally increases in proportion to the frangibility. Hence in trying the hardness a portion of the mineral is reduced to powder, while in trying the frangibility it is only broken into fragments.

A mineral is more easily frangible by a sharp blow from a small hammer than by a harder and heavier blow from a large hammer: hence it appears that the frangibility of a substance depends much on its elasticity. The degrees of frangibility are affected partly by the relation of the integrant molecules to each other, and partly by the structure of minerals; and these two general modifying causes comprehend under each two or more subdivisions. The molecules may adhere to each other with greater or less force without admitting of any sliding of particle on particle: where this is the case the result is perfect *brittleness;* the degrees of which are measured by the force required to produce fracture Thus we have the brittle and very easily frangible, as Sulphur; and the brittle and moderately frangible, as Diamond. But brittleness may be detected almost as well by the knife as by the hammer, in those substances upon which the knife is capable of making any impression. If the edge of this instrument is drawn over the surface of a brittle mineral, with a sharp and at the same time rather forcible cutting stroke, the detached fragments will be observed to dart off rapidly in the form of dust or of larger portions in proportion to the hardness of the mineral; while the new surface thus produced will present, on examination with a magnifier, a number of minute shining conchoidal depressions separated from each other by a dull smooth surface, showing the action of the knife to have been partly that of wearing off, and partly of tearing up; the latter effect being indicative of the brittleness of the substance.

The passage from the most brittle minerals into those which are excessively *tough*, takes place so gradually that it is impossible to mark with absolute precision where the one begins or the other ends, although in most cases there is no difficulty in ascertaining to which of the two classes any particular substance belongs.

When a blow is given to a tough mineral, the part actually struck is always more or less bruised and de-

depressed, and it requires several repeated strokes, taking advantage at the same time of the thinnest and most prominent parts, before the fracture can be accomplished. Common Hornblende and most of the Trap Rocks are remarkable for their toughness, the greater part of the argillaceous Limestones are in the same condition, and even Gypsum when compared with Heavy Spar or Granular Limestone exhibits this character in rather a striking degree.

All minerals, except the brittle ones, yield to the knife, and may be divided into two or three degrees according to the resistance which they oppose to this instrument.

The new surface thus produced is entirely even, without any of those small, shining, conchoidal depressions by which the brittle minerals are characterized. In the harder minerals of this class the fragments detached by the knife, instead of being in thin sharp shivers or in fine powder, present the appearance of blunt grains or coarse powder, the particles of which are often slightly adherent to each other.

A still further degree of toughness, approaching to semi-malleability, is observable in some of the metallic ores and in a few of the earthy minerals. These all yield without difficulty to the knife, affording more or less perfect but fragile shavings rather than slightly coherent grains, and the new surface is not only smooth but shining. Substances presenting these characters are *sectile*, of which Plumbago and Soapstone are examples.

The character of sectility passes by degrees into that of *malleability*, which is the direct reverse of brittleness. The most malleable minerals, as native Gold and native Silver, can scarcely be said to be at all frangible; they are on the contrary extremely flexible, tough, and inelastic: by means of a knife perfect shavings may be obtained from them, which will bear to be unrolled and flattened without breaking, and the cut surface is smooth, even, and of a high polish. This class is chiefly occupied by a few of the native metals.

The frangibility of the earthy minerals, though not of the native metals and metallic sulphurets, is affected by their dryness or moisture. Almost all minerals, whether crystallized or amorphous, so long as they remain in their native bed are imbued with a greater or less proportion of moisture, which appears to penetrate every part, not only percolating actual cavities and natural joints, but in a manner separating the integrant molecules from each other. The consequence is, that not only the frangibility but also the hardness of minerals thus situated is considerably different in degree from that possessed by the very same specimens after they have been detached, and have been exposed to the dryness of the external air. This moisture, often actually visible in the form of fine dew on the recently fractured surface of a mineral fresh from the quarry, is entirely exhaled in the course of a few weeks or perhaps days, according to the magnitude of the specimen: the space which it occupied is filled with air, and a highly compressible substance is thus substituted for one almost incompressible; the consequence of which is, that the energy of a blow is greatly deadened, and of course the frangibility of a mineral materially diminished. Hence it is that in the manufacture of gun-flints the stones are used as fresh as possible. The long prisms of Siberian Aquamarine (according to the very respectable testimony of Patrin) immediately after they have been gathered from their native rock are so fragile as often to crack across, like Sulphur, by the mere warmth of the hand. The Opal in similar circumstances is said to be sometimes quite friable; and, of the coarser minerals, the softness and fragility of common Bath Freestone when recent is an example within the personal observation of every one.

3. *Structure.*

The next distinctive character of simple minerals is their structure, or the order in which their molecules are arranged so as to form masses. Of Structure there appear to be three great divisions or gradations; namely, the *crystalline,* the *imperfectly crystalline,* and the *promiscuous,* of which the former may be regarded as the most and the latter as the least perfect. In considering the crystalline structure I shall regard it as wholly independent of external figure, and therefore of crystallography properly so called, which explains the external figure of a crystal from data furnished by its internal structure.

The *crystalline structure* may be defined an aggregation of molecules, each individually too small to be perceived, and offering parallel joints or planes of section in at least three different directions. The most simple plane-surfaced solid must have at least two parallel planes as the boundaries of each of its three dimensions, and therefore joints in three directions; not unfrequently the direction of the joints (or the *cleavage*) is four-fold, and in some cases five- or six- or many-fold. Sometimes all, or at least three, of the joints are so very open, that a slight blow will cause the mass to fly asunder as if it were exceedingly brittle: this however is a mere deception, for on examining the fragments it will be found that they are all regular solids bounded by plane surfaces, whereas a true fracture passes obliquely across the natural joints, forming an irregular uneven surface, and its fragments have by no means a symmetric and similar form. Thus common Galena separates, by a slight shock, in the direction of its joints, affording a multitude of fragments, and from this circumstance might be considered as brittle, while from the test of the knife it would appear to be almost sectile. These two appearances are not however in fact at all contradictory of each other, the knife alone showing the frangibility or the mutual cohesion of its integrant molecules, while the cubic fragments obtained by the hammer only manifest the openness of the crystalline structure.

In some few species all the joints are for the most part concealed, being not only difficult to perceive even by a strong light, but with their sides so firmly adherent to each other, that a fracture will take place in any direction rather than in that of the cleavage: of this, Rock Crystal is a good example. It often happens that the joints in one direction are easy to be seized, but more or less concealed in every other: thus Topaz splits in plane surfaced laminæ by a force applied at right angles to the axis of its prism, while in the opposite or in any other direction the true fracture surface will be produced. Of joints obvious in two directions Felspar is a characteristic example; and of joints in three directions, besides Galena already mentioned, there are Rock Salt and Calcareous Spar.

In massive specimens the existence of parallel joints is the only circumstance indicative of real crystalline structure; and as the ascertainment of the structure may often be a point of some theoretical importance, it will not be improper briefly to mention the means by which a structure, imperceptible on a slight examination, may be satisfactorily ascertained. In the first place an accurate scrutiny of the fracture surface will often detect portions of plane smooth surface, (very different from the uneven or undulating appearance of the other parts,) occasioned by the casual breaking in upon a natural joint. Sometimes straight and parallel striæ may be observed indicating the edges of lamellæ, and of course the direction of the cleavage. Often, turning the specimen slowly round in the sunshine or in any other powerful light, will afford reflections indicative of the structure; and when other means fail, heating a portion of the specimen red hot, and allowing it to cool gradually, will very often open the joints so as to render them sufficiently obvious.

The *imperfectly crystalline* structure includes a series of varieties, which at one extremity graduates into the perfect crystalline, and at the other into the promiscuous; even in the lowest, however, there are more or less evident traces of the operation of that active principle of crystalline polarity which collects the molecules of minerals, and of unorganized matter in general, into polyhedral groups, the forms of which are similar in each species.

The smallest deviation from the crystalline structure is in those cases where the joints, instead of exhibiting plane surfaces, are more or less curved. This is sometimes connected with a regular external form, as in the spheroidal Diamond, and in Pearl Spar; and sometimes occurs massive, as in common sparry Iron Ore, and curved lamellar Heavy Spar. The cause of this curvilinear structure has not been much investigated, whether it is a mere variety of crystalline attraction, or whether it is produced by the conjunct energy of two distinct forces, of which crystallization is one.

The next variety exhibits plates or laminæ of a form more or less resembling the blade of a knife, that is, thin and long in proportion to their breadth, and often with a sharp edge along one side; these blades are rarely parallel to each other, generally crossing and interlacing, of which common Hornblende and Kyanite are examples. At one, and sometimes at each narrow extremity of the blade, the termination is ragged and as it were fibrous; thus forming the passage into the truly fibrous, and showing that this latter structure is produced by the greater openness of the longitudinal joints. The several varieties of Tremolite afford admirable examples of this passage, and of the natural connexion between the truly crystalline and the *bladed* and *fibrous* structures.

The direction of the fibres (a matter however of trivial importance) has given rise to a few technical terms which may be summarily mentioned. If the fibres lie evenly side by side the structure is called *parallel fibrous*, when radiating or diverging on one side they form the *scapiform*, when diverging on opposite sides the *fasciculated*, and when diverging on all sides the *stellated* structures.

In some cases two distinct modes of structure are combined: thus a particular variety of Gypsum is straight-lamellar in one direction, and parallel-fibrous in the opposite direction. The most frequent example however of compound structure is the curved lamellar, with the fibrous or bladed diverging on all sides from a common centre. This is usually connected with a particular external figure, and is often indicative of a particular mode of formation. Thus the *stalactitic* form consists of concentric cylinders, or more properly of very long hollow cones inserted one into the other, each of which is itself composed of an aggregate of fibres or blades diverging on all sides at right angles to the common axis of the stalactite. A perfectly analogous structure belongs to the *mammillated* and *botryoidal* forms, as these indeed are only more or less perfect stalactites both in structure and in the manner of their production.

The last and lowest variety of imperfectly crystalline structure (if it is really crystalline at all) is the *slaty*, consisting of straight or curved lamellæ of various thickness, traversed at distant intervals, and usually in two directions, by nearly parallel natural joints. The joints can rarely be shown in hand specimens, but the lamellæ unless very thick and coarse are sufficiently obvious.

Of the *promiscuous* structure the first variety to be mentioned is that composed of *distinct concretions*, or globular and subangular aggregates promiscuously compacted, and forming a mass either by means of a small proportion of cement or by a slight degree of mutual cohesion. By an unexperienced eye this structure might be mistaken for a casual conglomerate of rolled or angular fragments: there are however many distinctive marks which, when once known, prevent in almost every case the possibility of mistake. In the first place all the concretions, together with the amorphous matter by which they may be cemented, are of one and the same mineralogical species; secondly, the globular concretions are composed of concentric laminæ, which are themselves often formed of laterally aggregated fibres; and the subangular concretions are distinguished by the want of symmetry and occasional curvature of surface from true crystals, and by their internal structure from mere fragments. Pisolite, Oolite, Pearlstone, and Heavy Spar, afford examples of the different varieties of distinct concretions.

The *granular* structure is a promiscuous aggregate of small concretions: in the coarsely granular the structure of the concretions themselves may generally be perceived by the naked eye; in the finely granular this is impossible; and in the most minutely granular or earthy the concretions themselves are often hardly to be seen.

The last variety of promiscuous structure, if that can with propriety be so called in which no distinction of parts is visible, is the *compact*.

4. *Fracture and form of the Fragments.*

The Wernerian School of Mineralogy has made no distinction between structure and fracture, and in doing so has I think confounded together two characters that are essentially different, and which it is of much importance, both practically and with a view to the philosophical arrangement of mineral characters, to keep distinct. Structure is that division of a whole into smaller aggregates which has been made by nature according to general laws; fracture is the casual division of a whole into fragments. Of Proper Fracture there are four kinds. Sometimes the fractured surface is varied with circular wrinkles and flat round elevations and depressions, constituting the *conchoidal* fracture, and of this there are two varieties, the perfect and the imperfect: in the latter the whole cavity is shallow in proportion to its extent, and the partial elevations and depressions instead of being perfectly curvilinear are irregular and angular. When these deviations from the regular form become considerable the fracture passes into the *uneven*; and on the other hand when the surface is nearly flat and uninterrupted the *even* fracture is produced. Of these three kinds of fracture the first always, and the second generally, are characteristic of brittle minerals; the third is common to the brittle and moderately tough, but in its most perfect state is generally indicative of the former. This by insensible degrees slides into the *splintery* fracture, the surface of which is covered by wedge-shaped scales (improperly called splinters) adhering by their thick end. The splintery fracture is nearly as characteristic of the tough minerals as the conchoidal is of the brittle. The last kind of fracture remaining to be noticed is the *hackly*, it is peculiar to the malleable metals, and consists of short, sharp-pointed, harsh protruding fibres.

Of *Fragments* considered with regard to their form there are three kinds: first, the *geometrical*, produced by improper fracture; that is, by a blow which divides a mineral only in the direction of its natural joints. Of this variety of fragments there is are the cubical, the rhomboidal, and the tetrahedral. Secondly, the *determinate*, exhibiting a more or less regular though not a geometrical figure, and containing the following varieties; namely, the *wedge-shaped*, *splintery*, *spicular*, and *tabular*, all of which are peculiar to the minerals of imperfectly crystalline structure. Thirdly, the *indeterminate*, of which some have very sharp edges and angles, and are peculiar to the hard and brittle minerals; while in the rest the angles and edges are more or less blunt in proportion to their softness or toughness.

5. *External form.*

I now proceed to consider how far the differences of external form which minerals present can be made available for the discrimination of species or varieties.

On this subject it may first of all be observed, that the characters derived from external form are by no means universally applicable like those which have been already mentioned. A considerable proportion of the specimens admitted into cabinets are bounded entirely by the surfaces of fracture, or of structure, and therefore strictly speaking have no natural external form. This is the case with all cut and polished specimens, and in general with all those natural aggregates the bulk of which renders them, when entire, inadmissible into our cabinets.

Minerals considered with regard to external form may be divided into three classes; namely, *crystalline*, of *definite* or *particular forms*, and *indefinite* or *amorphous*.

A crystal, as far as its external figure is concerned, may be defined a more or less symmetrical solid bounded by plane surfaces, and the surfaces themselves bounded by right lines. These surfaces are commonly called *planes* or *faces*, and when very minute, *facets*. The line formed by the junction of two planes is called an *edge*; and the point in which three or more planes unite is called a *solid angle*. Where the primitive form of a mineral is well known, all the secondary crystals may be described as modifications of this form; in this case, however, it will be necessary to have recourse to diagrams or figures, in order to explain by a glance what no words can give an adequate idea of. But where figures are not at hand, and words are the only medium that we can make use of, it is convenient and indeed absolutely necessary to assume certain regular forms of solids as models, with which existing crystals may be compared, and thus briefly and clearly described.

The *prism*, formed of three or any greater number of sides, is a model to which a great variety of crystals may be conveniently referred. It consists essentially of planes parallel to and surrounding an imaginary axis, and of two others (called bases), one at each extremity of the axis. Hence in every prism we have *lateral faces* and *lateral edges*, *terminal faces*, and *edges* and *solid angles adjacent to the terminal faces*. A very long prism is often called a *capillary* crystal, particularly when the diameter is so small as to render the lateral faces indistinct: a very short prism on the other hand obtains the name of *tabular*, where the length of the terminal faces exceeds that of the lateral ones. Werner indeed has adopted the *table* as one of the primary models of crystals, but I believe that it will be found more convenient to regard this form as an extreme sometimes of the prism, and sometimes of the single and double pyramid. The opposite lateral faces of a prism are symmetrical, the adjacent ones are rarely so, there being for the most part a considerable difference in their respective breadth. When of two prisms of the same species the number of lateral faces in the one exceeds that of the other by an equal, a double, or any other multiple, it is convenient to consider that with the most faces as a variety of the other produced by new sections on the lateral edges, and parallel to the axis: if the lateral edge is replaced by a single face, as in the conversion of a four- or six-sided prism to an eight- or twelve-sided one, the edge is simply *replaced* or *truncated*. If the edge is replaced by two faces it is said to be *bevelled*, and so if the number of faces be still greater it is bevelled and truncated, doubly bevelled, &c.; or, more simply, replaced by three, four, five, &c. secondary faces. In like manner the edges adjacent to the bases may be replaced. A solid angle may be replaced by a single plane, in which case it is said to be truncated; or it may be replaced by sections along the edges of the planes, converging more rapidly than the edges or planes themselves: this is not an uncommon modification, and it is rather remarkable that no simple term should have been invented expressive of it.

The lateral faces of a prism never undergo any change, except such as is occasioned by the modifications of the adjacent edges or solid angles: but the terminal faces are very frequently modified by the superposition of pyramids; when this happens the prism is said to be *terminated by pyramids.*

The number of faces of the terminal pyramid is usually either equal to that of the lateral faces, or one half, or some other sub-multiple. The terminal pyramids are symmetrical with regard to each other, except in Tourmaline and a few others, where they differ remarkably in the number of faces, and in the angle of their inclination upon the lateral faces of the prism. The terminal pyramids are *conformable* when, corresponding in the number of their faces, they also correspond in the relative position of these with regard to the lateral faces; and *unconformable* when this correspondence does not take place. The terminal pyramids themselves are liable to the modification of truncature on the edges of the pyramid; and both of simple truncature and of replacement by secondary pyramids on the point or apex of the pyramid.

The second general model to which crystals may be referred is the *cube* and *rhomboidal dodecahedron.* In these the most perfect symmetry of form is observable, all lines passing through the centre of the crystal and at right angles to each other are equal. When one solid angle or edge undergoes a modification, all the others generally do the same, and to an equal extent; hence there is no distinction of lateral and terminal planes.

The third general model is the *regular tetrahedron.* It is not of frequent occurrence, but is extremely well characterized: it is a trihedral pyramid, in which the triangular faces that compose the sides and base of the figure are all equal. Hence the points of all the three solid angles are equidistant from the centre of the crystal, and they all undergo the same modifications, which are often considerably complicated. The same perfection of symmetry is observable in the edges of the crystal, whether they are entire, or replaced by one or more secondary planes.

The fourth general model is the *double pyramid*, formed by two equal and similar pyramids joined together by a common base. The edges indicating this base are either in the same plane or in different planes: to the latter variety belong the *rhomboids*, which may conveniently be regarded as double pyramids, of which the line passing through the two solid acute angles may be regarded as the axis. The opposite angles and edges of this class of crystals are usually symmetrical, and undergo the same modifications; but this symmetry does not extend to the adjacent angles and edges. Sometimes a prism is interposed between the two pyramids, and such varieties may be regarded as belonging to the first model or the prism. All the bevelled, and bevelled and truncated tabular crystals of Werner may with more propriety be considered as deeply truncated double pyramids with or without a short intervening prism.

There are none but a few of the most complicated and irregular crystals which may not be very intelligibly described as one of the four above-mentioned general forms, more or less modified on the solid angles, the edges, or the terminal faces. It must however be carefully kept in mind that these general or primary models have no connexion with the real *primitive* forms of crystals; and that they are adopted merely for the convenience of abbreviating and rendering more intelligible the descriptions of their external forms. If however the student should imagine that the real crystals of minerals, such as nature presents them, are formed with all the precision that characterizes the models of the crystallographer, he will in general find himself much mistaken. By far the greater number of crystals are either imbedded in other substances from which it is difficult to disengage them without much injury, or inhere by one extremity in amorphous or imperfectly crystallized matter of the same nature with themselves. Hence it is that very few prisms occur both terminations of which are entire. Not unfrequently also, crystals by being formed in narrow clefts are excessively compressed, or in other ways are variously mutilated by the action of disturbing forces as yet uninvestigated, and thus perplex not only the student but the accomplished mineralogist. Their minuteness too, when the parts are much complicated, is frequently such as to elude the keenest eye, and the most adroit use of the common goniometer.

It is often also by no means easy to distinguish between real and spurious crystals. These latter are generally supposed to have been moulded in cavities occasioned by the decomposition and removal of real crystals. Thus Quartz is sometimes met with forming the walls of cubical cells once occupied by crystals of Pyrites; now, if Chalcedony, Calcareous Spar, or any other substance should be deposited on the surface of this cellular Quartz, it is evident that it will take the impression of the mould; and if afterwards separated, either forcibly or by the gradual solution or erosion of the Quartz, will appear to be studded with cubical crystals. By a similar process, as is commonly supposed, Calamine assumes the form of certain varieties of Calcareous Spar; and the Steatite of Bareith imitates the form both of Calcareous Spar and of Quartz.

From the crystalline forms I proceed to the consideration of the *definite* or *particular* forms, of which there are three different kinds. The first, or that which approaches the nearest to the regular crystalline, is the *arborescent*. In general appearance it bears a more or less close resemblance to a vegetable spray, hence its name; but if examined minutely will be found to consist of crystals, occasionally very perfect, implanted one into another, and diverging or branching off in various directions. Sometimes the whole figure is nearly in one plane, like the elegant and perfectly analogous forms exhibited by water crystallizing into hoar frost on the panes of windows; and to this variety belong the beautiful arborescences exhibited by the Carbonates of Iron and Manganese in Calcareous Slate; some of the native metals too, especially Copper and Gold, are very apt to assume this compressed arborescent form. Sometimes the branches spread equally on all sides as in the artificial Arbor Dianæ, and in native Silver, which not unfrequently occurs shooting through a mass of Calcareous Spar. Certain varieties of arborization have obtained peculiar names, as *retiform* when the branches anastomose, and thus resemble more or less the meshes of a net; *pectinated*, when a number of short lateral branches are given out at right angles from nearly equal distances, on the same side or on opposite sides of a main branch, like the teeth of a comb, a form which Galena sometimes assumes, and which is evidently to be traced to the open jointed cubic crystallization so characteristic of this mineral. In all these cases there is an evident combination of two powers; one, common or solitary crystallization, which arranges matter in solitary polyhedral rectilinear figures; and the other a more active power, resembling the lower forms of vegetable organization, and accordingly called by chemists efflorescence or saline vegetation, which arranges matter in fibres, either simple or branched, with a strong tendency to a curvilinear outline. Sometimes we may perceive the effects of this latter power uncombined with that of common crystallization, as in filamentous Native Silver, the fibres of which are simply thread-shaped without any appearance of the jointed semi-crystalline form of the proper arborizations.

The second kind of definite form appears, in some cases at least, to arise from crystallization modified and more or less disturbed by the combined effects of concentric attraction and gravitation. It has evidently been occasioned by matter in a semifluid state, either from a viscous tenacity or from a kind of imperfect coagulation, being exposed to the simultaneous action of the three forces just mentioned. To crystallization is owing the minute structure in short prisms or fibres laterally aggregated; to the concentric attraction it is owing that each of these fibres converges towards a real or imaginary centre, forming of the whole a curved thick plate, or several plates in successive coats like the structure of the onion; and lastly it is owing to gravitation that these concretions do not form perfect spheres, but are more or less elongated into the mammillary, the reniform, the botryoidal, and the stalactitic varieties. In some of the globular forms, as in globular Pyrites, the crystalline structure is very apparent, and the surface is generally roughened by protruding points of crystals; but in others there is no appearance of crystalline structure.

Those minerals the forms of which are neither crystalline nor definite, are called *Indefinite* or *Amorphous*. Sometimes one dimension, the thickness, bears but a small proportion to the other two; hence results that variety of indefinite form called *superficial* or *investing*, and which in almost every instance belongs to friable and pulverulent minerals; also another variety called *plated* or *membranaceous*, and accompanied generally by a certain degree of tenacity, as in membranaceous Grey Silver. Where the three dimensions are not very different from each other, if the whole bulk is not considerable, the substance is said to be in *pieces*; and, on the contrary, if the bulk is considerable the mineral is said to be *Massive*.

6. I now proceed to another set of external characters depending for their existence, or at least for their manifestation, on the *Action of Light*; they are often modified by each other, and therefore it will be most convenient to treat of them together.

The first of these characters relates to the degree in which minerals are permeable by light, or their *transparency*.

A mineral is *transparent* when the forms of external objects are transmitted through it to the eye without any material alteration, as is the case in the purer varieties of Rock Crystal. When from a slight degree of cloudiness in the medium the precision and distinctness of the outline begins to be impaired, transparency begins to pass into *semi-transparency*.

When, from the progress of cloudiness, form can scarcely if at all be observed, *translucency* begins, as in Chalcedony: the obstructions to the passage of light still further increasing, the translucency is only visible in thin shivers or *at the edges* of the specimen; and when the passage of light is entirely stopped *opacity* comes on. Although in most cases the degradation from perfect transparency is caused by a cloudiness or milkiness, yet sometimes these effects are produced by the mere intensity of colour;

in this case, however, perfect opacity never takes place.

Most mineral specimens are translucent, often indeed very faintly so. Crystals alone, and not many of these, are transparent; more of them are semitransparent. All the native Metals and those of the Sulphurets which have a metallic lustre, are always, and in all the circumstances in which nature presents them, perfectly and absolutely opake.

The reflection of light occasions the *lustre* of a mineral; and of this there are two or three kinds, and of each kind various degrees. Perfectly opake minerals being impenetrable by light, the reflection takes place wholly at their surface, and therefore without undergoing any refraction. The Metals, most of the metallic Sulphurets, and Plumbago exhibit the *metallic lustre* of various degrees of intensity, from the lowest glimmering to the full splendour of the scaly Pyrites, or of fluid Quicksilver. A scratch on the surface of most minerals is remarked by its want of lustre, and by its being of a lighter colour than that of the mass; in minerals of true metallic lustre, on the contrary, the colour, if untarnished, is not altered in the scratch, and the lustre is considerably heightened. By these two characters the *mixed* or *semi-metallic lustre* which exists in various red coloured ores, such as Cinnabar, Red Silver, Red Copper, and many of the red Iron Ores, is distinguished from the true; the scratch being always of lighter colour than the mass, and the substances being in certain positions more or less translucent.

Next to the mixed metallic is the *adamantine lustre.* All the minerals which exhibit this kind of lustre are more or less translucent: the lustre itself is reflected from the interior of the mass with great vivacity, and is therefore not only reflected but refracted light. This kind of lustre is only possessed by substances the refractive power of which is very considerable, such as Diamond, Sulphur, and the native Salts of Lead. In all these substances, although by polishing the intensity of the lustre is increased, yet its kind or character is by no means so distinct, owing no doubt to the increased reflection from the surface, of light which has not undergone refraction, mixing with and confusing the refracted light from the interior.

The next kind of lustre is the *resinous:* it exists well characterized and with the highest degree of intensity that it is capable of, in the translucent varieties of Blende; also in some of the Pitchstones and the resinous Flints.

The last kind of lustre is the *common* or *vitreous,* of which Rock-crystal furnishes one of the most perfect examples.

The *degrees* of lustre, according to the German mineralogists, are the following: *splendent,* or the highest possible, *shining, weakly shining, glistening,* and *glimmering,* which last passes into *dull* or the entire absence of lustre.

Slight change of place produces, in most minerals, either no change of lustre, or a rapid and flashing succession of light and comparative darkness. In all those minerals however of fibrous structure that are not absolutely dull and opake, the lustre varies slowly, passing from one fibre to another as the position of the mineral is slightly altered, producing the same mutation of soft light as that which distinguishes satin from other stuffs : hence this kind of lustre is sometimes called *satiny* or *silky*, and when somewhat indistinct *pearly*. In fibrous Gypsum, in fibrous Arseniate of Copper, and especially in that variety of fibrous Carbonate of Lime called Satin Spar, may this character be observed in high perfection. A similar mutable lustre, but collected into a single mass, exists in the mineral called Cat's-eye, in Adularia, and with remarkable brilliance in the Chrysoberyl. In this latter the moving refracted light begins to be coloured; it may therefore be considered as forming in some degree the passage to those beautiful and vivid reflections of coloured refracted light, often pseudo-metallic, which are with reason so highly admired in the Opal, the Labrador Felspar, the Bronzite, and the Schiller Spar.

From these casual and adventitious colours we pass to the true or inherent *Colours of Minerals*. These are infinitely various, and many of them remarkably beautiful; it is no wonder therefore that they should at all times have attracted special notice. In the works of Pliny and of the other ancient naturalists, colour is often the only external character that is mentioned. The beauty of the gems, and therefore their entire value considered merely as objects of decoration, depends on their lustre and their colour; hence the colour of minerals is generally more attended to as a discriminating character than it really deserves to be; and much time and attention have been unprofitably employed in composing and arranging, with some parade, voluminous suites of colour for particular minerals. The comparative value of characters in natural history is founded entirely on their precision, and therefore on the brevity with which they are capable of being expressed; but when we are told that the colours of a particular mineral are white, blue, red, green, yellow, that of white such and such varieties occur, such and such of blue, of red, of green, and of yellow, what can candour itself infer than that all this is egregious trifling? Where Nature has shown herself so capricious with regard to one character, it is reasonable to suppose (and we find the inference corroborated by fact) that she has compensated the vagueness of that by the precision of some other. That colour is, in many cases, of high importance it would be the very excess of prejudice to deny; but these cases are precisely those in which it may be expressed with the same brevity as any other character. The colours of minerals, as far as they have been chemically examined, are principally owing to metallic oxides and inflammable matter, since the Earths, the Acids, and the Alkalies, in a state of purity are white or colourless; but of the earthy minerals the essential ingredients are white, and those to which they owe their colour are regarded for the most part as accidental and unimportant ingredients, if not impurities. In the inflammable minerals however, in the metallic ores, and in a few of the earthy minerals, the colouring matter is at least as important, and generally much more so and in larger proportion than the other parts: hence in these latter the colour varies but little in each species, and is a character of importance precisely in proportion to its unity.

7. The next general character of minerals is their *Specific Gravity*, for which a few words will suffice. Specific gravity, as every one knows, is the comparative weight of equal bulks of matter of different species, and, distilled water being the common term of comparison, the gravities of all other substances are expressed by the ratio which they bear to this assumed unit. The range of mineral specific gravities is longer than that of any other class of natural substances, extending from 17 or 18, the gravity of native Platina, to less than 1, the gravity of the supernatant minerals. All those species the specific gravity of which exceeds five times that of water belong to the class of metallic ores. The heaviest earthy minerals range from 3·5 to 4·5, and include the gems and the Barytic and Strontian genera; most of the other solid earthy minerals are between 2· and 3·5; and the lower degrees are occupied chiefly by the clays, and by other porous minerals of the argillaceous and magnesian classes.

8. Another general character, but of restricted application, is derived fom the impression made on the sense of touch by mineral substances, vulgarly called the *Feel*.

Some minerals are decidedly *unctuous*, like soap, to the touch, as Soapstone. Others though scarcely unctuous are perfectly *smooth*, as Pipe clay. Some again are *dry* or *arid*, as Chalk, earthy Felspar, and Tripoli. Some are *rough*, as Pumice; and, lastly, others are *harsh*, as Actynolite.

9 and 10. *The Odour and the Taste*.

These characters are applicable only in a very few cases, but where they can be at all made use of are precise, and not liable to error. By the odour when rubbed, Swinestone is distinguished from common Limestone; and the saline minerals are distinguished from the rest by their sapidity, and from each other by their peculiar affections of the palate.

The above characters are usually denominated the external characters of minerals, in contradistinction to the physical and chemical ones, which yet remain to be noticed. The distinction is not indeed very accurate or of much consequence; I shall therefore without loss of time proceed to the enumeration and explanation of these characters.

One observation may be made with regard to the whole of them; namely, that they are not, like hardness, specific gravity, structure, &c. applicable to all mineral substances. In compensation however for this want of universality they are, generally speaking, capable of affording important distinctions wherever they do occur.

11. *Magnetism.*

Few minerals in their native state affect the magnetic needle, but a considerable number do so after being subjected to the action of the blowpipe. A very small and merely accidental portion of Iron in the metallic state or in that of black oxide, will act vigorously on the needle, while a much larger portion in a higher state of oxydation has no effect. This character however distinguishes pretty accurately the Ores of Iron from other substances.

12. *Electricity* is a character of but small consequence. It serves indeed to point out the Tourmaline and other pyro-electric minerals, and is connected with some curious and important crystallographical facts; it must not therefore be entirely neglected.

13. *Phosphorescence* is a character of more extensive application, though not very precise; and as it may be excited in the minutest portions of minerals, is of use in serving to ascertain the species in those cases where, from intimate mixture with other substances, the ordinary means of distinction cannot be had recourse to. Sandy Fluor disseminated through Quartz may thus be ascertained. There are two

modes of exciting phosphorescence, heat and friction. Fluor is an example of the former; Phosphorescent Blende of the latter.

14. *Double Refraction*, where it exists in a marked degree, is a character of considerable importance. It applies indeed to only a few of the crystallized minerals, but in these is an admirable specific distinction. In some minerals, as Calcareous Spar and Jargoon, the double refraction is perceived even through parallel surfaces, but in others it is necessary to have even surfaces obliquely inclined on each other for the manifestation of this character.

15. The next character is the *Action of Water*, which is partly chemical and partly mechanical. By its solvent power it distinguishes the mineral salts from the other classes: in these latter however there are several species which, though insoluble, are more or less acted on by water, and derive from this circumstance distinctive characters of some importance. Some minerals, as the unctuous clays, become plastic by mixture with water; others, as Fullers' Earth, fall to pieces and are diffused through this fluid without, however, either dissolving in it or becoming plastic. A few, as Porcelain Clay, Lithomarga, and Bole, are permanent in water, but absorb it abundantly and with great energy, and hence adhere more or less to the moist tongue.

16. The *Action of Acids* is next to be considered;

but as the object in the use of these very powerful reagents is not to analyse the subject of experiment but only to obtain certain indications, the acid (which is generally the muriatic) is to be employed moderately dilute and at the ordinary temperature. The native carbonates effervesce and are soluble in the menstruum. In some, as Calcareous Spar, and Witherite, the effervescence is vigorous and the solution rapid; in others, as Bitter Spar, even when pulverized, the effervescence is trifling and the solution slow. Certain of the earthy minerals which contain silex, water, and alkali, in a particular state of combination, if pulverized and covered with acid, are, in the course of a few hours, converted into a perfect jelly, as the Mesotype.

17. The last set of characters are those derived from the use of the *Blowpipe*. The habitudes of a mineral with the blowpipe are, in fact, the effects produced upon it by exposure to various degrees of heat, from the lowest almost to the highest; either by itself or assisted by the concurring action of fluxes of various kinds: with this advantage, however, over experiments performed in a furnace, that in the latter case only the results are seen, whereas in the former the whole train of phænomena from the beginning to the end of the process are brought immediately under inspection. These phænomena are all modifications of chemical action, relating therefore to the essential properties of the component particles of bodies; and hence deserving of much

reliance on, in every attempt to form a natural arrangement of mineral substances.

A blowpipe is a tube of metal or of glass, generally of the former material, for the purpose of delivering a continued stream of air. This stream being directed across a flame deflects it more or less from its natural vertical position, concentrating it at the same time and occasioning a more vigorous combustion. The air employed is generally either that of the atmosphere, or air which has been breathed; sometimes oxygen gas is made use of, and sometimes an inflammable gas, as the vapour of boiling Alcohol. All of the latter class afford a large bulky flame; but wavering, unconcentrated, and therefore of little intensity. Oxygen gas gives an enlarged but well defined flame, very white and of intense energy; too intense indeed to be of much utility, for almost every mineral melts before it, and so rapidly as scarcely to afford time for observing the previous changes. Common air might seem *à priori* greatly preferable to air that has been breathed; yet in fact there is no very perceptible difference between them in energy; and this very important circumstance is the foundation of the distinction between the fixed and the portable blowpipe, and has eminently contributed to the utility of this instrument as an article of mineralogical apparatus.

The continued stream of air, if inflammable vapour, or oxygen gas, or atmospheric air, is made use of, must be furnished by some mechanical contrivance, as a pair of double bellows, a gasometer, or a large bladder; all of which are more or less cumbrous and imperfect, and detract much from the facility with which at all times and in all places the examination of a mineral ought to be conducted. But by employing air that has been breathed, no other apparatus is required than a pipe of very simple construction, the lungs and the mouth serving the purpose of double bellows.

Few persons are able at first to produce a continued stream of air through the blowpipe, and the attempt often occasions a good deal of fatigue; I shall make no apology therefore for treating this matter somewhat in detail. The first thing to be done is to acquire the habit of breathing easily and without fatigue through the nostrils alone; then to do the same while the mouth is filled and the cheeks inflated with air, the hinder part of the tongue being at the same time slightly raised to the roof of the mouth in order to obstruct the communication between the mouth and the throat. When this has been acquired, the blowpipe may be put into the mouth and the confined air expelled through the pipe by means of the muscles of the cheeks: as soon as the air is nearly exhausted, the expiration from the lungs instead of being made through the nostrils is to be forced into the cavity of the mouth; the communication is then instantly to be shut again by the tongue, and the remainder of the expiration is to be expelled through the nostrils. The second and all subsequent supplies of air to the blowpipe are to be introduced in the same manner as the first: thus with a little practice the power may be obtained of keeping up a continued blast for a quarter of an hour or longer without inconvenience.

Much depends on the size of the external aperture of the blowpipe. If so large that the mouth requires very frequent replenishing, the flame will be wavering and the operator will soon be out of breath: if on the other hand the aperture be too small, the muscles of the cheeks must be strongly contracted in order to produce a sufficient current, and pain and great fatigue of the part will soon be the consequence. An aperture about the size of the smallest pin-hole will generally be found the most convenient, though for particular purposes one somewhat larger or a little smaller may be required.

Several varieties of form have been recommended for the blowpipe: they all have their advantages and disadvantages. Upon the whole it appears desirable that there should be an expansion of the tube somewhere between the two extremities; both for the sake of collecting and retaining the condensed moisture of the breath, and for producing a regulated pressure and therefore a regular blast: the nosle also should be tipped with a moveable piece for the convenience of giving at least three different sizes of aperture. These conditions being obtained, other circumstances are of small importance, provided neither the bulk nor weight of the instrument be troublesome.

The fuel for this little reverberatory furnace (as the blowpipe apparatus may without impropriety be denominated) is oil, tallow, or wax kept in combustion by means of a wick: the oil is the worst, the tallow is better, and the wax is the best; not only as being the cleanest and free from any offensive smell, but also as affording a greater heat. The management of the wick, too, is a matter of some nicety: it should neither be too high nor snuffed too low, and should be a little bent at its summit *from* the blast of the pipe. All casual currents and drafts of wind ought to be carefully avoided, as rendering the flame unsteady, and very materially impairing its strength. The above conditions being duly complied with, the flame while acted on by the pipe will evidently consist of two parts, an outer and inner: the latter will be of a light blue colour, converging to a point at the distance of about an inch from the nosle; the former will be of a yellowish white colour, and will converge less perfectly. The most intense heat is just at the point of the blue flame. The white flame consists of matter in a state of full combnstion, and calcines or oxygenates substances immersed in it: the blue flame consists of matter in a state of imperfect combustion, and therefore partly deoxygenates metallic oxides which are placed in contact with it.

The supports of the various substances while undergoing the action of the blowpipe come next to be considered. Of supports there are two kinds, combustible and incombustible. The combustible support (used chiefly for metallic ores) is Charcoal. The closest grained and soundest pieces are to be selected for this purpose, and even the best often split and become rifty after being used for a short time;

this will not unfrequently happen in the middle of an experiment, when the melted globule sinks into the cracks, is lost, and the experiment must be begun again. Instead of sticks of charcoal some persons recommend that the charcoal, after being very finely pulverized, should be moistened with a solution of gum tragacanth, and moulded into a convenient form, a plan that well deserves to be fairly tried: perhaps simply moistening the charcoal-powder, and then submitting it to the action of a very strong screw-press, might be still better. The incombustible supports are Metal, Glass, and Earth; in the use of all which one general caution may be given: to make them as little bulky as possible. The support always abstracts more or less of the heat; and in many cases, especially where metallic spoons are employed, entirely prevents the flame from producing its due effect. The best metallic support is Platina, because it is infusible, and transmits heat to a less distance and more slowly than other metals. A pair of slender forceps of brass pointed with platina is the best possible support for non-metallic minerals that are not very fusible: for the fusible earthy minerals, and for the infusible ones when fluxes are used, leaf-platina will be found the most convenient; it may be folded like paper into any desirable form, and the result of the experiment may be obtained simply by unfolding the leaf in which it was wrapped up. Glass supports are slender tubes or rods of this substance: if the mineral to be examined is of a longish or fibrous shape, one end may be cemented to the top of the glass rod by heating it, and in this state it may be further examined with great convenience. Earthen supports are used only for extemporaneous cupellation; they are best made of bone-ash, and must of necessity be of a certain bulk in order to absorb the litharge and other impurities which it is the object of this process to separate from the *fine metal*. With regard to the magnitude of the specimens required for examination no very precise rule can be given: the most fusible, such as some of the metallic ores, may be as large as a small pea, while the more refractory of the earthy minerals should scarcely exceed the bulk of a pin's head.

The heat that is first applied to investigate the properties of mineral substances should be very low, not exceeding that which exists a little on the outside even of the yellow flame; at this temperature the phosphorescence is best elicited, and decrepitation for the most part takes place; the fusible inflammables begin to melt, and the metallic and most other mineral salts lose their water of crystallization. The white flame will raise a substance to a tolerably full red heat, by which the following effects are produced. Many changes of colour take place, all the yellow ores of Iron become red, and the peach-blossom tinge of flowers of Cobalt becomes blue: certain earthy minerals lose their water of crystallization or of composition, and exfoliate, as Gypsum; or throw up coarse and irregular ramifications, as Prehnite and Mesotype. At this temperature also, carbonate of Strontian begins to tinge the flame with its peculiar crimson colour, and muriate of Copper with its bright green colour. The roasting of all the metallic ores is best carried on at this heat: Sulphur and Arsenic are driven off and exhibit their characteristic odours, grey Antimony melts, native Bismuth runs out from the matrix through which it is disseminated, and Pearlspar and spathose Iron blacken and become magnetic. In the still higher degree of heat produced by the interior white flame, although some minerals still continue perfectly refractory, and undergo but little change of any kind, yet the greater part are very sensibly altered. Some, as Pearlstone, enlarge very considerably in bulk at the first impression of the heat, but are with difficulty afterwards brought to a state of fusion; others become covered with a superficial glazing, and the sharp angles and edges become glossy and rounded off. Others consisting really, though not visibly, of an intimate mixture of two substances differing in fusibility, undergo the process of *fritting*, in which refractory grains are dispersed through a vitreous mass. In others a complete fusion takes place, and produces a spongy, opake, semivitreous mass called a Slag, or an opake glass called an Enamel, or a more or less transparent or true glass; which latter may vary in texture from compact to porous and spongy or intumescent.

In examining the habitudes of the earthy minerals with the blowpipe no fluxes are required, whereas to most of the metallic ores fluxes will be found at almost all times a very useful and often a necessary addition. The ores of the difficultly reducible metals, such as Manganese, Cobalt, Chrome, and Titanium, are characterized by the colour which their oxides give to glass: in all these cases therefore vitreous fluxes must be largely made use of, both to dissolve the earthy matter with which the oxides are generally mixed very intimately, and to furnish a body, with little or no colour of its own, which may receive and sufficiently dilute the inherent colour of the oxide. I say *sufficiently* dilute, because the colour of most oxides is excessively intense, and most persons in their first experiments of this kind are very apt to obtain ambiguous results in consequence of using so large a proportion of oxide that the glass whether blue, red, or green, appears quite black. With regard to fluxes, the following will, I believe, be found amply sufficient. Where the object is not only to dissolve the oxide, but at the same time to retain it at a high state of oxydation, the flux employed should be either nitre or a mixture of this with glass of borax, or, still better, nitrous borax, formed by dissolving common borax in hot water, neutralising its excess of acid by nitric acid, then evaporating the whole to dryness, and lastly hastily melting it in a platina crucible. For an active and at the same time non-alkaline flux boracic acid may be used, or neutral borate of Soda: and where a slight excess of alkali is required, or at least does no harm, common borax by itself, or mixed with a little cream of tartar when a strong reducing flux is wanted, may be had recourse to. For coloured glasses the proper support is leaf-platina, but for reductions charcoal. In the latter case the ore, previously roasted if it contain either sulphur or arsenic, is to be pulverized, and accurately mixed with the flux; a drop of water being then added to make it cohere, it is to be formed into a ball, and deposited in a shallow hole in the charcoal, being also covered by a piece of charcoal if a high degree of heat is wanted. The easily reducible metals however may be treated with less ceremony; a bit of the ore being placed on the charcoal, and covered with glass of borax, will in the space of a few seconds be melted by the blowpipe, and converted into a metallic globule imbedded in a vitreous scoria.

In all cases where a metallic globule is obtained, it should be separated from the adhering scoria, and examined as to its malleability, and other external characters; being then placed a second time on the charcoal but without flux, it is to be brought to a state of gentle ebullition, during which the surface being oxygenated will exhale a heavy vapour that condenses on the blowpipe, or falls down on the charcoal in form of a powder or of spicular crystals, from the colour and other characters of which the nature of the metal may probably be ascertained. If any suspicion is entertained of a portion of silver or of gold being mixed with the oxydable metal, the button must be placed on an earthen support, and there brought to a full melting heat: by degrees the oxydable metal will become scorified, and will entirely sink into the support, leaving on the surface a bright bead of *fine metal* if any such was contained in the alloy: but the proportion of this last being generally very small, and the entire mass of the alloy often not exceeding a large shot, it is not unfrequently necessary to have recourse to the magnifying glass to be fully convinced of the presence or absence of fine metal.

I have now described all the external, physical, and chemical characters that are employed in identifying simple minerals; and the student who makes himself familiar with these will have gained no slight advance in the knowledge of mineralogy. If a specimen is presented to him he will be able to undertake a scientific (or at least a technical) description of it, and may perceive in what circumstances it resembles, and in what it differs from, any other specimen with which he may choose to compare it. He will however naturally be anxious not only to investigate a substance himself, but to examine the account given of it by those mineralogical writers whose works are deservedly in high repute. If it happens that he has been told the name of the substance in question, he has only to refer to the Index or Table of Contents, and is immediately directed to the object of his search.—But if the name is unknown to him, how is he to proceed? Probably, judging from the analogy of the kindred branches of Zoology and Botany, he will refer in full confidence to the beginning of the book for a Synoptical Table, in which the different species shall be arranged conformably to certain essential characters, the presence or absence or peculiar modification of which will enable him to detect first the class, then the order, next the genus, and lastly the species, to which any individual belongs. On inspection however of the Table he will find that the species are indeed arranged into groups, but that either no common characters are prefixed to the groups, or that they relate to the real or supposed results of chemical analysis. If he himself knows any thing of practical chemistry, he will be well aware how long and difficult a problem it is to perform a correct analysis, and will therefore, if excluded from all assistance except that of books, abandon his pursuit in disgust from the mere impossibility of proceeding; or, if he has access to an instructor or a ticketed cabinet, must consult them at every step, with the certainty of being misled whenever they are themselves erroneous. In this respect the student of zoology or of botany has an infinite advantage over a mineralogical student: he gathers a plant in his walk; he perceives that it is possessed of the usual organs of fructification, and therefore that it is a phænogamous plant, and of course not a cryptogamous one: the phænogamous plants are arranged in twenty-three classes, according to the number and position of the stamina: he finds that the individual in question has a considerable number of stamina situated on the receptacle: this character directs him with certainty to the thirteenth class, and thus excuses him from the necessity of paying any attention on this occasion to the eighteen other classes. Proceeding in his search he finds a number of pistilla surrounded by the stamens; hence he is assured that his plant is in the last order of the class; or in technical phraseology that it belongs to the class Polyandria, and the order polygynia: the order is again subdivided into sections according to the number of leaves in the calyx, and the plant in question belongs to that which has a five-leaved calyx. In this section there are only four genera, one of which is characterized by a nectariferous scale at the base of each petal; this determines his plant to be of the genus Ranunculus: he then observes the lanceolate form of the leaves, and the upright stem, and thus ascertains it to be the species Lingua. All this is done with little risk of error, by the sole assistance of Linnæus's Systema or any other analogous work; the student perceives that he makes progress, and at every step becomes more and more attached to his pursuit. If on the other hand he strikes a specimen from a rock, or procures a mass of crystals from a mine, and again has recourse to his Linnæus, he finds indeed a regular arrangement of minerals into Earths, Salts, Inflammables, Metallic Ores, and Organic Remains, but no precise characters by which these several classes may be distinguished from each other. The sapidity and solubility of the Salts, the combustibility of the Inflammables, and the structure of the Organic Remains, may indeed serve for these three classes; but for the two others, which include at least four fifths of the whole, there is no distinction whatsoever. Here therefore our student is stopped at the very outset. If, however, trusting to chance or to his own notions or prejudices, he considers his specimen as belonging to the class of Earths and seeks for it among them, he soon proceeds from doubt to utter uncertainty; turns in despair to the class of Metallic Ores with no better success, and finishes with a resolution to take some other guide than Linnæus through the Mineral Kingdom.

If we discard the Linnæan arrangement of minerals as incorrect and wholly inadequate to the use of the student, and have recourse to more modern authorities, we shall not find ourselves in this particular much benefited by the change. Haüy and Werner, the masters of the two rival schools, have each of them furnished us with their methods; the latter indeed only through the medium, but the authorised medium, of his pupils.

Haüy distributes all the known mineral substances among four classes. The first comprehends the *Acidiferous* bodies, being those into the composition of which any acid enters; this is again subdivided into four orders, according as the acid is either free or combined with an earth, with an alkali, or with a compound alkalino-earthy base. The second class, entitled *Earthy* substances, is not subdivided into orders or genera, but consists of forty-two species with an appendix of twenty-six other substances, the claims of which to the rank of species are considered as dubious. The third class takes the *Non-metallic Combustibles.* The fourth and last class is the *Metallic,* in which the native metals and their ores are arranged in three orders, denoting the difficulty or ease with which they are reduced to the metallic state, and these orders are again subdivided into twenty-two genera. From this short summary it is evident that the arrangement of Haüy is neither calculated nor intended for the assistance of the student, but is to be regarded as an imperfect attempt at a natural arrangement founded on the composition of minerals as deduced from the results of chemical analysis.

The Wernerian arrangement differs in many important particulars from that of Haüy; it approaches much nearer to a natural order, but is scarcely more useful to the student. It is divided into the four classes of Earthy, Saline, Inflammable, and Metallic Minerals. The Earthy Minerals are subdivided into eight undefined genera, seven of which appear from their names to be purely chemical, but in fact are only partially so. Of these the first is the Diamond genus, including only one species, Diamond; it appears at the head of the Earthy class in consequence, doubtless, of its external character of hardness and its infusibility. The second is the Zircon genus; chemical, inasmuch as it includes the few minerals in which the Zircon earth has been found, but in some degree depending on other characters as it includes the Cinnamon stone, which has not yet been analysed, and in which therefore the existence of Zircon earth can only be presumed. The third is the Flint genus including 56 species: among those are some in which the proportion of siliceous earth scarcely amounts to 5 per cent., while in others it amounts to upwards of 90 per cent.: this genus therefore is only imperfectly chemical; nor is it more consistent with itself if tried by the test of external characters; for while seven of the families into which it is divided, namely, the Chrysolite, the Garnet, the Ruby, the Schorl, the Quartz, the Pitchstone, and the Felspar families, may be characterized by the higher degrees of hardness, yet the other, the Zeolite family, includes several minerals of by no means remarkable hardness. The Clay genus, with its Clay, Clay Slate, Mica, Trap, and Lithomarga families, is open to precisely the same kind of remarks as the Flint genus. The same also may be said of the Talc genus. The Calcareous genus is purely chemical, as also are its subdivisions of Carbonate, Phosphate, Fluate, and Sulphate of Lime. The Barytic and Strontian genera are likewise purely chemical. The ninth or Hallite genus relates merely to the easy fusibility of the two species which compose it.

Hence it appears that even the Wernerian arrangement, with all its excellence, is by no means calculated for the use of a learner so situated as to be obliged to depend on books and on his own industry, with such specimens as he can himself procure from the rocks in his vicinity. The general result therefore is, and it is somewhat mortifying, that while the thousands and almost the tens of thousands of species which solicit the attention of the Zoologist and Botanist are very capable of a proper graduated arrangement, in which the inquirer proceeds from the most general characters to those that are less so, and thus by degrees arrives at those which are specific and peculiar, the Mineralogist, who may draw his distinctions from external appearance and impressions, from physical properties or chemical phænomena, has hitherto been completely baffled in his attempts to bring under a similar arrangement the two or three hundred species that form the objects of his study. It appears however to me, that the causes of these failures have arisen rather out of incidental circumstances than out of the nature itself of the subject. Linnæus himself was not by any means the first mineralogist, and scarcely among the first of his day; and the knowledge possessed even by the ablest, the most accurate, and the most inquisitive persons at that time, of mineral substances, was very limited, vague, and erroneous, when compared with the information on this subject possessed by the moderns. If the Linnæan arrangement was both deficient and erroneous at the period of its publication, how can it be that these defects should not have been aggravated tenfold in the endeavour to make it comprehend all the subsequent discoveries in a science of which almost all that is really valuable has been collected during the last forty years? With regard to the two modern systematic authors, it should be borne in mind that they are also teachers of mineralogy, and amply furnished with specimens and all other aids; most of the first mineralogists of Europe have proceeded from their schools, they have had ample practical proof of the efficacy of their mode of instruction, and would naturally therefore be led to discourage, or at least to take no pains in facilitating, the progress of the solitary student, who, whatever be his abilities and whatever be his industry, must long feel his inferiority to one who has been educated in a regular school of the science, enjoying the advantage not only of books, but of living instructors, of well furnished cabinets, and of that encouragement and emulation which can only be duly excited, in scientific as well as in other pursuits, by the support of companions and the opposition of rivals.

Under these circumstances it becomes very desirable that some new attempt should be made to construct an arrangement, whether natural or artificial is of little consequence, which by enabling the unassisted student to identify species, may thus introduce him to the published systems at least of those eminent professors to whose works and instructions the science is so deeply indebted.

The present attempt to supply this acknowledged deficiency will, I am certain, be received with candour; and if it shall be found to facilitate in any material degree the progress of the mineralogical student, I shall consider my labour in its composition as well repaid.

GENERAL SYNOPSIS.

CLASS I.

NON-METALLIC COMBUSTIBLE MINERALS.

§ 1. Combustible with flame.
§ 2. Combustible without flame.

CLASS II.

NATIVE METALS AND METALLIFEROUS MINERALS.

ORDER I.

Volatilizable, wholly or in part, by the blowpipe on charcoal, into a vapour which condenses in a pulverulent form on a piece of charcoal held over it.

§ 1. Entirely, or almost entirely, volatilizable.
† *Lustre metallic.*
†† *Lustre non-metallic.*

§ 2. Partly volatilizable; the residue affording metallic grains with borax, on charcoal,
† *Lustre metallic.*
†† *Lustre non-metallic.*

§ 3. Partly volatilizable; the residue not reducible to the metallic state.
† *Lustre metallic.*
†† *Lustre non-metallic.*

ORDER II.

Fixed; not volatilizable except at a white heat.

§ 1. Assume or preserve the metallic form, after roasting on charcoal while any thing is dissipated, and subsequent fusion with borax.
† *Lustre metallic.*
†† *Lustre non-metallic.*

§ 2. Not reducible to the metallic state before the blowpipe on charcoal, either with or without borax.
† *Magnetic after roasting.*
†† *Not magnetic after roasting.*

CLASS III.

EARTHY MINERALS.

ORDER I.

Soluble, either wholly or in considerable proportion, in cold and moderately dilute muriatic acid.

§ 1. Effervesce vigorously.

§ 2. Effervesce very feebly in cold, but more vigorously in warm, muriatic acid.

ORDER II.

Fusible before the blowpipe.

§ 1. Hardness equal or superior to that of Quartz.

§ 2. Hardness superior to that of common window glass; generally yield in some degree to the knife.

§ 3. Yield to the knife; and sometimes feebly scratch glass.

§ 4. Yield easily to the knife, and sometimes to the nail.

§ 5. Very soft; yield to the nail.

ORDER III.

Infusible before the blowpipe.

§ 1. Hardness equal or superior to that of Quartz.

§ 2. Scratch glass; sometimes yield to the knife.

§ 3. Yield to the knife.

§ 4. Yield to the nail.

CLASS IV.

SALINE MINERALS.

ORDER I.

When dissolved in water afford a precipitate with carbonated Alkali.

ORDER II.

Do not afford a precipitate with carbonated Alkali.

CLASS I.

NON-METALLIC COMBUSTIBLE MINERALS.

The substances of this class are of low specific gravity, scarcely exceeding 2 when pure; the hardest yield with ease to the knife; some of them are eminently combustible, and the rest with greater or less ease and more or less completely, by the action of the blowpipe.

SYNOPTICAL TABLE.

§ 1. Combustible with flame.

1.* Mineral Oil. Fluid.

Brown and brownish black.	2. Mineral Pitch. Melts. 3. Brown Coal. Burns with a weak flame and an odour like peat.
Black.	4. Jet. Shining; fracture large conchoidal; does not soil. 5. Black Coal. Shining; fracture slaty and small conchoidal; soils. 6. Candle Coal. Greyish black; glimmering.

7. Amber. Yellow and yellowish white; strongly resino-electric by friction.
8. Sulphur. Yellow, greenish, grey; burns with a blue flame and a suffocating odour.

§ 2. Combustible without flame.

Greyish black.	9. Mineral Charcoal. Lustre glimmering, silky; soils strongly. 10. Blind Coal. Lustre between resinous and metallic. 11. Plumbago. Lustre metallic; sectile; unctuous.

12. Mellite. Yellowish brown; translucent.

* The numbers in this and in the following Synoptical Tables refer to the species.

CLASS I.

Non-metallic Combustible Minerals.

Sp. 1.
MINERAL OIL. Erdöl *W.* Bitume liquide *H.*
Liquid.

α Naphtha.
Perfectly fluid; transparent; colour pale yellowish or greenish; takes fire on the approach of flame, affording a bright white light.—Sp. gr. 0·7.

β Petroleum.
Fluid, more or less viscid; translucent; colour redish brown passing to black; burns readily with a wick, but scarcely without unless previously heated.

Sp. 2.
MINERAL PITCH. Erdpech *W.*
When heated becomes soft, and approaches a state of viscid fluidity; burns with a bright yellow flame till nothing is left but a few ashes.

α Cohesive.—Erdiges Erdpech *W.* Bitume glutineux *H.*
Colour blackish brown; dull; fracture earthy, uneven; sectile; with a strong bituminous odour.

β Elastic.—Mineral Caoutchouc. Elastiches Erdpech *W.* Bitume élastique *H.*
Colour blackish and greenish brown passing into cream-brown; translucent on the edges; elastic; sectile.—Sp. gr. 0·9—1·2.

γ Compact.—Asphalt. Schlackiges Erdpech *W.* Bitume solide *H.*
Colour black and brownish black; fracture conchoidal with a shining resinous lustre; opake; rather brittle.—Sp. gr. 1.—1·6.

Sp. 3.
BROWN COAL. Bovey Coal.
Colour brown, generally blackish brown; structure that of wood, or of other vegetables, where any particular structure can be observed; burns with a weak flame and an odour resembling that of peat. The more compact varieties have a moderately resinous lustre, an imperfectly conchoidal fracture, and yield easily to the knife. The looser and lighter varieties are the palest in colour, are almost or quite without lustre, have an uneven earthy fracture, and generally yield to the nail.

α Slaty.—Kimmeridge Coal.
Colour liver brown; fine slaty; burns feebly, and leaves a large earthy residue.

Sp. 4.
JET. Pechkohle *W.* Jayet *H.*
Colour black; occurs in elongated reniform masses, in plates, and in the form of branches; structure ligneous; fracture large and perfectly conchoidal, with a shining resinous lustre; does not soil.—Sp. gr. 1·2.—Burns with a greenish flame and a bituminous odour.

Sp. 5.

BLACK COAL. Common Coal. Schiefer kohle Blätter kohle Grob-kohle *W.* Houille *H.*

Colour black; occurs massive; structure thick slaty, with usually thin interposed layers of mineral charcoal; fracture small and imperfectly conchoidal, passing into uneven; lustre shining resinous; soils.—Sp. gr. 1·2.—1·3.—Burns with a bright flame and much smoke.

Sp. 6.

CANDLE COAL. Cannel Coal. Kennel kohle *W.* Houille *H.*

Colour greyish black; occurs massive; fracture imperfectly slaty, in the great, large and flat-conchoidal or even, in the small; lustre glimmering resinous; does not soil; burns with a bright flame, at the same time decrepitating and flying into angular fragments.

Sp. 7.

AMBER. Bernstein *W.* Succin *H.*

Strongly resino-electric by friction; yields easily to the knife.—Sp. gr. 1·07.—Burns with a yellow flame and a fragrant odour, at the same time intumescing, but scarcely melting.

α Colour yellow passing into orange; transparent; fracture perfectly conchoidal, with a shining lustre between vitreous and resinous.

β Colour yellowish white; more or less translucent; fracture imperfectly conchoidal, with a glistening resinous lustre.

Sp. 8.

SULPHUR. Schwefel *W.* Soufre *H.*

Colour yellow, passing on one hand to greenish and greyish, and on the other to orange; translucent, sometimes transparent; occurs in nodular masses and crystallized; form, an acute pyramidal octohedron with scalene triangular faces, and its varieties; fracture uneven passing to splintery, also conchoidal; lustre more or less shining, between resinous and adamantine; yields with great ease to the knife.—Sp. gr. about 2.—Resino-electric by friction; readily fusible into a brown liquid; easily inflammable, burning with a lambent blue flame and a suffocating odour.

α Volcanic Sulphur.
Stalactitic, spongiform, pulverulent; opake or slightly translucent.

Sp. 9.
MINERAL CHARCOAL. Mineralische holzkohle *W.*
Colour greyish black; occurs in thin laminæ, mostly interposed between the layers of Black Coal; structure fibrous and ligneous, with a glimmering silky lustre; soils strongly; friable; burns nearly as rapidly as common charcoal, without either flame or smoke.

Sp. 10.
BLIND COAL. Kilkenny Coal. Welsh Culm. Glanz kohle *W.* Anthracite *H.*
Colour greyish black, with a shining lustre between resinous and metallic; burns with difficulty, without either flame or smoke; does not when half consumed form a cinder as Black Coal does.

Sp. 11.
PLUMBAGO. Graphite. Black-lead. Graphit *W.* Graphite *H.*
Colour iron grey: lustre glistening metallic;

streak shining, lead grey; unctuous to the touch; yields to the nail; soils; burns, by a full red long continued heat, without flame or smoke, leaving behind a portion of red oxide of iron.

90·9 carbon; 9·1 iron. *Berthollet.*

Sp. 12.

MELLITE. Honigstein *W.* Mellite *H.*

Colour honey yellow of various degrees of intensity; occurs granular and crystallized; form, a pyramidal octohedron, with the common base square; sometimes the solid angles of the base are replaced, forming a dodecahedron; fracture conchoidal passing into splintery; lustre glimmering; translucent; softer than amber.—Sp. gr. about 1·6.—Slightly resino-electric by friction; before the blowpipe it becomes of an opake white with black spots, and is at length reduced to ashes; when heated in a close vessel it becomes black.

84 mellilitic acid and water; 16 alumine. *Klapr.*

CLASS II.

NATIVE METALS AND METALLIFEROUS MINERALS.

Some of the substances in this class are inflammable, but all such greatly exceed in specific gravity the heaviest of the combustible minerals.

SYNOPTICAL TABLE.

ORDER I.

Volatilizable, wholly or in part, by the blowpipe on charcoal, into a vapour which condenses in a pulverulent form on a piece of charcoal held over it.

§ 1. Entirely, or almost entirely, volatilizable.

† *Lustre metallic.*

Vapour alliaceous.	84. Native Arsenic. Pale lead grey; fracture granular. 68. Native Antimony, var. α. Tin white; structure lamellar. 62. Native Bismuth. Redish white; structure lamellar.
Vapour sulphureous.	69. Grey Antimony. Very fusible. 83. Molybdena. Scarcely fusible.
	95. Native Tellurium. Vapour acrid like that of horse-radish.
	68. Native Antimony. Tin white: structure lamellar, splendent.
	13. Native Quicksilver. Fluid.

†‡ *Lustre non-metallic.*

Vapour sulphureous.	15. Cinnabar. Streak florid blood colour. 15. Hepatic Quicksilver. Streak cochineal red. 70. Red Antimony. Streak brownish red.
	86. Realgar. Streak lemon yellow and pale orange; very fusible; inflammable; vapour alliaceous and sulphureous.
	64. Bismuth Ochre. Yellowish and greenish grey; is reduced to metallic grains, and then evaporates.

72. Antimonial Ochre. Yellowish and brownish; whitens and evaporates without melting.

71. White Antimony. Melts easily, and then evaporates.

16. Horn Quicksilver. Greyish; lustre adamantine; evaporates without melting?

§ 2. Partly volatilizable; the residue affording metallic grains with borax, on charcoal.

† *Lustre metallic.*

Vapour alliaceous.

85. Mispickel. Silver white; fracture granular uneven.

74. Arsenical Cobalt. Silver white; fracture fine granular; tinges borax blue.

23. White Copper. Yellowish white; fracture fine grained uneven.

73. Bright White Cobalt. Silver white; structure lamellar; tinges borax blue.

4. Antimonial Silver, var. α. Silver white; structure lamellar.

77. Copper Nickel. Yellowish copper red; scarcely yields to the knife.

7. Brittle Sulphuretted Silver. Dark grey.

14. Silver Amalgam. Silver white; whitens the surface of copper when rubbed warm upon it.

9. White Silver. Light lead grey; fracture even or uneven.

4. Antimonial Silver. White; structure lamellar.

95. Native Tellurium, var. α. and β. Steel grey and yellowish white; vapour acrid like horse-radish.

12. Bismuthic Silver. Light lead grey; fracture fine grained uneven.

63. Sulphuretted Bismuth. Light lead grey; structure foliated; vapour sulphureous, sometimes also alliaceous.

50. Triple Sulphuret of Lead. Dark blackish grey; yields a globule of copper surrounded by a shell of galena.

95. Native Tellurium, var. γ. Dark lead grey; structure lamellar; sectile, in thin laminæ flexible.

20. Grey Copper. Dark or yellowish grey; fracture imperfectly conchoidal; decrepitates.

†‡ *Lustre non-metallic.*

Vapour alliaceous. {
29. Arseniate of Copper. Affords a globule of copper.
30. Martial Arseniate of Copper.
56. Arseniate of Lead. Affords a globule of lead.
}

8. Red Silver. Dark metallic grey by reflected, blood red by transmitted light; vapour sometimes alliaceous.

§ 3. Partly volatilizable; the residue not reducible to the metallic state.

† *Lustre metallic.*

36. Common Pyrites, var. α. Vapour alliaceous.

69. Grey Antimony, var. α. Dark lead grey; minutely capillary.

†‡ *Lustre non-metallic.*

Vapour alliaceous. {
48. Arseniate of Iron. Green.
87. Pharmacolite. White.
76. Red Cobalt. Crimson; tinges borax blue.
75. Earthy Cobalt. Bluish and brownish black; tinges borax blue.
}

15. Hepatic Quicksilver. Streak cochineal red; vapour sulphureous.

ORDER II.

Fixed; not volatilizable except at a white heat.

§ 1. Assume or preserve the metallic form, after roasting on charcoal while any thing is dissipated, and subsequent fusion with borax.

† *Lustre metallic.*

Malleable.
1. Native Platina. Greyish white; in grains; infusible.
33. Native Iron. Pale iron grey; flexible; magnetic.
2. Native Gold. Yellow, whitish yellow.
3. Native Silver. White.
17. Native Copper. Red.
6. Sulphuretted Silver. Dark grey; vapour sulphureous.

10. Black Silver. Iron black; fracture small-conchoidal.

11. Carbonated Silver. Greyish black; fracture fine grained uneven.

49. Galena. Lead grey; sectile; vapour sulphureous; yields a globule of lead.

51. Blue Lead Ore. Bluish grey; feebly glimmering; vapour sulphureous; yields a globule of lead.

21. Yellow Copper. Brass or gold yellow; brittle.

18. Glance Copper. Dark grey; sectile; fracture imperfectly conchoidal.

20. Grey Copper. Dark or yellowish grey; brittle; fracture imperfectly conchoidal; decrepitates.

19. Purple Copper. Redish brown with blue tarnish; scarcely sectile.

†‡ *Lustre non-metallic.*

5. Horn Silver. Malleable; very fusible.

Yield a globule of metallic copper.

24. Red Copper. Lead grey by reflected, blood red by transmitted light.
28. Emerald Copper. Green; lustre vitreous; scratches glass feebly; tinges the flame of the blowpipe green.
25. Blue Copper. Blue.
26. Malachite. Emerald green or whitish green; yields easily to the knife.
32. Muriate of Copper. Green; tinges the flame of the blowpipe of a bright green and blue.

31. Phosphate of Copper. Green; yields a redish grey globule.

27. Copper Green. Bluish green; lustre resinous; fracture small-conchoidal.

Yield a globule of metallic lead.

52. Carbonate of Lead. Lustre adamantine; fracture fine grained uneven, and small-conchoïdal.
53. Muriate of Lead. Lustre adamantine; structure lamellar; sectile.
54. Phosphate of Lead. Lustre adamantine; fusible, by itself, on charcoal into a globule which becomes polyhedral by cooling.
55. Sulphate of Lead. Lustre adamantine; fracture compact; yields very easily to the knife.
58. Chromate of Lead. Lustre adamantine; orange red; tinges borax green.
57. Molybdate of Lead. Lustre resinous glistening; yellow, brown.
59. Native Minium. Scarlet; pulverulent.

60. Tinstone. Decrepitates strongly; scarcely yields to the knife; lustre resinous: difficultly reducible.

78. Nickel Ochre. Greenish white; dull; gives a globule of nickel, and tinges the borax hyacinth brown.

§ 2. Not reducible to the metallic state before the blowpipe on charcoal, either with or without borax.

† *Magnetic after roasting.*

Vapour sulphureous. {
34. Magnetic Pyrites. Bronze yellow; magnetic.
36. Common Pyrites. Brass yellow and steel grey.
35. White Pyrites. Tin white, yellowish.
37. Liver Pyrites. Liver brown superficially.
}

38. Magnetic Iron Ore. Streak brownish black; magnetic with polarity.

39. Iron Glance. Streak red.

40. Jaspery Iron Ore. Brownish red; fragments cuboidal.

41. Brown Iron Ore. Streak yellowish brown.

44. Clay Iron Stone. Streak grey, pale yellowish, or brownish; yields easily to the knife.

45. Bog Iron Ore. Streak light yellowish grey; lustre glistening, resinous.

46. Blue Iron Ore. Blue; dull; friable.

42. Sparry Iron Ore. Structure lamellar; fragments rhomboidal; lustre pearly.

43. Black Iron Ore. Tinges borax violet.

24. Red Copper, var. γ.? Brick red and metallic grey.

27. Copper Green? Bluish green; soluble in nitrous acid, with little if any effervescence.

90. Titanite, var. β. and γ. Iron black; granular.

†† *Not magnetic after roasting.*

22. Black Copper. Bluish or brownish black; vapour sulphureous; fusible by itself into a black slag; tinges borax green.

82. Phosphate of Manganese. Redish brown; structure lamellar; fusible by itself into a black enamel.

89. Wolfram. Brownish black; metallic; structure lamellar; decrepitates; fusible by itself into a black scoriaceous globule.

61. Tin Pyrites. Steel grey and yellowish white; vapour sulphureous.

67. Blende. Redish, brownish, and yellowish; lustre adamantine and pseudo-metallic; structure lamellar; infusible.

79. Grey Manganese. Steel grey and iron black; infusible; tinges borax purple.

81. Sulphuret of Manganese. Vapour sulphureous; tinges borax purple.

75. Earthy Cobalt. Bluish or brownish black; infusible; tinges borax blue.

97. Tantalite. Bluish black, with a feeble metallic lustre; in large grains.

98. Yttro-Tantalite. Iron black, with a shining metallic lustre; in large grains.

91. Octohedrite. Blue or brown by reflected light, greenish yellow by transmitted light; scratches glass; infusible.

92. Sphene. Redish, yellowish, greyish, and blackish brown; scratches glass; fusible into a blackish glass.

93. Pitchblende. Greenish, or brownish black; lustre resinous; heavy; infusible.

94. Uranite. Yellow or green; sectile; infusible, but becomes brown by heat; tinges borax yellow.

90. Titanite. Brownish red; structure lamellar; infusible; tinges borax redish yellow.

90. Titanite, var. α. Brownish black; in angular and rounded grains: structure lamellar.

96\. Cerite. Flesh red; compact splintery; infusible, but becomes yellow by heating.

80\. White Manganese. White, yellowish, and redish; infusible; tinges borax purple.

65\. Calamine. Greyish and yellowish white; infusible, but loses 34 per cent. by calcination.

66\. Electric Calamine. Strongly pyro-electric; infusible, but loses 12 per cent. by calcination.

88\. Tungsten. Greyish white; translucent; infusible; heavy.

47\. Chromate of Iron. Black; scratches glass; infusible; heavy; tinges borax green.

CLASS II.

Native Metals and Metalliferous Minerals.

Sp. 1.
NATIVE PLATINA. Gediegen Platin *W.* Platine natif *H.*
Colour between steel grey and silver white; occurs in small flattened grains or small spongy masses; lustre shining metallic; nearly as hard as iron; malleable,—Sp. gr. 15·6.—Infusible.

Sp. 2.
NATIVE GOLD. Gediegen Gold *H.* Or natif *H.*
Colour orange yellow passing into yellow, (when impure yellowish white and greyish yellow,) with a shining metallic lustre; occurs crytallized in cubes and octohedrons with their varieties, also lamelliform, capillary, ramified, and in particular masses of various sizes; soft, flexible, and malleable.—Sp. gr. 12 to 19.—Fusible into a globule which is not altered by continuance of the heat.

α Pulverulent.
Colour redish brown; lustre glimmering or dull; in loose powder, or friable masses.

Sp. 3.
NATIVE SILVER. Gediegen Silber *W.* Argent natif *H.*
Colour pure white, with a shining metallic lustre, but generally tarnished externally to brown-

ish and greyish black; occurs crystallized in cubes and octohedrons, also lamelliform, capillary, and massive; soft, flexible, and malleable.—Sp. gr. about 10.—Fusible into a globule which is not altered by continuance of the heat.

Sp. 4.

ANTIMONIAL SILVER. Spiesglas Silber *W.* Argent antimonial *H.*

Colour between silver and tin white, with a shining metallic lustre, often tarnished externally redish or yellowish; occurs crystallized in 4- or 6-sided prisms deeply striated longitudinally, also in grains and massive; structure lamellar; fracture flat-conchoidal; easily frangible, with at the same time a slight degree of malleability; soft.—Sp. gr. 9·4.—9·8. —Before the blowpipe it melts into a globule, and the antimony flies off in white vapour, leaving behind a bead of pure silver.

84. } silver. 14. } antimony. *Klapr.*
77. } 23. }

α Arsenical Antimonial Silver.—Arsenik Silber *W.* Argent antimonial arsenifère et ferrifère *H.*

Tarnished blackish externally; occurs in small globular and reniform masses, and amorphous; structure finely lamellar, fracture even; harder than Antimonial Silver and with a weaker lustre; before the blowpipe the arsenic and antimony are for the most part volatilized, leaving a globule of impure silver surrounded by slag.

44·25 iron; 35 arsenic; 12·75 silver; 4 antimony. *Klapr.*

Sp. 5.

HORN SILVER. Hornerz *W.* Argent muriaté *H.*

Colour pearl grey passing into greenish, or redish blue or brown; externally tarnished brownish or slate blue; occurs crystallized in minute cubes and in lengthened more or less acicular parallelopipeds; also lamelliform, scaly, investing, and massive; translucent, with a shining or glistening waxy lustre: soft; tenacious, so as to bear being stamped, and to afford shavings when cut with a knife; fusible in the flame of a candle; before the blowpipe on charcoal reducible to a metallic globule, giving out at the same time vapours of muriatic acid; when rubbed with a piece of moistened zinc the surface becomes covered with a thin film of metallic silver.

Composition of a massive variety, 88·7 muriate of silver; 6 oxide of iron; 1·75 alumine; 0·25 sulphuric acid. *Klapr.*

α Buttermilk Silver. Buttermilch Silber *W.*

Colour brownish white, externally slate blue; massive; opake; dull; earthy; before the blowpipe on charcoal it feebly agglutinates, and minute globules of silver appear oozing through the mass.

32·92 muriate of silver; 67·08 alumine, with a trace of copper. *Klapr.*

Sp. 6.

SULPHURETTED SILVER. Silver Glance *J.* Glaserz *W.* Argent sulfuré *H.*

Colour dark lead grey, often with a superficial iridescent tarnish; occurs crystallized, capillary, ramose, lamelliform, and amorphous; form the cube, octohedron, and rhomboidal dodecahedron; fracture flat-conchoidal, with a more or less shining metallic lustre; soft; malleable.—Sp.gr. about 7.—Fusible at a red heat, the sulphur flies off, and a bead of pure silver remains.

85 silver; 15 sulphur. *Klapr.*

α Black Sulphuretted Silver.—Silberschwarze *W.* Argent noir *H.*

Colour nearly the same as common Sulphuretted Silver, but it is without lustre, or at most feebly glimmering; occurs massive, corroded, and pulverulent; fracture uneven; streak shining metallic; more or less sectile; easily fusible; is converted into a slaggy mass containing globules of impure silver.

Sp. 7.

BRITTLE SULPHURETTED SILVER. Brittle Silverglance *J.* Spröd glaserz *W.* Argent noir *H.*

Colour dark grey passing into iron black; when pulverized dark grey, or brownish when passing into Sp. 8; occurs crystallized in hexahedral prisms variously terminated, or in quadrilateral tables which are usually cellularly aggregated; also membranous, massive, and disseminated; externally brightly shining, internally less so, with a metallic lustre; fracture of the crystals imperfectly conchoidal, of the other varieties uneven; soft; brittle; melts before the blowpipe; sulphur, antimony and arsenic fly off, and there remains a bead of brittle silver surrounded by a slag.

66·5 silver; 10 antimony; 12 sulphur; 5 iron; 0·5 copper and arsenic; 1 earthy impurities. *Klapr.*

Sp. 8.

RED OR RUBY SILVER. Rothgültigerz *W.* Argent antimonié sulfuré *H.*

Colour, by reflected light, lead grey and iron black; by transmitted light, carmine, light blood, and cochineal red; streak bright orange passing into dull crimson; occurs crystallized, dendritic, membranous, massive, and disseminated; form, a hexahedral prism variously terminated, a pyramidal dodecahedron with scalene triangular faces variously modified; structure lamellar, (rarely visible,) shining; fracture uneven and imperfectly small-conchoidal, glimmering; brittle; yields easily to the knife.—Sp. gr. about 5·6.—Before the blowpipe it first decrepitates, then melts with a slight effervescence and the disengagement of sulphureous and antimonial yellow and white vapours, (rarely also arsenical,) leaving behind a globule of silver.

Composed, by inference from *Klaproth's Analysis*, of 70·5 sulphuretted silver (60 sil. + 10·5 sul.); 29·4 antimonial kermes (20·3 ant. + 3·2 ox. + 5·9 sul.).

Sp. 9.

WHITE SILVER. Weissgültigerz *W.*

Colour light lead grey passing to steel grey; occurs massive, disseminated, and generally mixed with cubic Galena; fracture even, with a glistening metallic lustre, sometimes uneven when passing to Sulphuretted Silver, sometimes fibrous when passing to Plumose Antimony; streak shining; soft; moderately brittle.—Sp. gr. 5·3.—Before the blowpipe it melts and partly evaporates, leaving a bead of impure silver surrounded by yellow powder.

48·06 lead; 20.4 silver; 7·88 antimony; 2·25 iron; 12·25 sulphur; 7 alumine; 0·25 silex. *Klapr.*

Sp. 10.

BLACK SILVER. Schwarzgültigerz *W.*

Colour iron black passing into steel grey; occurs crystallized in tetrahedrons, also disseminated and massive; fracture small-conchoidal passing into even, with a shining metallic lustre; moderately hard; brittle.

It appears to be merely the argentiferous variety of Grey Copper, Sp. 20.

Sp. 11.

CARBONATED SILVER. Argent carbonaté *H.*

Colour greyish passing to iron black; occurs massive and disseminated; fracture fine-grained uneven passing to even, with a glistening metallic lustre; soft; moderately brittle; heavy.

72·5 silver; 12 carbonic acid; 15·5 oxide of antimony, and a trace of copper. *Selb.*

Sp. 12.

BISMUTHIC SILVER.

Colour light lead grey, becoming deeper on exposure to the air; occurs disseminated, rarely massive; fracture fine grained uneven, with a glistening metallic lustre; soft; not very brittle; before the blowpipe metallic globules begin to ooze out, and on the addition of borax unite into one mass, the flux at the same time acquiring an amber colour; the metallic button is brittle, and of a tin white colour.

33 lead; 27 bismuth; 15 silver; 4·3 iron: 0.9 copper; 16·3 sulphur. *Klapr.*

Sp. 13.

NATIVE QUICKSILVER. Gediegen Quecksilber *W.* Mercure natif *H.*

Colour silver white; lustre splendent, metallic;

occurs in fluid globules; volatilizes entirely before the blowpipe at less than a red heat.

Sp. 14.

SILVER AMALGAM. Naturliches Amalgam *W.* Mercure argental *H.*

Colour silver white or greyish, often tarnished externally; occurs crystallized in small octohedrons or rhomboidal dodecahedrons; also lamelliform, massive, and disseminated; it is sometimes semi-fluid; when solid it exhibits a flat conchoidal fracture; it is soft, creaks when cut, and is very heavy; it whitens the surface of copper when rubbed warm on it; before the blowpipe the mercury is volatilized, and a bead of pure silver remains.

36 silver; 64 mercury. *Klapr.*

Sp. 15.

CINNABAR. Zinnober *W.* Mercure sulfuré *H.*

Colour scarlet passing into cochineal red and lead grey; streak bright scarlet; yields metallic mercury on distillation with iron filings; before the blowpipe it melts, and is volatilized with a blue flame and a sulphureous odour.—Sp. gr. 7·7.—8·16.

† *Nearly pure.*

α Crystallized.

In small hexahedral prisms, pyramidal octohedrons, trihedral pyramids, and pyramidal hexahedrons; lustre splendent, almost pseudo-metallic; translucent.

β Lamellar.

Structure strait or curved lamellar, often superficially striated; lustre shining, between adamantine and semi-metallic; translucent.

84·5—85 mercury; 14·75—14·25 sulphur. *Klapr.*

γ Fibrous.

Structure minutely fibrous; lustre glimmering, silky.

δ Massive.

Fracture fine grained uneven passing into even and conchoidal; opake, or nearly so.

† † *Mixed with earth and other impurities.*

ε Hepatic Cinnabar. Quecksilber lebererz *W.* Mercure sulfuré bituminifère *H.*

Colour dark crimson passing to lead grey; receives a polish by friction, and gives a streak of a cochineal red colour; occurs compact and slaty; lustre usually glistening and semi-metallic; opake; easily frangible; sectile.—Sp. gr. 7·1.

95·5 cinnabar; 2·3 carbon; 0·6 silex; 0·5 alumine; 0·2 oxide of copper. *Klapr.*

ζ Bituminous.

Consists of Hepatic Cinnabar mixed in various proportions with coarse Coal or bituminous Shale.

Sp. 16.

Horn Quicksilver. Quecksilber hornerz *W.* Mercure muriaté *H.*

Colour greyish white, yellowish, and greenish grey; occurs crystallized in minute tetrahedral prisms terminated by tetrahedral pyramids, also in tubercular crusts and massive; translucent; lustre between adamantine and pseudo-metallic; sectile; totally volatilizable before the blowpipe; soluble in water, and the solution gives an orange precipitate with limewater.

76 oxide of mercury; 16·4 muriatic acid; 7·6 sulphuric acid. *Klapr.*

Sp. 17.

NATIVE COPPER. Gediegen Kupfer *W.* Cuivre natif *H.*

Colour yellowish red with a glistening metallic lustre, often tarnished externally yellowish, blackish, or greenish; occurs crystallized, dendritic, capillary, granular and massive; form, the cube either entire or replaced on its edges and angles, the octohedron, either regular or combined with the cube, a pyramidal dodecahedron with an interposed short six-sided prism; the crystals are commonly dendritically aggregated; harder than silver; perfectly sectile, exhibiting a shining metallic lustre; malleable and flexible.—Sp. gr. 7·7—8·5.—Fusible before the blowpipe into a bead of apparently pure copper.

Sp. 18.

GLANCE COPPER. Kupferglanz *W.* Cuivre sulfuré *H.*

Colour lead or iron grey, often black superficially; occurs crystallized in hexahedral prisms, either perfect or with the terminal edges replaced by secondary planes, or in pyramidal dodecahedrons; fracture imperfectly conchoidal, with a shining metallic lustre; sectile, but not so perfectly as Sulphuretted Silver.—Sp. gr. 5·6.—Readily fusible before the blowpipe, without decrepitation and with ebullition, into a grey globule which does not act on the magnetic needle.

81 copper; 19 sulphur. *Chenev.*

The above are the characters of this species when perfectly pure; but as some of the crystallized and all of the uncrystallized varieties are more or less impure, chiefly from a mixture of iron, the following modifications must be admitted:

Occurs massive and disseminated; moderately sectile; fracture uneven, even, and flat-conchoidal, exhibiting sometimes traces of a lamellar structure; lustre glistening; yields before the blowpipe a grey globule, which acts on the magnetic needle.

78·5 copper; 18·5 sulphur; 2·25 iron; 0·75 silex. *Klapr.*

Sp. 19.

PURPLE COPPER. Bunt Kupfererz *W.* Cuivre pyriteux hépatique *H.*

Colour between copper red and tombac brown, with an iridescent sky-blue tarnish and green spots; occurs massive, lamelliform, and rarely crystallized; form, the cube, either perfect, or with curvilinear faces, or with the solid angles replaced by triangular planes; fracture imperfectly conchoidal passing into fine grained uneven; soft; scarcely sectile.—Sp. gr. 5.—Fusible, but not so easily as Glance Copper, and with less ebullition, into a globule which acts powerfully on the magnetic needle.

69·5—58 copper; 19 sulphur; 7·5—18 iron. *Klapr.*

Sp. 20.

GREY COPPER. Fahlerz *W.* Cuivre gris *H.*

Colour steel grey passing into iron black on one hand, and into yellowish on the other; occurs crystallized, massive, and disseminated; form, the tetrahedron with its varieties; fracture uneven inclining to imperfectly conchoidal, with a shining or glistening metallic lustre; brittle; yields a black or redish brown powder.—Sp. gr. about 4·5.—Before the blowpipe decrepitates, and then melts into a brittle grey globule, giving out a white (sometimes arsenical) vapour.

Crystallized—52 copper; 23 iron; 14 sulphur. *Chenev.*

Massive—31·36 copper; 3·3 iron; 11·5 sulphur; 34·09 antimony; 14·77 silver. *Klapr.*

The argentiferous varieties of this species are black, with a fracture more or less conchoidal and a shining metallic lustre.

Sp. 21.

YELLOW COPPER. Copper Pyrites. Kupferkies *W.* Cuivre pyriteux *H.*

Colour brass or gold yellow, often iridescently tarnished externally; occurs crystallized, dendritic, stalactitic, and amorphous; form, the regular tetrahedron and its derivative octohedron and dodecahedron; structure lamellar, rarely visible; fracture granular passing into imperfectly conchoidal, uneven, or even, with a more or less shining metallic lustre; yields pretty easily to the knife; softer than Iron Pyrites; brittle.—Sp. gr. 4·3.—Fuses before the blowpipe into a black globule emitting a sulphureous vapour, and by degrees acquiring the colour of metallic copper.

Sp. 22.

BLACK COPPER. Kupferschwärtze *W.*

Colour bluish or brownish black; occurs massive, disseminated, and investing; is friable; scarcely soils; heavy; before the blowpipe it gives out a sulphureous vapour, melts into a slag, and colours borax green.

Sp. 23.

WHITE COPPER. Weiss Kupfererz *W.*

Colour between silver white and pale brass yellow, with a glistening metallic lustre; fracture fine grained uneven; occurs amorphous; yields easily to the knife; brittle.—Sp. gr. 4·5.—Before the blowpipe it gives a white arsenical vapour, and fuses into a greyish black slag.

Sp. 24.

Red Copper. Ruby Copper. Rothkupfererz *W.* Cuivre oxydulé *H.*

Colour by reflected light lead grey and cochineal red, by transmitted light between crimson and scarlet; when pulverized approaches to the colour of vermilion; lustre of the grey colour metallic, of the red adamantine; occurs crystallized in the regular octohedron or cube, with their varieties; structure lamellar; fracture granular uneven; transparent or translucent; yields easily to the knife; brittle.—Sp. gr. 3·9.—Easily reducible to the metallic state before the blowpipe on charcoal.

91 copper; 9 oxygen. *Klapr.*

α Capillary.

Colour between scarlet and crimson; lustre shining, adamantine; translucent; in aggregated capillary crystals.

β Amorphous.

Colour dark cochineal red; opake or slightly translucent; massive, membranous, and spongiform.

γ Ferruginous. Tile ore. Ziegelerz *W.*

Colour brick red passing into redish brown and metallic grey; massive; fracture earthy, more or less flat-conchoidal, with a glimmering lustre; opake; blackens, but does not fuse before the blowpipe; gives a dirty green to borax.

Sp. 25.

BLUE COPPER. Mountain-blue. Kupferlazur *W.* Cuivre carbonaté bleu *H.*

Colour sky blue inclining to blackish blue; occurs in small crystals aggregated into globular and clustered masses, or stalactitic; also massive and investing; form, an oblique rhomboidal prism, either simple or terminated by unconformable trihedral summits, or an octohedral prism with dihedral summits; lustre vitreous, more or less shining, passing to resinous; the crystals are strongly translucent, the other varieties less so; yields easily to the knife; brittle.—Sp. gr. 3·2.—3·4.—Soluble with effervescence in nitric acid; before the blowpipe without addition it blackens, but does not melt; with borax on charcoal it effervesces, gives a metallic globule, and colours the flux green.

56 copper; 14 oxygen; 24 carbonic acid; 6 water. *Klapr.*

α Earthy.

Colour smalt blue, generally investing, rarely massive; dull; opake; stains the fingers slightly; easily frangible.

Sp. 26.

MALACHITE. Malachit *W.* Cuivre carbonaté vert *H.*

Colour emerald green passing into grass and leek green; occurs in slender prismatic crystals or fibres, which are aggregated in bundles or stellated; externally shining, internally glistening, with a silky lustre; translucent; very soft; brittle; effervesces with acids; before the blowpipe it blackens, and finally is reduced to the metallic state; with borax it readily affords a bead of copper, and colours the flux green.

α Massive.

Occurs botryoidal, reniform, stalactitic, and cellular; structure concentric-lamellar in one direction, finely fibrous in the other; sometimes the fibres are so exceedingly fine as to be scarcely distinguishable; fracture conchoidal or uneven; lustre usually glistening, silky.—Sp. gr. 3·5.

58 copper; 12·5 oxygen; 18 carbonic acid; 11·5 water. *Klapr.*

Sp. 27.

Copper Green. Kupfergrün *W.*

Colour verdigris green, passing on one hand into emerald green, and on the other into leek and olive green; occurs botryoidal and reniform, also massive and investing; fracture small conchoidal, with a more or less shining resinous lustre; more or less translucent; soft; dissolves in nitric acid with little if any effervescence; before the blowpipe is infusible, but becomes brown; it melts with borax, and tinges it green.

Sp. 28.

Emerald Copper. Kupferschmaragd *W.* Cuivre dioptase *H.*

Colour emerald green; occurs crystallized in lengthened dodecahedrons; structure lamellar, with joints in 3 directions parallel to the faces of an obtuse rhomboid; translucent passing to semi-transparent; lustre shining, vitreous; scratches glass feebly; brittle.—Sp. gr. 3·3.—Before the blowpipe it becomes of a chesnut brown, and tinges the flame green, but is infusible; with borax it gives at length a bead of copper.

25·57 oxide of copper; 42·85 carbonate of lime; 28·57 silex. *Vauq.* (From an analysis of only 4 grains.)

Sp. 29.

ARSENIATE OF COPPER. Cuivre arseniaté *H.* Linzenerz & Olivenerz *W.*

Before the blowpipe it melts, gives out an arsenical vapour, and by subsequent fusion with borax affords a bead of copper.

α Prismatic Arseniate. *Bournon.*

Colour brownish and yellowish green of various degrees of intensity; occurs in irregular acute octohedrons, with or without an intervening prism, or capillary; translucent passing to transparent, with a lustre between vitreous and resinous; harder than Fluor Spar.—Sp. gr. 4·2.—Before the blowpipe it first boils, and then gives a hard redish brown scoria.

60 oxide of copper; 39·7 arsenic acid. *Chenev.*

β Octohedral Arseniate. *Bourn.*

Colour deep blue, rarely bluish white, greenish white, grass green; occurs in very obtuse pyramidal octohedrons, almost lenticular; structure lamellar; more or less transparent, with a vitreous lustre; not so hard as Fluor Spar.—Sp. gr. 2·88.—Before the blowpipe it is converted to a black friable scoria.

49 oxide of copper; 14 arsenic acid; 35 water. *Chenev.*

γ Hexahedral Arseniate. *Bourn.*

Colour deep emerald green; occurs in thin hexagonal tables, with a bright and often pseudo-metallic lustre; softer than Calcareous Spar.—Sp. gr. 2·5.—Before the blowpipe it decrepitates, and passes first to the state of a black spongy scoria, after which it melts into a black globule of a slightly vitreous appearance.

58 oxide of copper; 21 arsenic acid; 21 water. *Chenev.*

δ Trihedral Arseniate. *Bourn.*

Colour deep bluish green passing to black; occurs in three-, four-, and six-sided prisms, in rhomboids and irregular octohedrons; also capillary and mammillated; somewhat harder than calcareous spar.—Sp. gr. 4·2. —Before the blowpipe it flows like water, and in cooling crystallizes in small rhomboidal plates of a brown colour.

54 oxide of copper; 30 arsenic acid; 16 water. *Chenev.*

ε Hæmatitic Arseniate. *Bourn.*

Colour brownish or whitish yellow; occurs mammillated, often drusy superficially; structure finely and diverging fibrous with a silky lustre; before the blowpipe gives a hard black cellular scoria.

50 oxide of copper; 29 arsenic acid; 21 water. *Chenev.*

ζ Amianthiform Arseniate. *Bourn.*

Colour bluish and grass green, brown green, golden brown, straw yellow, and white; occurs in extremely minute parallel or diverging flexible fibres, or in thin dusty lamellæ, with more or less of a silky lustre.

50 oxide of copper; 29 arsenic acid; 21 water. *Chenev.*

Sp. 30.

MARTIAL ARSENIATE OF COPPER.

Colour bright sky blue; occurs in small compressed rhomboidal prisms, which by truncature of the lateral edges pass into six- and eight-sided prisms; the crystals are very minute, and generally grouped into small globular concretions; lustre shining vitreous; transparent; harder than Calcareous Spar.—Sp. gr. 3·4.

22·5 oxide of copper; 27·5 oxide of iron; 33·5 arsenic acid; 12 water; 3 silex. *Chenev.*

Sp. 31.

PHOSPHATE OF COPPER. Phosphor Kupfer *W.* Cuivre phosphaté *H.*

Colour externally greyish black; internally, between emerald and verdigris green; occurs crystallized in small rhomboids with curvilinear faces; also mammillary with a finely fibrous structure, and massive; lustre glimmering, silky; opake; moderately hard; on the first impression of the heat it fuses into a brownish globule, which by the further action of the blowpipe extends on the surface of the charcoal, and acquires a redish grey metallic colour.

68·18 oxide of copper; 30·95 phosphoric acid. *Klapr.*

Sp. 32.

MURIATE OF COPPER. Salzkupfer *W.* Cuivre muriaté *H.*

Colour emerald green passing into olive; occurs in minute cuneiform octohedrons, often truncated on the summits; also massive and in the form of sand; structure of the crystals lamellar; soft.—Sp. gr. 4·4.—It tinges the flame of the blowpipe of a bright green and blue, muriatic acid rises in vapours, and a bead of copper remains on the charcoal.

Sp. 33.

NATIVE IRON. Gediegen Eisen *W.* Fer natif *H.*

Colour paler than that of common Iron, resembling that of Platina; occurs irregularly ramose or cellular; hard; flexible; malleable; magnetic.—Sp. gr. 6·48.

88 iron; 12 nickel. *Howard. Proust.*

Sp. 34.

MAGNETIC PYRITES. Magnetkies *W.* Fer sulfuré ferrifère *H.*

Colour between bronze yellow and copper red, with a more or less shining metallic lustre; occurs amorphous; fracture uneven passing into imperfectly conchoidal; hard; brittle. —Sp. gr. 4·5.—Affects the magnetic needle; before the blowpipe melts into a greyish black globule, giving out a faint sulphureous odour.

63·5 iron; 36·5 sulphur. *Hatchett.*

Sp. 35.

WHITE PYRITES. Strahlkies *W.* Fer sulfuré blanc *H.*

Colour, when pure, tin white passing into brass yellow and steel grey; occurs in small octohedral crystals variously modified, also stalactitic, reniform, and botryoidal; hard; brittle; easily frangible.—Sp. gr. 4·7.—Before the blowpipe it melts, gives out a light sulphureous vapour, and then acts on the magnetic needle; it decomposes much easier than common Pyrites.

46·4—45·66 iron; 53·6—54·34 sulphur. *Hatchett.*

Sp. 36.

COMMON PYRITES. Gemeiner schwefelkies *W.* Fer sulfuré *H.*

Colour brass yellow passing into greenish yellow and steel grey; occurs crystallized, capillary, cellular, massive, disseminated, and investing; form, the cube, octohedron, and dedecahedron, with their varieties; fracture granular-uneven; hard; brittle.—Sp. gr. about 4·8.—Before the blowpipe it melts, gives out a strong sulphureous odour, and then acts on the magnetic needle.

47·3—47·85 iron; 52·7—52·15 sulphur. *Hatchett.*

α Arsenical Pyrites. Fer sulfuré arsenifère *H.* Colour paler than that of common Pyrites; before the blowpipe yields an arsenical as well as sulphureous vapour; does not become magnetic?

Sp. 37.

LIVER PYRITES. Leberkies *W.* Fer sulfuré épigène? *H.*

Colour pale brass yellow inclining to steel grey, generally brown superficially; occurs crystallized in hexahedral prisms and in hexahedral pyramids; also stalactitic, globular, cellular, and amorphous; fracture even, passing into uneven and flat-conchoidal, with a glimmering metallic lustre; in other characters it agrees with common Pyrites.

Sp. 38.

MAGNETIC IRON ORE. Magneteisenstein *W.* Fer oxydulé *H.*

Colour iron black with a shining or glimmering metallic lustre; streak brownish black; occurs crystallized, lamelliform, and massive; form, the octohedron, rhomboidal dodecahedron, rectangular prism terminated by tetrahedral pyramids; fracture granular-uneven, or small conchoidal; with an imperfectly lamellar structure.—Sp. gr. 4·2—4·9.—Highly magnetic, with polarity; before the blowpipe it becomes brown, and does not melt; colours borax of a dirty green.

α Sandy. Eisensand *W.*

Colour dark iron black; occurs in loose octohedral crystals, or in small roundish and angular grains; fracture conchoidal, rarely exhibiting any traces of lamellar structure; lustre brightly shining metallic; yields to the knife.—Sp. gr. 4·6—4·9.

82 oxide of iron; 12·6 oxide of titanium; 4·5 oxide of manganese; 0·6 alumine; a trace of oxide of chrome. *Cordier.*

β Earthy.

Colour blackish brown; more or less friable and staining.

Sp. 39.

Iron Glance. Red Iron Ore. Eisenglanz *W.* Fer oligiste *H.*

Colour, when finely divided, red; very feebly magnetic, in some varieties scarcely at all so; infusible before the blowpipe on charcoal, but becomes magnetic; with borax gives a dirty yellowish green glass.

α Regularly crystallized.

Form, a rhomboid, pyramidal octohedron with its modifications, and pyramidal dodecahedron with its summits truncated; structure lamellar, with joints parallel to the faces of a cuboidal rhomboid; colour deep steel grey, with a brilliant and often iridescent metallic lustre externally; fracture uneven granular, with little lustre; opake.—Sp. gr. 5.—5·2.

β Irregularly crystallized. Volcanic or Specular Iron.

Occurs in very compressed and irregular crystals, often with curvilinear surfaces;

external lustre very brilliant; fracture conchoidal, shining; in other characters agrees with *α*.

γ Lamelliform. Fer oligiste lamelliforme *H.*
Colour iron black; occurs in straight or somewhat curved lamellæ; lustre shining, metallic; the lamellæ in a strong light are translucent, and exhibit a blood colour; more highly magnetic than the other varieties.

δ Micaceous. Iron Mica. Eisenglimmer *W.* Fer oligiste écailleux *H.*
Colour by reflected light iron black, by transmitted light blood red; occurs in minute shining scales, either loose or slightly cohering; unctuous to the touch; when loose adheres to the fingers, but may be blown off again without leaving any stain.

ε Red scaly Iron Ore. Rother Eisenrahm *W.* Fer oligiste luisant *H.*
Colour red with a tinge of brown, and a glistening somewhat metallic lustre; occurs in slightly cohering scaly particles; unctuous to the touch; stains strongly; it passes into var. *δ*.

ζ Red Hæmatite. Rother Glaskopf *W.* Fer oligiste concrétionné *H.*
Colour bluish grey, with a glimmering slightly metallic lustre, passing into brownish red; streak blood red; by friction acquires a high metallic lustre; occurs botryoidal, globular, and stalactitic; structure diverging fibrous in one direction, and concentric lamellar in the other; yields with difficulty to the knife. —Sp. gr. 4·7—5.

η Compact. Fer oligiste compacte *H.*
Colour iron grey passing into brownish red, when pulverized blood red; external lustre of the iron grey usually shining, of the brown glimmering; internal lustre more or less glistening; occurs massive, slaty, specular, and in pseudo-crystals; fracture even, granular-uneven, and flat-conchoidal; yields to the knife.—Sp. gr. 3·5—5.

θ Red Ochre. Ockricher Rotheisenstein *W.* Fer oligiste terreux *H.*
Colour blood red mixed more or less with brown; occurs massive or investing; nearly dull; fracture earthy; usually friable; somewhat meagre to the touch; stains the fingers.—Sp. gr. 3.

Sp. 40.
JASPERY IRON ORE. Jaspisartiger thoneisenstein *W.*
Colour brownish red; occurs massive; fracture flat-conchoidal passing into even, with a glimmering lustre; its fragments approach more or less to cubical; opake; yields to the knife; brittle and easily frangible; blackens and becomes magnetic before the blowpipe.

Sp. 41.
BROWN IRON ORE. Brauneisenstein. Fer oxydé (in part) *H.*
Colour, when pulverized, brown; blackens and becomes magnetic before the blowpipe; infusible; tinges borax olive green.

α Crystallized?
Form, a cube.

β Scaly. Brauner Eisenrahm *W.*
Colour between steel grey and clove brown;

occurs in the form of shining scales, with somewhat of a metallic lustre; either loose, or slightly aggregated into irregularly dendritic forms, or amorphous; stains strongly, and is unctuous to the touch.

γ Brown Hæmatite. Brauner Glaskopf *W.* Fer oxydé hématite *H.*

Colour clove brown, blackish brown, or steel grey; occurs botryoidal and stalactitic, also reniform, tuberous, and coralloidal; structure diverging fibrous in one direction, and generally concentric lamellar in the other; when the fibres are very fine the fracture is more or less conchoidal; lustre of the fibrous glistening, silky; of the conchoidal, shining resinous; streak ochre yellow; softer than red Hæmatite.—Sp. gr. about 4.

79—82 peroxide of iron; 15—14 water; 2 oxide of manganese; 3—1 silex. *Daubuisson.*

δ Compact. Dichter Brauneisenstein *W.*

Colour clove brown; occurs massive and cellular; fracture even passing into flat-conchoidal and granular-uneven; lustre glimmering, somewhat metallic; yields pretty easily to the knife.—Sp. gr. 3·5—3·7.

84—69 peroxide of iron; 11—13 water; .—3 oxide of manganese; 2—10 silex; 0—3 alumine. *Daub.*

ε Ochery. Ockricher Brauneisenstein *W.* Fer oxydé pulverulent *H.*

Colour pale brown, mixed more or less with yellow; fracture earthy; soft; stains the fingers.

83 peroxide of iron; 12 water; 5 silex. *Daub.*

Sp. 42.

SPARRY IRON ORE. Spath Eisenstein *W.* Fer oxydé carbonaté *H.*

Colour yellowish grey, passing by decomposition into yellow, brown, and brownish black; occurs crystallized in rhomboids (generally more or less curvilinear), or massive; structure straight or curved lamellar, with joints parallel to the faces of a rhomboid; fragments rhomboidal; lustre of the undecomposed pearly; yields easily to the knife.—Sp. gr. 3·6—3·8.—Blackens and becomes magnetic before the blowpipe, but does not melt; effervesces with muriatic acid.

58 oxide of iron; 35 carbonic acid; 4·25 oxide of manganese; 0·5 lime; 0·75 magnesia. *Klapr.*

Sp. 43.

BLACK IRON ORE. Schwarz Eisenstein *W.*

Colour bluish black passing into steel grey; occurs botryoidal, reniform, globular, and massive; fracture of the massive conchoidal passing into uneven, of the other varieties even; exhibiting more or less of a fine and diverging fibrous structure; lustre glimmering, imperfectly metallic; becomes shining by friction; yields with some difficulty to the knife; brittle.—Sp. gr. 4.—Infusible; affords a violet glass with borax.

Sp. 44.

CLAY IRONSTONE. Thoneisenstein *W.* Fer oxydé massif et geodique *H.*

Colour ash grey inclining to yellowish and bluish, also brown and redish brown, which last colour is usually the effect of exposure to the weather; fracture even, passing into flat-conchoidal and earthy, with sometimes a slaty structure; glimmering or dull; occurs globular and irregularly reniform (sometimes solid, sometimes hollow or pulverulent internally, forming in the latter case ætites) in tabular masses or amorphous; yields easily to the knife; meagre to the touch.—Sp. gr. 3.—3·5.—Blackens and becomes very magnetic before the blowpipe.

Analysis of Ætites.

76—78 peroxide of iron; 14—13 water; 2—0 oxide of manganese; 5—7 silex; 0—1 alumine. *Daub.*

α Columnar. Stanglicher Thoneisenstein.
Colour brownish red; occurs massive and in globular and angular pieces composed of columnar concretions like starch; dull; soft; brittle; magnetic.

β Lenticular.
Colour redish, or yellowish brown, or greyish black, with a glistening pseudo-metallic lustre; occurs in small granular or lenticular concretions aggregated into masses; often magnetic.

γ Pisiform. Bohnerz *W.* Fer oxydé globuliforme *H.*
Colour yellowish or blackish brown; occurs in small spheroidal grains, rough and dull externally; more or less glistening internally, with a fine earthy or even fracture.
70—73 peroxide of iron; 15—14 water; 0—1 oxide of manganese; 6—9 silex; 7—0 alumine. *Daub.*

Sp. 45.

BOG IRON ORE. Raseneisenstein *W.*

Colour brown passing into black; when pulverized light yellowish grey; occurs tuberous, spongiform, granular, and amorphous; fracture imperfectly conchoidal, uneven, and earthy, with a glistening resinous lustre; soft; becomes magnetic before the blowpipe; fusible?

61 peroxide of iron; 19 water; 7 oxide of manganese; 6 silex; 2 alumine; 2·5 phosphoric acid. *Daub.*

α Earthy.

Colour yellowish brown; occurs in porous cellular masses more or less friable, with little or no lustre.

Sp. 46.

BLUE IRON ORE. Phosphate of Iron. Blaue Eisenerde *W.* Fer phosphaté *H.*

Colour when fresh dug white, by exposure to air becomes smalt or indigo blue; occurs massive, disseminated, and investing; very soft, friable; dull; meagre; rather light; before the blowpipe becomes redish brown, and then melts into a brownish black slag attractable by the magnet.

Sp. 47.

CHROMATE OF IRON. Fer chromaté.

Colour black with somewhat of an olive tinge superficially; occurs massive and disseminated; fracture small and imperfectly conchoidal, imperfectly lamellar and uneven; lustre between resinous and metallic, shining; scratches glass; opake.—Sp. gr. 4·03.—Not magnetic; infusible; tinges borax green.

43 oxide of chrome; 35 oxide of iron; 20 alumine; 2 silex. *Vauq.*

α

Colour pure black with a shining resinous lustre; occurs in granular concretions mixed with pale crimson talc; fracture small and very flat-conchoidal, passing into imperfectly lamellar; does not yield to the knife; heavy.

Sp. 48.

ARSENIATE OF IRON. Würfelerz *W.* Fer arseniaté *H.*

Colour dark brownish green or brownish yellow; occurs crystallized and massive; form, the cube, either perfect or with the solid angles replaced; the planes of the crystals are smooth and shining; internal lustre glistening, vitreous; structure indistinctly lamellar; translucent; yields easily to the knife; brittle.—Sp. gr. 3.—Before the blowpipe it melts, and gives out arsenical vapours.

48 oxide of iron; 18 arsenic acid; 32 water; 2 carbonate of lime. *Vauq.*

By decomposition it acquires a brownish red colour, and at length becomes pulverulent.

Sp. 49.

GALENA. Bleiglanz *W.* Plomb sulfuré *H.*

Colour lead grey; lustre metallic; occurs crystallized, reticulated, and amorphous; form, the cube and octohedron with their varieties; structure lamellar, with joints in three directions parallel to the faces of a cube; fragments rectangular; soft; sectile; easily frangible.—Sp. gr. 7·5.—Before the blowpipe it decrepitates, then melts, emitting a sulphureous odour, and a globule of metallic lead remains.

85·13 lead; 13·02 sulphur; 0·5 oxide of iron. *Thomson.*

κ Lamellar.

In straight or curved lamellar concretions.

β Radiated.

Composed of plates or blades or flattened fibres, either simply divergent or feathery; fragments indeterminate. This variety contains also silver and antimony in various proportions, and forms the passage from Galena into White Silver, Sp. 9.

γ Granular.

Composed of granularly foliated concretions; fragments indeterminate.

δ Compact.

Fracture even, passing into flat-conchoidal with a glistening metallic lustre; fragments indeterminate; passes into White Silver.

Sp. 50.

TRIPLE SULPHURET OF LEAD.

Colour dark grey inclining to black, with a shining metallic lustre; occurs crystallized; form, a rectangular tetrahedral prism either simple, or with the solid angles and edges replaced, or terminated by low tetrahedral pyramids; fracture granular uneven; yields easily to the knife; brittle and easily frangible.—Sp. gr. 5·7.—Before the blowpipe it generally splits and decrepitates, then melts, emitting a white and sulphureous vapour; after which there remains a crust of sulphuretted lead inclosing a globule of copper.

42·62 lead; 24·23 antimony; 12·8 copper; 1·2 iron; 17 sulphur. *Hatchett.*

α Massive.

It is probable that some of the greyer varieties of White Silver belong to this species. The following is an analysis of one of these by Klaproth.

34·5 lead; 16 antimony; 16·25 copper; 2·25 silver; 13·75 iron; 13·5 sulphur; 2·5 silex.

Sp. 51.

BLUE LEAD. Blau Bleyerz *W.*

Colour between lead grey and indigo blue; occurs crystallized and massive; form, a six-sided prism, often somewhat bulging; fracture even, passing into fine grained uneven and flat-conchoidal; lustre feebly glimmering, metallic; fragments indeterminate; soft; approaching to sectile.—Sp. gr. 5·4.—Fuses before the blowpipe, emitting a pungent sulphureous vapour, and is reduced to the metallic state.

Sp. 52.

CARBONATE OF LEAD. Weiss bleyerz and Schwarz bleyerz *W.* Plomb carbonaté *H.*

Colour greyish or yellowish white, light brown, ash grey, smoke grey, and greyish black; occurs crystallized, fibrous, massive, or investing; form, the rectangular octohedron, pyramidal dodecahedron either with or without an intervening six-sided prism: the fibrous consists of acicular prisms, either solitary, diverging, or laterally aggregated into striated columns; lustre adamantine or resinous, varying from splendent to glistening; fracture small conchoidal passing into fine grained uneven, fine splintery or imperfectly fibrous; more or less translucent or transparent; when transparent doubly refractive in a high degree; yields easily to the knife; brittle.—Sp. gr. 6—7·2.—Before the blowpipe decrepitates, becomes yellow, then red, and is immediately reduced to the metallic state; effervesces in dilute muriatic acid, especially if warm.

α Blue or green.
Colour white, more or less streaked and spotted with green or blue from the infiltration of carbonate of copper.

β Lead grey.
Superficially of a metallic grey colour, exhibiting the partial conversion of the Carbonate into Galena.

γ Earthy. Bleyerde *W.*
Colour grey, tinged occasionally greenish, yellowish, and redish; occurs massive, disseminated and superficial; fracture fine grained uneven, passing into fine splintery, earthy and flat-conchoidal; lustre glistening resinous, or dull; opake or slightly translucent on the edges; soft, often friable; heavy.

Sp. 53.
MURIATE OF LEAD. Hornblei *W.*
Colour pale grey passing into wine yellow; occurs crystallized in cuboidal prisms, either simple, or terminated by tetrahedral pyramids, or bevelled on the edges. In one direction it exhibits a lamellar structure with joints in three directions parallel to the faces of a cuboidal prism; in the other exhibits a conchoidal fracture; lustre splendent adamantine; more or less transparent; very soft; sectile and easily frangible.—Sp. gr. 6. —On exposure to the blowpipe on charcoal

it melts into an orange coloured globule, reticular externally when solid; when again melted it becomes white, and on increase of the heat the acid flies off, and minute globules of lead remain behind.

85·5 oxide of lead; 8·5 muriatic acid; 6 carbonic acid. *Klapr.*

Sp. 54.

PHOSPHATE OF LEAD. Grün Bleyerz *W.* Plomb phosphaté *H.*

Colour olive green passing into yellowish green and yellow, and into grass green and greenish grey; occurs crystallized (solitary or in groups), botryoidal, reniform, and massive; form, a hexahedral prism, either simple, or terminated by hexahedral pyramids, or with the lateral edges replaced; fracture small grained uneven passing into splintery, with a glistening resinous or adamantine lustre; more or less translucent; yields easily to the knife; is brittle and easily frangible.—Sp. gr. 6·2—6·9—Before the blowpipe on charcoal it usually decrepitates, then melts, and on cooling forms a polyhedral globule, the faces of which present concentric polygons; if this globule be pulverized and mixed with borax and again heated, a milk white opake enamel is the first result; on continuance of the heat the globule effervesces, and at length becomes perfectly transparent, the lower part of it being studded with globules of metallic lead.

80 oxide of lead; 18 phosphoric acid; 1·62 muriatic acid. *Klapr.*

α Brown Phosphate. Braun Bleyerz *W.*

Colour hair brown passing into grey; occurs in lengthened six-sided prisms or massive;

surface of the crystals blackish and rough; fracture small grained uneven, passing into splintery, with a glistening resinous lustre. Before the blowpipe it melts into a globule, which on cooling concretes into a radiated mass.

78·58 oxide of lead; 19·73 phosphoric acid; 1·65 muriatic acid. *Klapr.*

Sp. 55.

SULPHATE OF LEAD. Bley Vitriol *W.* Plomb sulfaté *H.*

Colour light grey passing into smoke grey; occurs crystallized, tabular, granular, and incrusting; form, a pyramidal octohedron with rectangular bases, and its varieties; fracture compact, with a splendent lustre between adamantine and resinous; more or less translucent; soft, yields to the nail.—Sp. gr. 6·3.—Before the blowpipe it decrepitates, then melts, and is soon reduced to the metallic state.

71—70·5 oxide of lead; 24·8—25·75 sulphuric acid; 2·—2·25 water; 1·—0 oxide of iron. *Klapr.*

Sp. 56.

ARSENIATE OF LEAD. Flokkenerz *K.* Plomb arsenié *H.*

Colour grass green, wine yellow, and wax yellow; occurs in small slender hexahedral crystals, in capillary fibres, compact masses, and granular concretions; is translucent or transparent, with a vitreous, resinous, or silky lustre; when transparent scratches glass; easily frangible.—Sp. gr. 5·0—6·4.—Before the blowpipe on charcoal it exhales arsenical vapours, and is reduced to metallic lead.

69·76 oxide of lead; 26·4 arsenic acid; 1·58 muriatic acid. *Gregor.*

α Reniform. Bleiniere *K.*

Colour brownish red passing by exposure to air into ochre and straw yellow; occurs in reniform masses; fracture conchoidal, glistening with a resinous lustre; opake, soft, brittle.—Sp. gr. 3·9.—Before the blowpipe on charcoal it melts, emits an arsenical vapour, and is at length converted into a black shining globule in which grains of lead are discernible.

Sp. 57.

Molybdate of Lead. Gelbes Bleyerz *W.* Plomb molybdaté *H.*

Colour wax yellow passing into lemon or orange yellow, or dirty honey brown; occurs crystallized, rarely massive; form, a rectangular octohedron, cuboidal prism, a rectangular, eight- or twelve-sided table. The tabular varieties for the most part intersect each other, giving the whole mass a cellular appearance; structure imperfectly lamellar; fracture small grained uneven, passing into small conchoidal, with a glistening resinous lustre; translucent, soft, rather brittle.—Sp. gr. 5·09.—Before the blowpipe it decrepitates, and fuses into a dark grey mass in which globules of reduced lead are visible; with a little borax it forms a brownish globule, and with a larger proportion forms a blue or greenish blue glass.

64·42 oxide of lead; 34·25 oxide of molybdena. *Klapr.*

58·4 oxide of lead; 38 molybdic acid; 2·08 oxide of iron. *Hatchett.*

Sp. 58.

CHROMATE OF LEAD. Roth Bleyerz *W.* Plomb chromaté *H.*

Colour orange red, when pulverized orange yellow; occurs crystallized, rarely disseminated or massive; form, a compressed oblique eight-sided prism, with dihedral or tetrahedral summits, but the crystals are generally very imperfect; structure imperfectly lamellar; fracture fine grained uneven; lustre splendent, between adamantine and resinous; more or less translucent; yields easily to the knife, is brittle and easily frangible.—Sp. gr. 6.—When exposed to the blowpipe it crackles, and melts into a greyish slag; with borax it is in part reduced to the metallic state, and gives a green colour to the flux.

Sp. 59.

NATIVE MINIUM. Plomb oxydé rouge *H.*

Colour vivid scarlet; occurs amorphous and pulverulent, but when examined by the lens exhibits a flaky and crystalline structure; before the blowpipe on charcoal it is converted first to litharge, and then to metallic lead.

Sp. 60.

TINSTONE. Zinnstein *W.* Etain oxydé *H.*

Colour brown passing into nearly black, or redish brown deep or pale, whence it passes into yellowish and greenish white; when pulverized greyish white; occurs crystallized, amorphous, and in loose rolled pieces from the size of the fist to that of grains of sand; form, a pyramidal octohedron with square bases, and its varieties, which are very numerous, many of them being hemitrope crystals; external lustre of the crystals splendent, vitreous; structure lamellar, rarely visible; fracture uneven and imperfectly conchoidal, with a more or less shining resinous lustre; scarcely yields to the knife; gives sparks with steel; brittle.—Sp. gr. 6·7—7.—Before the blowpipe it strongly decrepitates; when finely pulverized and mixed with borax it is reducible on charcoal to the metallic state.

77·5 tin; 21·5 oxygen; 0·25 oxide of iron; 0·75 silex. *Klapr.*

α Wood Tin. Kornisches Zinnerz *W.*

Colour hair brown passing into yellowish grey; occurs in detached pieces either wedge-shaped or reniform; structure divergingly fibrous in one direction, concentric lamellar in the other; lustre glimmering, silky.—Sp. gr. 6·4.

Sp. 61.

Tin Pyrites. Zinnkies *W.* Etain sulfuré *H.*

Colour steel grey passing into yellowish white; occurs amorphous; fracture granular uneven passing into imperfectly conchoidal and lamellar, with a weakly shining metallic lustre; yields easily to the knife; brittle.—Sp. gr. 4·3.—Not magnetic; before the blowpipe fuses into a black slag, exhaling at the same time a sulphureous odour; tinges borax yellowish green.

34 tin; 36 copper; 25 sulphur; 2 iron. *Klapr.*

Sp. 62.

Native Bismuth. Gediegen Wismuth *W.* Bismuth natif *H.*

Colour silver white with a tinge of red, and more or less tarnished externally; occurs crystallized, in feathery and reticular dendrites, lamellar, or amorphous; form, the regular octohedron, or an acute rhomboid; structure perfectly lamellar, with joints in three directions; soft; sectile; not very frangible.—Sp. gr. 9.—Fusible by the mere flame of a candle; before the blowpipe it is volatilized in the form of a white vapour, giving out generally an arsenical odour from an admixture of that latter metal.

Sp. 63.

Sulphuretted Bismuth. Wismuthglanz *W.* Bismuth sulfuré *H.*

Colour between tin white and lead grey; occurs acicular, lamellar, and amorphous; structure lamellar, with joints parallel to the sides and to the short diagonal of a rhomboidal prism; the latter joints are very distinct, the others less so. Of some varieties the structure is radiated; lustre of the lamellar splendent, of the radiated shining; soft, often staining the fingers; brittle.—Sp. gr. 6·1.—It melts in the flame of a candle; before the blowpipe it is for the most part volatilized with a sulphureous odour, leaving a residue which is reducible with difficulty to the metallic state.

Sp. 64.

Bismuth Ochre. Wismuthocher *W.* Bismuth oxydé *H.*

Colour yellowish grey with a tinge of green; occurs massive and pulverulent; fracture fine grained uneven passing into foliated or earthy; lustre, according to the kind of fracture, glistening, shining, or dull; opake; soft, often friable.—Sp. gr. 4·37.—Before the blowpipe on charcoal is easily reducible to the metallic state.

Sp. 65.

CALAMINE. Galmei *W.* Zinc carbonaté *H.*

Colour greyish and yellowish, with a lustre between resinous and vitreous; occurs crystallized in obtuse and acute rhomboids, and in longish quadrilateral tables; structure small and imperfectly lamellar; more or less transparent; yields easily to the knife.—Sp. gr. 4·3.—Dissolves with effervescence in muriatic acid; infusible; loses about 34 per cent. by ignition.

65·2 oxide of zinc; 34·8 carbonic acid. *Smithson.*

α Compact.

Colour greyish, greenish, and yellowish, often brown by mixture with iron; with a glistening lustre between vitreous and resinous; occurs stalactitic, reniform, mammillated, curved-lamellar, pseudomorphous, cellular, and amorphous; fracture splintery and uneven, with an imperfectly fibrous structure; the lighter coloured varieties are translucent on the edges.

64·8 oxide of zinc; 35·2 carbonic acid. *Smithson.*

β Earthy.

Colour greyish or yellowish white; dull; occurs massive and investing; fracture earthy; yields to the nail; opake; adheres to the tongue.—Sp. gr. 3·58.

71·4 oxide of zinc; 13·5 carbonic acid; 15·1 water. *Smithson.*

Sp. 66.

ELECTRIC CALAMINE. Galmei *W.* Zinc oxydé *H.*

Colour greyish, bluish, or yellowish white; occurs crystallized, lamelliform, mammillated, or massive; form, a hexahedral prism with dihedral summits; the crystals are small, and either solitary, or in radiating groups like zeolite; lustre shining vitreous; structure imperfectly lamellar or diverging fibrous; transparent or opake; yields to the knife, but is much harder than common calamine.—Sp. gr. 3·4. —When gently heated is strongly electric; infusible; loses about 12 per cent. by ignition; soluble in muriatic acid without effervescence, and the solution gelatinizes on cooling.

66 oxide of zinc; 33 silex. *Klapr.*

68·3 oxide of zinc; 25 silex; 4·4 water. *Smithson.*

Sp. 67.

Blende. Blende *W.* Zinc sulfuré *H.*

Colour yellowish, redish, or blackish brown, or very dark blood red passing into redish black; occurs crystallized and amorphous; form, the rhomboidal dodecahedron, octohedron, and tetrahedron, with their varieties. The lighter coloured varieties are more or less translucent with a resinous or adamantine lustre; the darker are opake or nearly so, with a pseudo-metallic lustre; structure straight lamellar with joints in six directions; yields pretty easily to the knife; brittle, and easily frangible.—Sp. gr. 3·7 to 4.—Infusible; gives an hepatic odour when pulverized and digested in sulphuric acid.

α Phosphorescent.

Colour yellow mixed more or less with green and brownish red; translucent passing into transparent, with a splendent adamantine lustre; phosphorescent by friction.

β Fibrous.

Colour redish brown; occurs reniform and massive; structure delicately and divergingly fibrous in one direction, concentric lamellar in the other.

Sp. 68.

NATIVE ANTIMONY. Gediegen spiessglanz *W.* Antimoine natif *H.*

Colour tin white, opake, with a splendent metallic lustre; occurs reniform and amorphous; structure straight or slightly curved lamellar, with joints in various directions; yields to the knife; rather sectile; easily frangible. —Sp. gr. 6·7.—Before the blowpipe it melts easily, and volatilizes in the form of a grey inodorous vapour; if the melted button be allowed to cool slowly, it becomes covered with white brilliant acicular crystals. A very minute bead of silver generally remains after the antimony has been volatilized.

98 antimony; 1 silver; 0·25 iron. *Klapr.*

α Arsenical.

Alloyed with a small and variable proportion of arsenic; in consequence of which its vapour when exposed to the blowpipe has an arsenical odour.

Sp. 69.

GREY ANTIMONY. Grau-spiessglanzerz *W.* Antimoine sulfuré *H.*

Colour light lead grey, externally often iridescent; opake, with a metallic lustre; occurs crystallized, lamelliform, in diverging blades or fibres, granularly foliated and fine granular; form, an oblique tetrahedral or hexahedral prism, terminated by tetrahedral pyramids; joints only in one direction parallel to the axis of the prism; lustre of the foliated and bladed varieties splendent, of the others more or less glistening; yields easily to the knife; easily frangible.—Sp. gr. 4·3—4·5.—Melts by the mere flame of a candle; evaporable almost totally before the blowpipe in the form of a white vapour with a sulphureous odour.

κ Plumose. Federerz *W.* Antimoine sulfuré capillaire *H.*

Colour dark lead grey, often iridescent; opake, with a glimmering imperfectly metallic lustre; occurs in very minute capillary crystals, investing the surface of other minerals as with a delicate down or wool, often so interlaced and mutually adherent as to appear like an amorphous crust.—Sp. gr. 3·5.—Before the blowpipe it melts into a black slag, after giving out a vapour which when condensed appears in the form of a white and yellow powder.

Sp. 70.

RED ANTIMONY. Roth spiessglanzerz *W.* Antimoine oxydé sulfuré *H.*

Colour cherry red, externally brownish, bluish, or iridescent; occurs in minute diverging or interlaced capillary crystals, or amorphous; lustre shining between vitreous and adamantine; opake, brittle.—Sp. gr. 4.—Melts and evaporates before the blowpipe, giving out a sulphureous odour.

67·5 antimony; 10·8 oxygen; 19·7 sulphur. *Klapr.*

Sp. 71.

WHITE ANTIMONY. Weiss Spiessglanzerz *W.* Antimoine oxydé *H.*

Colour white, yellowish, or greyish; occurs crystallized, investing, and rarely massive; form, a rectangular table, which by pressure of the nail divides into fibres, or capillary crystals in diverging groups; lustre shining, between pearly and adamantine; translucent, soft, heavy; melts very easily before the blowpipe, and is volatilized in form of a white vapour.

86 oxide of antimony; 3 oxide of antimony with oxide of iron; 8 silex. *Vauq.*

Sp. 72.

ANTIMONIAL OCHRE. Spiessglanz okker *W.* Antimoine oxydé terreux *H.*

Colour straw yellow passing to brown; occurs investing other ores of antimony, and rarely massive; dull; fracture fine earthy; soft, brittle; before the blowpipe on charcoal it becomes white, and evaporates without entering into fusion; with borax it intumesces, and furnishes a few metallic globules.

Sp. 73.

BRIGHT WHITE COBALT. Glanzkobalt *W.* Cobalt gris *H.*

Colour silver white slightly inclining to redish; occurs crystallized, in striated cubes, in octohedrons and eicosihedrons; lustre externally splendent; structure specular lamellar, with joints parallel to the faces of a cube; fracture very fine grained almost even; yields with difficulty to the knife; brittle; not very frangible.—Sp. gr. 6·3—6·5.—Before the blowpipe it first becomes black, then as it gets red hot disengages arsenical fumes, and melts into a metallic globule of a dull black externally, which attracts the magnetic needle and tinges borax of a deep blue.

44 cobalt; 55·5 arsenic; 0·5 sulphur. *Klapr.*

α Stalactitic, botryoidal, amorphous.
Fracture fine grained uneven; structure radiated and imperfectly lamellar.

Sp. 74.
ARSENICAL COBALT. Weisser speiskobalt *W.* Cobalt arsenical *H.*

Colour silver white; occurs crystallized in cubes, in octohedrons and dodecahedrons; structure not visible; fracture fine grained uneven, with a glistening metallic lustre; yields with difficulty to the knife; brittle.—Sp. gr. 7·7.—Before the blowpipe it gives out a copious arsenical vapour on the first impression of the heat; it melts only partially, and that with great difficulty, and is not attractable by the magnet; on the addition of borax it immediately melts into a grey metallic globule colouring the borax of a deep blue.

α Botryoidal, massive.

Sp. 75.
EARTHY COBALT. Erdkobolt *W.* Cobalt oxydé noir *H.*

Colour bluish black, by mixture with iron and other impurities becomes liver brown and straw yellow; occurs mammillary, small botryoidal, investing, rarely massive; fracture fine earthy; dull, but acquires a polish by friction; yields easily to the knife and sometimes to the nail; somewhat sectile.—Sp. gr. 2—2·4.—Before the blowpipe generally gives an arsenical odour; tinges borax blue.

Sp. 76.

Red Cobalt. Rother Erdkobolt *W.* Cobalt arseniaté *H.*

Colour crimson passing to peachblossom red, or whitish; occurs in short divergent acicular prisms, or small botryoidal, or earthy and investing; the crystals are more or less shining and translucent; the other varieties are glimmering or dull, and nearly opake; soft, somewhat sectile; light; before the blowpipe emits an arsenical odour, and tinges glass blue.

Sp. 77.

Copper Nickel. Kupfernickel *W.* Nickel arsenical *H.*

Colour pale copper red, with a greyish or yellowish tinge; occurs in long irregular capillary crystals, reticulated, and botryoidal, but commonly massive; fracture imperfectly conchoidal passing into granular uneven, with a more or less shining metallic lustre; yields with difficulty to the knife; brittle, and difficultly frangible.—Sp. gr. 6·6.—Before the blowpipe it gives out an arsenical vapour, and then fuses, though not very easily, into a dark scoria mixed with metallic grains; is soluble in nitro-muriatic acid, forming a deep grass green liquor, from which caustic fixed alkali throws down a pale green precipitate, whereas from a solution of copper the precipitate is dark brown.

Sp. 78.

Nickel Ochre. Nickel-okker *W.* Nickel oxydé *H.*

Colour apple green, passing into grass green and greenish white; occurs generally investing, rarely massive; is in loose powder or friable; meagre to the touch and light; infusible before the blowpipe; with borax it is reduced, and the glass acquires a hyacinthine colour; insoluble in cold nitric acid.

Sp. 79.

GREY MANGANESE. Grau braunsteinerz *W.* Manganèse oxydé metalloide *H.*

Colour steel grey passing into iron black; occurs crystallized in rhomboidal prisms the alternate angles of which measure 100° and 80°, or in acicular and longitudinally striated prisms either diverging, radiated, or interlaced, or in rectangular tables, or massive with a lamellar, acicular, or finely granular structure, or pulverulent; soft, brittle; marks strongly when rubbed, its streak being black and dull.—Sp. gr. not exceeding 4·7. —Infusible; tinges borax purple; effervesces with muriatic acid, giving out oxymuriatic acid.

Rhomboidal—90·5 brown oxide; 2·25 oxygen; 7 water. *Klapr.*

Acicular—89 brown oxide; 10 oxygen. *Klapr.*

a Compact.

Colour steel grey passing to black, with a glistening lustre which is increased by friction; occurs stalactitic, botryoidal, massive; generally hard, scarcely yielding to the knife.

83·7 oxide of manganese; 14·7 barytes; 1·2 silex; 0·4 carbon. *Vauq.*

Sp. 80.

WHITE MANGANESE. Manganèse oxydé carbonaté *H.*

Colour white, yellowish, or redish; occurs crystallized in curvilinear rhomboids and in lenticular crystals; also mammillated and massive; structure of the crystallized, curved lamellar; translucent on the edges; glistening, with a lustre between resinous and vitreous; moderately hard.—Sp. gr. 2·8.—Effervesces with acids, giving out oxymuriatic acid on digestion with muriatic acid; infusible; becomes black by ignition.

Sp. 81.

SULPHURET OF MANGANESE. Manganglanz *K.* Manganèse sulfuré *H.*

Colour between brownish black and iron black, with a shining metallic lustre; streak dull greenish or brass yellow; occurs massive; fracture fine-grained uneven passing into obscurely foliated; opake; moderately hard. —Sp. gr. 3·95.—Before the blowpipe gives out sulphur, and tinges nitrous borax purple.

82 oxide of manganese; 11 sulphur; 5 carbonic acid. *Klapr.*

Sp. 82.

PHOSPHATE OF MANGANESE. Phosphormangan *K.* Manganèse phosphaté *H.*

Colour redish brown; structure lamellar, with a brilliant and somewhat chatoyant lustre; in thin lamellæ semitransparent; scratches glass.—Sp. gr. 3·6.—Readily fusible before the blowpipe into a black enamel.

42 oxide of manganese; 31 oxide of iron; 27 phosphoric acid. *Vauq.*

Sp. 83.

MOLYBDENA. Wasserblei *W.* Molybdène sulfuré *H.*

Colour pale lead grey with a shining metallic lustre; occurs crystallized in short hexahedral prisms, or massive; structure lamellar, with joints in one direction; sectile; somewhat flexible, but not elastic; unctuous to the touch; stains slightly; streak on paper metallic grey, on pottery or porcelain, greenish. Sp. gr. 4·5—4·7.—Before the blowpipe gives out a sulphureous odour, and when urged by the utmost force of the heat it gives out white vapours and a light blue flame; soluble with violent effervescence in carbonate of soda.

Sp. 84.

NATIVE ARSENIC. Gediegen arsenik *W.* Arsenic natif *H.*

Colour pale lead grey passing into tin white, with a glistening metallic lustre; by exposure to the air becomes greyish black and dull; occurs reniform, in botryoidal and flat mammillary masses, or carious; structure concentric lamellar; fracture fine-grained uneven, often combined more or less with a diverging fibrous structure; acquires a polish by friction; yields to the knife; rather sectile; easily frangible.—Sp. gr. 5·7.—Before the blowpipe it fuses, and burns with a bluish flame and a dense white arsenical vapour, and is volatilized, with the exception of a minute portion of iron sometimes mixed with silver or gold.

Sp. 85.

MISPICKEL. Arsenik kies *W.* Fer arsenical *H.*

Colour silvery white; occurs crystallized and amorphous; form, a right rhomboidal prism, either simple, or with dihedral or tetrahedral summits; lustre shining metallic; fracture granular uneven; hard; brittle.—Sp. gr. 6.5.

—Before the blowpipe it melts, gives out a copious white arsenical vapour, and there remains behind a brittle globule.

α Argentiferous.
Fracture very fine grained; contains from 1 to 10 per cent. of silver.

Sp. 86.
REALGAR. Rothes Rauschgelb *W.* Arsenic sulfuré *H.*
Colour bright aurora red passing into scarlet and orange; streak lemon yellow; occurs crystallized, massive, disseminated, and investing; form, an acute octohedron with scalene triangular faces, sometimes with an intervening tetrahedral prism; lustre splendent between vitreous and waxy; fracture uneven-granular and small conchoidal; translucent and semitransparent; yields to the nail; easily frangible.—Sp. gr. 3·3.—Idioelectric by friction acquiring the resinous electricity; before the blowpipe it melts instantly, and burns with a blue flame giving out sulphureous and arsenical vapours.
75 arsenic; 25 sulphur. *Thénard.*

α Orpiment. Gelbes rauschgelb *W.* Arsenic sulfuré jaune *H.*
Colour bright lemon yellow passing into gold yellow; with a brilliant lustre between adamantine and pseudo-metallic; occurs rarely in very minute crystals, generally massive with a lamellar structure and a single cleavage; translucent; in thin laminæ transparent and flexible.
57 arsenic; 43 sulphur. *Thénard.*

Sp. 87.

PHARMACOLITE. Arsenik blüthe *W.* Chaux arseniaté *H.*

Colour white, with a tinge of redish, yellowish, or grey; occurs in minute capillary crystals aggregated into globular masses, or botryoidal with a loose fibrous structure; lustre glimmering, silky; translucent on the edges; yields to the nail.—Sp. gr. 2·6.—Before the blowpipe is for the most part volatilized, with a dense white arsenical vapour.

50·54 arsenic acid; 25 lime; 24·46 water. *Klapr.*

α Earthy.

Occurs as a thin crust; friable; dull.

Sp. 88.

TUNGSTEN. Schwerstein *W.* Schéelin calcaire *H.*

Colour greyish or pale yellowish white; occurs crystallized and amorphous; form, an octohedron with isosceles triangular faces, either simple or with the solid angles adjacent to the base replaced by two triangular faces; fracture conchoidal and uneven with an obscurely lamellar structure; when massive, granular and splintery; lustre shining, vitreous, verging on adamantine; translucent, when massive opake; yields pretty easily to the knife.—Sp. gr. 5·5—6.—Before the blowpipe it crackles, and becomes opake but does not melt; with borax it forms a transparent or opake white glass, according to the proportions of each.

77·75 oxide of tungsten; 17·6 lime; 3 silex. *Klapr.*

Sp. 89.
WOLFRAM. Wolfram *W.* Schéelin ferruginé *H.*

Colour brownish black, greyish black, tarnishing into a mixture of steel blue and tombac brown; streak redish brown; occurs crystallized; also in concentric lamellar concretions, and massive; form a rectangular parallelopiped, either simple or with dihedral summits; structure lamellar with very distinct joints in one direction, and others very indistinct at right angles to the former; lustre of the principal joints nearly specular, metallic; yields readily to the knife; brittle and easily frangible.—Sp. gr. 7·1—7·3.—Before the blowpipe it decrepitates, and melts without much difficulty into a black somewhat scoriaceous globule, which does not act on the magnet.

Sp. 90.
TITANITE. Rutil *W.* Titane oxydé *H.*

Colour dark blood red passing into redish brown and copper red; streak between yellow and orange; occurs crystallized in rectangular prisms sometimes single, often geniculated; that is, united by one of its extremities with a similar prism, so that the two together form a very obtuse angle: it also occurs in capillary crystals, either single, divergent, or reticulated; or in small fragments or grains: the larger crystals are longitudinally striated, and present a lamellar structure with a double rectangular cleavage parallel to the lateral faces of the prim, and shining with a high adamantine lustre; fracture imperfectly conchoidal passing into uneven and with a glistening lustre; slightly translucent; scratches glass; does not yield to the knife; easily frangible.—Sp. gr. 4·1—4·24.—Infusible by itself; with borax it melts before the blowpipe into a transparent redish yellow glass.

Appears from Klaproth's analysis to be a nearly pure oxide of titanium.

α Nigrine.

Colour brownish black; streak yellowish brown; occurs in loose, angular and rounded grains; structure straight lamellar; fracture flat and imperfectly conchoidal; lustre glistening, adamantine; opake; not magnetic.—Sp. gr. 4·4.

84 oxide of titanium; 14 oxide of iron; 2 oxide of manganese. *Klapr.*

β Menachanite.

Colour iron black passing to greyish and brownish black, not materially altered in the streak; occurs in very small flattish angular grains; structure imperfectly lamellar; fracture fine grained uneven; lustre glistening, between adamantine and metallic; yields to the knife; opake; magnetic.—Sp. gr. 4·4.—Infusible; gives to borax a greenish colour inclining to brown.

45·25 oxide of titanium; 51 oxide of iron; 0·25 oxide of manganese; 3·5 silex. *Klapr.*

γ Iserine.

Colour iron black passing to brownish black, not altered in the streak; occurs in angular grains and rolled pieces; fracture conchoidal; lustre glistening, semimetallic; opake; scratches glass.—Sp. gr.

4·5.—Fusible into a blackish brown glass which acts on the magnet.

Sp. 91.

OCTOHEDRITE. Octaedrit *W.* Anatase *H.*

Colour by reflected light blue, or redish brown passing into steel grey; by transmitted light greenish yellow; occurs crystallized in small acute octohedrons and their varieties; structure lamellar with joints parallel to the faces and to the common base of the octohedron; lustre splendent, adamantine; varies from semi-transparent to opake; scratches glass; brittle.—Sp. gr. 3·8.—Infusible before the blowpipe; when mixed with an equal weight of borax it melts into an emerald green glass, which as it cools crystallizes in needles; by a further addition of borax the result is a clear glass of a hyacinth red, which when heated gently at the point of the flame becomes of a deep opake blue; by continuance of the heat the blue changes to white, and this last returns in a full heat to the original hyacinth red colour.

Appears from the experiments of Vauquelin to be a pure oxide of titanium.

Sp. 92.

SPHENE. Sphen *K.* Rutilite *J.* Titane siliceo-calcaire *H.*

Colour redish, yellowish, greyish, and blackish brown; when pulverized greyish white; occurs in small crystals and amorphous; form a rhomboidal prism terminated by tetrahedral pyramids, or with simple or compound wedge-shaped terminations; sometimes two crystals unite forming either a furrowed or canaliculated crystal, or a compressed rectangularly cruciform one; structure lamellar passing into bladed, with joints in two directions somewhat oblique with regard to the axis of the prism; fracture, at right angles to the axis, flat-conchoidal passing into even; lustre glistening or faintly glimmering; more or less translucent on the edges; scratches glass; brittle.—Sp. gr. 3·1—3·5.—Fusible with difficulty into a blackish glass; with borax gives a transparent yellowish green glass.

35 oxide of titanium; 35 silex; 33 lime. *Klapr.*

Sp. 93.

PITCH BLENDE. Pecherz *W.* Urane oxydulé *H.*

Colour greyish, greenish, or brownish black; occurs reniform, massive and disseminated; structure often imperceptible, sometimes thick and curved lamellar; fracture imperfectly conchoidal; lustre more or less shining, resinous; opake; yields to the knife; brittle.—Sp. gr. 7·5.—Infusible before the blowpipe; with borax it yields a grey slag, with phosphate of soda a clear green globule.

86·5 oxide of uranium; 6 galena; 2·5 black oxide of iron; 5 silex. *Klapr.*

Sp. 94.

URANITE. Uran glimmer *W.* Urane oxydé *H.*

Colour lemon yellow, passing into orange on one hand, and on the other into apple green and emerald green; occurs crystallized in cubes and rectangular tables, rarely in imperfect octohedrons; structure lamellar with joints in one direction parallel to the bases, the other joints being scarcely perceptible; the lamellæ inflexible; more or less translucent with a shining pearly lustre; yields easily to the knife; sectile.—Sp. gr. 3·1.—Before the blowpipe becomes brown, and with borax gives a yellowish green glass; soluble without effervescence in nitric acid.

The yellow, according to Klaproth, is pure oxide of uranium; the green contains, beside, a trace of copper.

α

Pulverulent, or in small tubercular warty excrescences; glimmering or dull; colour yellow, passing to orange or redish brown, and to yellowish green.

Sp. 95.

Native Tellurium. Gediegen Sylvan *W*. Tellure natif *H*.

Colour tin white passing into lead grey, with a shining metallic lustre; occurs in minute crystalline grains, either aggregated or solitary; structure of the grains lamellar; yields to the knife; somewhat brittle.—Sp. gr. 5·7—6·1.—Before the blowpipe it melts before ignition, and on increase of the heat it burns with a greenish flame, and is almost entirely volatilized in a dense white vapour, with a pungent acrid odour like that of horse-radish. It resembles Grey Antimony, but differs in the minuteness of its grains and in not giving out a sulphureous odour when roasted.

92·55 tellurium; 7·2 iron; 0·25 gold. *Klapr.*

α Graphic tellurium. Graphic Gold. Schrifterz *W*.

Colour steel grey, or tin white with a tinge of yellow; externally splendent, internally glistening with a metallic lustre; occurs crystallized in small compressed hexahedral prisms, either with or without tetrahedral summits, and for the most part arranged in rows on the surface of quartz; frequently to the extremities of the prisms are attached others at right angles, giving the whole row the appearance of a line of Persepolitan characters; occurs also, rarely, in granular masses; yields easily to the knife; brittle..—Sp. gr. 5·7.

60 tellurium; 30 gold; 10 silver. *Klapr.*

β Yellow Tellurium. Weiss Sylvanänerz *W.* Gelberz *K.*

Colour silver white passing into brass yellow and grey; occurs in grains and in minute compressed tetrahedral prisms with a lamellar structure and bright metallic lustre; soft; somewhat sectile.—Sp. gr. 10·6.

44·75 tellurium; 26·75 gold; 19·5 lead; 8·5 silver; 0·5 sulphur. *Klapr.*

γ Black Tellurium. Nagyagererz *W.* Blättererz *K.*

Colour between iron black and dark lead grey; occurs crystallized in thin longish hexagonal plates, or amorphous; structure more or less curved lamellar, with joints in one direction; lustre shining metallic; yields easily to the knife; sectile; in thin laminæ flexible; stains slightly.—Sp. gr. 8·9.—Before the blowpipe, it melts and evaporates for the most part, giving out a dense vapour which partly concretes on the charcoal in the form of a redish brown powder.

54 lead; 32·2 tellurium; 9 gold; 0·5 silver; 1·3 copper; 3 sulphur. *Klapr.*

Sp. 96.

CERITE. Cererit *K.* Cerium oxydé silicifère *H.*

Colour between rose red and flesh red; when pulverized, grey; occurs massive and disseminated; fracture compact splintery; shining; semi-transparent; scratches glass, scarcely yielding to the knife; brittle; easily frangible.—Sp. gr. 4·5.—Infusible before the blowpipe, but when pulverized its colour changes from grey to yellow.

54·5 oxide of cerium; 34·5 silex; 3·5 oxide of iron; 1·25 lime; 5 water. *Klapr.*

Sp. 97.

TANTALITE. Tantalit *K.* Tantale oxydé *H.*

Colour between bluish grey and iron black; occurs in imbedded single crystals of the size of a hazel nut; form an ill-defined octohedron; fracture compact with a feeble metallic lustre; gives sparks with steel.—Sp. gr. 7·9.

83 oxide of tantalium; 12 oxide of iron; 8 oxide of manganese. *Vauq.*

Sp. 98.

YTTROTANTALITE. Yttro Tantal *K.* Tantale oxydé yttrifère *H.*

Colour iron black, when pulverized greyish; occurs in nodules about the size of a hazel nut; fracture compact or finely granular, with a shining metallic lustre; yields with difficulty to the knife.—Sp. gr. 5·1.

45 oxide of tantalium; 55 yttria and oxide of iron. *Vauq.*

CLASS III.

EARTHY MINERALS.

Neither reducible to the metallic state before the blowpipe nor volatilizable.

SYNOPTICAL TABLE.

ORDER I.

Soluble, either wholly or in considerable proportion, in cold and moderately dilute muriatic acid.

§ 1. Effervesce vigorously.

102. Carbonate of Lime. Sp. gr. not exceeding 2·8.—Infusible; does not tinge the flame of the blowpipe; yields easily to the knife; fragments, of the crystallized varieties, rhomboidal.

103. Argillo-ferruginous Limestone. Differs from Sp. 102, in acquiring a buff colour by calcination, and in being only partially soluble in muriatic acid.

104. Marl. Differs from Sp. 102, in being readily fusible into a slag, and in being only partially soluble in muriatic acid.

105. Schiefer Spar. White, greenish, or redish; coarsely lamellar passing into slaty; pearly.

106. Arragonite. Yields, but with some difficulty, to the knife; fragments of the crystallized varieties not rhomboidal; in other particulars resembles Sp. 102.

Calamine. Infusible; loses 34 per cent. by ignition. See Class II. Sp. 65.

White Manganese. Colours borax purple. See Class II. Sp. 80.

108. Witherite. Sp. gr. about 4·3.—Fusible with ease into a white enamel.

110. Strontian. Sp. gr. about 3·6.—Infusible; tinges the flame of the blowpipe of a dark red purple colour.

§ 2. Effervesce very feebly in cold, but more vigorously in warm, muriatic acid.

107. Carbonate of Lime and of Magnesia. Does not blacken by calcination.

Brown Spar. Blackens and generally becomes magnetic by calcination. See Sparry Iron Ore, Class II. Sp. 42.

ORDER II.

Fusible before the blowpipe.

§ 1. Hardness equal or superior to that of Quartz.

6. Staurolite. Redish and greyish brown; in imbedded (usually cruciform) prisms; opake; glistening. Frits.

9. Euclase. Pale greyish green; structure lamellar with two rectangular joints; shining vitreous; melts into a white enamel.

10. Emerald. Green, bluish green, yellow green; in six- and twelve-sided prisms; shining vitreous; fusible with difficulty into a whitish frothy glass.

11. Iolite. Violet in one direction, brownish yellow in the other; difficultly fusible into a pale greenish grey enamel.

15. Tourmaline. Nearly as hard as quartz; pyro-electric with polarity; fusible into a frothy yellowish green glass.

16. Garnet. Red, brown, green, yellow, black; mostly muddy; when crystallized, in rhomboidal dodecahedrons, and their varieties; fusible with some difficulty into a black slag, which acts on the magnet.

17. Aplome. Dark brown; in rhomboidal dodecahedrons; scratches quartz slightly; fusible into a blackish glass.

18. Cinnamon Stone. Redish brown; in grains; scratches quartz with difficulty; fusible into a brownish black enamel.

38. Obsidian. Rarely so hard as quartz. See § 2.

46. Thallite. Rarely so hard as quartz. See § 2.

51. Tremolite. See § 2.

84. Gadolinite. Scarcely fusible. See Order III. § 1.

§ 2. Hardness superior to that of common window glass; generally yield in some degree to the knife.

15. Tourmaline. See § 1.

19. Axinite. Violet, brown, greenish; vitreous; fusible with ebullition into a greenish white glass.

22. Felspar. Lamellar with two joints at right angles; pearly; fusible into a frothy white glass.

23. Fettstein. Massive; greenish grey; lustre greasy, slightly chatoyant; easily fusible into a white enamel.

29. Spodumene. Greenish white; massive; pearly; joints in two directions at angles of 100° and 80°; splits, and melts with difficulty into a greyish glass.

30. Chiastolite. See § 3.

31. Gabbronite. Massive; bluish and redish; fracture splintery; difficultly fusible into a white enamel.

32. Wernerite. See § 3.

33. Scapolite. See § 3.

34. Meionite. White; shining; vitreous; in small crystals and grains; easily fusible with ebullition into a white frothy glass.

35. Sommite. White; shining; vitreous; in small crystals and grains; difficultly fusible into a glass.

36. Idocrase. Orange, greenish, yellowish; fracture small grained uneven; lustre vitreo-resinous; fusible into a yellowish glass.

37. Pitchstone. Massive; colours dark; resinous; fracture conchoidal and splintery; fusible into a frothy enamel.

38. Obsidian. Smoke grey passing into black; fracture conchoidal; lustre vitreous; melts into a grey porous mass.

40. Pearlstone. See § 3.

41. Clinkstone. Massive; glistening; easily fusible into a nearly colourless glass.

44. Basaltic Hornblende. Black; crystallized; joints in two directions at angles of 124° and 55°; splendent; difficultly fusible into a black glass.

46. Thallite. Green, bluish, or yellowish; joints in two directions at angles of 114°½ and 65°½, only one of which is very perceptible; fusible into a brownish black scoria.

β Brownish.

δ Sandy.

47. Smaragdite. See § 3 and Order III. § 2.

48. Augite. Blackish and brownish green; joints in two directions nearly rectangular; difficultly fusible into a black enamel.

50. Actynolite. Green, passing sometimes into greyish black; bladed or diverging fibrous; harsh to the touch; fusible into a grey enamel.

51. Tremolite. White, pale yellow, green, blue, or red; lamellar or bladed; pearly; fusible easily and with intumescence into a white enamel.

γ. δ Fibrous; silky.

66. Dipyre. Greyish or redish; in slender fasciculated prisms; vitreous; easily fusible with intumescence.

67. Spinellane. In dark brown crystals; becomes white, and melts with ease into a white frothy enamel.

68. Harmotome. White; generally in cruciform crystals; shining, between vitreous and pearly; phosphorescent by heat; fusible with intumescence.

69. Prehnite. See § 3.

72. Laumonite. Lamellar; exfoliates by exposure to air; fusible with little ebullition into a whitish enamel; gelatinizes.

73. Chabasie. See § 3.

74. Analcime. White or flesh red; form of the crystals garnet shaped; fracture compact conchoidal; fusible into a glass.

77. Melilite. In small orange and yellow crystals; fusible into a glass; gelatinizes.

78. Lapis Lazuli. Blue, not altered by a low red heat; massive; melts into a grey enamel; gelatinizes when calcined.

82. Datolite. Greenish grey; shining; intumesces into a milky mass, and then melts into a rose coloured globule.

85. Allanite. Brownish black; fracture conchoidal; lustre resino-metallic; fusible with intumescence into a brown slag; gelatinizes.

117. Porcellanite. Lilac or red; opake; slaty; fracture large conchoidal; nearly dull; melts into a spongy semitransparent enamel.

§ 3. Yield to the knife; and sometimes feebly scratch glass.

22. Felspar. See § 2.

30. Chiastolite. A slender black prism inclosed within a white one; the black yields a black glass; the white, a grey scoria.

32. Wernerite. Greenish grey; lamellar with rectangular joints; fusible with intumescence into a white enamel.

33. Scapolite. Greyish and greenish; lamellar; between resinous and pearly; scarcely yields to the knife; fusible with intumescence into a shining white enamel.

40. Pearlstone. Grey; in subangular concretions; shining, pearly; swells, splits, and then melts into a grey frothy glass.

41. Clinkstone. See § 2.

42. Basalt. Greyish and bluish black; massive; dull; fuses easily into a black glass.

45. Common Hornblende. Dark brownish green; bladed; tough; lustre between pearly and vitreous; fusible easily into a black glass.

47. Smaragdite. Emerald green, or pseudo-metallic brown; lamellar or bladed; fusible into a grey or greenish enamel.

51. Tremolite. See § 2.

69. Prehnite. Scarcely scratches glass; pale greenish or yellowish; glistening, pearly; pyro-electric; fusible into a frothy yellowish glass.

73. Chabasie. Scarcely scratches glass; white; lamellar, joints parallel to the faces of a cuboidal rhomboid; fusible into a spongy whitish enamel.

78. Lapis Lazuli. See § 2.

83. Boracite. Greenish grey; in cubic crystals; pyro-electric with polarity; fuses with ebullition into a yellowish enamel.

112. Whetslate. Greenish; slaty: fracture splintery; dull; becomes white, and acquires a vitreous glazing.

§ 4. Yield easily to the knife, and sometimes to the nail.

24. Mica. Perfectly lamellar in one direction; the lamellæ elastic; fusible into an opake white enamel.

39. Pumice. Porous; pearly; harsh to the touch; fusible into a grey glass.

43. Wakke. Yellowish grey; dull; massive; streak shining; fusible into a porous slag.

55. Asbestus. See § 5.

70. Stilbite. White; pearly; first exfoliates, and then melts with ebullition into a white enamel.

71. Mesotype. White; pyro-electric with polarity; fusible into a spongy enamel; gelatinizes.

75. Ichthyophthalmite. White, yellowish, greenish; lamellar; pearly and iridescent; exfoliates, and melts with difficulty into a white enamel; gelatinizes.

80. Cryolite. Greyish white; imperfectly lamellar; glistening vitreous; first becomes very liquid, and then forms a slag.

97. Fluor. Lamellar with joints in several directions; shining, between vitreous and resinous; phosphorescent by heat; decrepitates; melts into a glass.

β Gives an emerald green light when heated; does not decrepitate.

100. Anhydrous Gypsum. By exposure to the blowpipe becomes glazed over with a friable white enamel; does not exfoliate.

101. Glauberite. Wine yellow; in oblique rhomboids: decrepitates, and melts into a white enamel; partly soluble in water.

109. Heavy Spar. Heavy; decrepitates, and melts into a hard white enamel; when calcined and laid on the tongue, gives a flavour of sulphuretted hydrogen.

111. Celestine. Rather heavy; melts into an opake white enamel of a caustic acrid flavour.

113. Clay Slate. Slaty; glistening; does not adhere to the tongue; fusible into a slag.

§ 5. Very soft; yield to the nail.

25. Lepidolite, Lilac or grey; scaly; pearly; intumesces, and melts with ease into a semi-transparent white globule.

28. Soapstone. White, greenish, purple; fracture uneven, splintery; very unctuous; fusible into a white somewhat translucent enamel.

55. Asbestus. Fibrous; flexible; unctuous; fuses with difficulty into an enamel or scoria.

55. Mountain Cork. Light, generally supernatant; meagre; fusible into a black slag.

57. Talc. Pale greenish white; pearly; unctuous; in flexible inelastic lamellæ or scales; melts with great difficulty into a white enamel.

64. Chlorite. Blackish green; scaly; glistening; unctuous; becomes black and glazed superficially.

65. Green Earth. See Order III. § 4.

71. Mesotype. See § 4.

72. Laumonite. See § 2.

99. Gypsum. Effloresces and exfoliates, and then melts into a white enamel.

109. Heavy Spar. See § 4.

115. Black Chalk. Greyish and bluish black; soils; meagre; acquires a glazing from the blowpipe.

116. Shale. Grey or blackish; slaty; dull; meagre; adheres to the tongue; melts to a slag.

120. Clay. Plastic with water; melts to a slag.

122. Bole. Glimmering; unctuous; streak shining; adheres to the tongue; fusible into a slag.

124. Fullers' Earth. Greenish and yellowish grey; dull, streak shining; unctuous; fusible into a brownish black slag.

ORDER III.

Infusible before the blowpipe.

§ 1. Hardness equal or superior to that of quartz.

1. Diamond. Scratches every other substance; structure lamellar; lustre splendent adamantine.

2. Zircon. Scarcely scratches Quartz; in grains and small crystals; fracture conchoidal; lustre splendent adamantine; doubly refractive.

α Structure lamellar; lustre shining vitreo-resinous.

3. Corundum. Scratches every substance except diamond; translucent; structure lamellar, with joints parallel to the faces of a rhomboidal prism.

α Fracture conchoidal; structure scarcely visible.

γ Massive. Fracture uneven passing to splintery; nearly opake.

4. Andalusite. Violet red; imperfectly lamellar, with joints parallel to the sides of a nearly rectangular prism; translucent.

7. Cymophane. Yellow mixed with brown; semi-transparent; fracture conchoidal; lustre resino-vitreous, sometimes chatoyant.

8. Spinelle. In octohedral crystals; red, and with tints of blue and yellow; structure imperfectly lamellar; splendent vitreous.

α Purple, green, black; fracture conchoidal.

12. Topaz. Structure lamellar at right angles to the axis of the prism; fracture small-conchoidal; splendent, vitreous; massive, and in striated prismatic crystals.

13. Pycnite. Yellowish, greenish, and redish white; in long prisms or parallel prismatic concretions; glistening; fragile.

15. Tourmaline, var. β. Crimson or violet; in striated prisms; pyro-electric.

79. Latialite. Blue and bluish green; fracture uneven; vitreous; fragile; gelatinizes when finely pulverized.

84. Gadolinite. Greenish and brownish black; as hard as Quartz; fracture conchoidal; shining, vitreous; magnetic; decrepitates strongly; gelatinizes.

86. Lazulite. Light blue; as hard as Quartz; falls to pieces and becomes of a light grey before the blowpipe.

87. Quartz. Scratches glass with ease; fracture conchoidal; lustre shining, vitreous.

β Lustre greasy.

γ Lustre resino-vitreous.

88. Cat's Eye. Grey, greenish, brown; chatoyant; fracture even or imperfectly conchoidal.

89. Opal, var. β. δ. Colours dark, green, red, yellow; fracture conchoidal; lustre resinous; translucent or opake.

91. Chalcedony. Bluish, white, or grey; fracture even, fine splintery, flat-conchoidal; nearly dull; translucent.

α β Red, orange, yellow; fracture conchoidal; glistening.

ζ Apple green. Scarcely so hard as Quartz.

92. Plasma. Dull green with yellow and whitish dots; fracture flat-conchoidal; glistening; translucent.

93. Heliotrope. Dark bluish green, generally with red and yellow spots; fracture imperfectly conchoidal; glistening, somewhat resinous.

94. Flint. Grey, greyish black; fracture conchoidal; glimmering; translucent; easily frangible.

95. Hornstone. Fracture splintery or conchoidal; dull or glimmering; slightly translucent; tough.

114. Indurated Slate. Slaty; as hard as Quartz; fracture splintery or conchoidal; nearly dull; translucent.

α Black; fracture conchoidal.

§ 2. Scratch glass; sometimes yield to the knife.

14. Cyanite. Blue, grey, and bluish green; lustre pearly; lamellar, with the principal joints in one direction; semi-transparent; yields to the knife.

20. Anthophyllite. Brownish, pseudo-metallic; structure lamellar, with joints in two directions at right angles.

21. Leucite. Whitish; in twenty-four-sided crystals; yields to the knife.

47. Smaragdite, var. α. Brown, pseudo-metallic; structure fibrous lamellar.

48. Augite, var. α. Greenish black; in slightly cohering grains.

49. Sahlite. Pale greenish grey; lamellar, with two joints forming alternate angles of 88° and 92°; shining, resino-vitreous.

52. Chrysolite. Yellow mixed with green and brown; doubly refractive; fracture conchoidal; splendent, vitreous.

α Fracture conchoidal and imperfectly lamellar.

59. Jade. Muddy green, greenish white; fracture splintery; glistening; more or less translucent; tough; somewhat unctuous; yields to the knife.

76. Sodalite. See § 3.

89. Opal. Milk white, bluish, or yellowish, with brilliant reflections of blue, yellow, green, and red; fracture conchoidal; shining, vitreous.

α Green, yellow, red, white; lustre resinous; semi-transparent.

90. Hyalite. In small botryoidal concretions, resembling gum Arabic in colour and lustre; fracture small-conchoidal.

91. Chalcedony, var. ζ. See § 1.

93. Heliotrope. See § 1.

96. Tabular Spar. Greyish white; structure lamellar; shining, pearly; fragile; phosphorescent by friction.

§ 3. Yield to the knife.

5. Pinite. Blackish grey or greenish brown; in dodecahedral prisms; fracture fine grained uneven; glistening, resinous.

27. Agalmatolite. Pale greenish yellow; fracture splintery; lustre glimmering, greasy; translucent; unctuous.

53. Schiller Spar. Olive green, with a shining pseudo-metallic lustre; structure lamellar.

54. Hyperstene. Brownish or greenish black with, usually, pseudo-metallic reflections of a copper red; structure lamellar; opake.

56. Indurated Talc. Pale greenish grey; structure confusedly fibrous, bladed and curved slaty; glistening, pearly; rather unctuous.

60. Serpentine. Dark green; fracture splintery passing into conchoidal; glistening, resinous; more or less translucent.

61. Potstone. Greenish grey; structure undulatingly slaty; glistening, pearly; unctuous.

76. Sodalite. Bluish green; structure lamellar; shining, resinous; fracture conchoidal, vitreous.

81. Wavellite. Greyish or greenish; in stellated, short, acicular prisms, or stalactitic; silky; loses about 25 per cent. by strong ignition before the blowpipe.

98. Apatite. White and pale green, yellow, or violet; in short six- or twelve-sided prisms, with or without pyramidal terminations; soluble in muriatic acid.

γ Curved lamellar and finely granular; massive; opake; phosphorescent by heat.

119. Indurated Clay. Grey; earthy.

§ 4. Yield to the nail.

22. Felspar, var. γ. Redish and yellowish white; meagre; soils slightly; scarcely plastic with water.

55. Mountain Cork. See Order II. § 5.

57. Talc. Ditto.

58. Steatite. Colour pale greenish or yellowish; unctuous; streak shining; translucent on the edges.

62. Meerschaum. Yellowish white; fracture fine earthy; opake; adheres to the tongue; light.

63. Native Magnesia. Cream colour; fracture splintery and flat-conchoidal; dull; opake; rather meagre; adheres to the tongue.

65. Green Earth. Greyish or bluish green; fracture flat-conchoidal, even or earthy; dull; streak glistening.

115. Black Chalk. See Order II. § 5.

116. Shale. Ditto.

118. Tripoli. Yellowish grey; fracture coarse earthy; meagre and rough.

121. Pure Clay. White; fracture fine earthy; meagre; soils slightly.

123. Lithomarga. White, red, bluish, grey; fracture flat-conchoidal or even; dull, streak shining; unctuous; adheres to the tongue; light.

125. Cimolite. Greyish white; fracture earthy, uneven; dull; adheres to the tongue.

CLASS III.

Earthy Minerals.

Sp. 1.

DIAMOND. Diamant *W.* Diamant *H.*

Occurs crystallized, and in roundish grains which often present indications of crystalline faces; form, the regular octohedron, and its varieties, which are usually curvilinear polyhedrons; structure perfectly lamellar, with joints parallel to the faces of the octohedron; lustre splendent, adamantine; more or less transparent; hardness superior to that of every other substance.—Sp. gr. 3·5—3·6.—Infusible; very slowly combustible at a white heat.

Sp. 2.

ZIRCON. Zircon *H.*

Somewhat harder than Quartz; natural joints in two directions, parallel to the axis of the crystal; doubly refractive.—Sp. gr. about 4·4.—Infusible.

α Hyacinth. Hiacinth *W.*

Colour brownish orange, passing into redish and yellowish; occurs crystallized and in grains; form, a dodecahedron composed of four hexagonal lateral faces and four rhomboidal terminal ones at each extremity; structure lamellar, with a splendent resino-vitreous lustre; more or less transparent.

70 zircon; 25 silex; 0·5 oxide of iron. *Klapr.*

β Jargoon. Zirkon *W.*

Colours grey, green, brown, redish, always more or less smoky; occurs crystallized and in grains; form, a flat octohedron, either with or without an intervening tetrahedral prism, generally with modifications on the solid angles and edges common to the prism and to the terminal pyramids; structure rarely visible; fracture small conchoidal; lustre splendent adamantine.

69 zircon; 26·5 silex; 0·5 oxide of iron. *Klapr.*

66 zircon; 31 silex; 2 oxide of iron. *Vauq.*

γ Zirconite.

Redish brown; occurs in small crystals imbedded in Sienite; form, a tetrahedral prism with pyramidal terminations, modified on the common solid angles and edges.

65 zircon; 33 silex; 1 oxide of iron. *Vauq.*

Sp. 3.

CORUNDUM. Corindon *H.*

Natural joints parallel to the faces of a rhomboid, the alternate angles of which are 86° 38′ and 93° 22′; inferior in hardness only to Diamond; infusible.

α Telesia. The Oriental Gem. Corindon *H.* Saphir *W.*

Occurs in crystals and small rolled pieces; form, a plane hexahedral prism, a pyramidal dodecahedron variously modified; more or less transparent.—Sp. gr. 4—4·08.

Var. 1. Sapphire. Oriental Chrysolite. Oriental Topaz.

Very hard; fracture conchoidal; natural

joints nearly perceptible; colourless, blue, yellow.

98·5 alumine; 0·5 lime; 1 oxide of iron. *Klapr.*

92 alumine; 5·25 silex; 1 oxide of iron. *Chenev.*

Var. 2. Oriental Ruby. Oriental Amethyst. Less hard than var. 1; structure lamellar; often chatoyant.

90 alumine; 7 silex; 1·2 oxide of iron. *Chenev.*

β Common Corundum. Adamantine Spar. Korund *W.* Corindon harmophane *H.*

Occurs crystallized, massive, and in rolled pieces; form, a hexahedral prism, either perfect or bevelled on the terminal edges; structure lamellar; more or less translucent; colour pale greyish or greenish, redish and brown.—Sp. gr. 3·87.

89·5—84 alumine; 5·5—6·5 silex; 1·25—7·5 oxide of iron. *Klapr.*

γ Emery. Schmiergel *W.* Corindon granulaire *H.*

Occurs massive and disseminated; fracture uneven passing into splintery, with a glistening lustre; translucent on the edges; colour blackish and bluish grey.

86 alumine; 3 silex; 4 oxide of iron. *Tennant.*

53·83 alumine; 12·66 silex; 1·66 lime; 24·66 oxide of iron. *Vauq.*

Sp. 4.

ANDALUSITE. Andalusit *W.* Feldspath apyre *H.*

Occurs crystallized in nearly rectangular prisms, or massive; structure imperfectly lamellar, with rectangular joints; scratches Quartz with ease; infusible; colour redish, more or less translucent.—Sp. gr. 3·16.

52 alumine; 38 silex; 8 potash; 2 oxide of iron. *Vauq.*

Appears to be an intimate mixture of corundum and felspar.

Sp. 5.

PINITE. Pinit *W.* Pinite *H.*

Occurs crystallized in dodecahedral prisms, the solid angles of which are sometimes replaced; fracture fine grained uneven, with slight indications of joints parallel to the sides and especially to the bases of a hexahedral prism, hence it sometimes presents a lamellar structure; colour blackish grey or greenish brown, externally ochreous; lustre glistening resinous; translucent on the edges; yields easily to the knife.—Sp. gr. 2·98.

63·75 alumine; 29·5 silex; 6·75 oxide of iron. *Klapr.*

Sp. 6.

STAUROLITE. Staurolith *W.* Staurotide *H.*

Occurs crystallized in rhomboidal or broad hexahedral prisms, either simple or with the terminal edges replaced; the crystals generally intersect each other by pairs at right angles or obliquely, sometimes by threes, rarely are solitary: fracture uneven or imperfectly conchoidal; lustre glistening, between vitreous and resinous; colour redish or greyish brown; opake or translucent; in hardness about equal to quartz.—Sp. gr. 3·2.—Before the blowpipe it becomes brown, and then frits.

52·25—41 alumine; 27—37·5 silex; 18·5—18·25 oxide of iron. *Klapr.*

Sp. 7.

CYMOPHANE. Chrysoberyll *W.* Cymophane *H.*

Occurs in rounded pieces and small crystals; form, a short and broad hexahedral prism, either simple or terminated by truncated pyramids; structure very rarely visible; fracture perfectly conchoidal, with a splendent resino-vitreous lustre; colour green, mixed more or less with yellow and brown; semitransparent; scratches quartz.—Sp. gr. about 3·8.—Infusible.

71·5 alumine; 18 silex; 6 lime; 1·5 oxide of iron. *Klapr.*

α

With a moving internal lustre of bluish white light.

Sp. 8.

SPINELLE. Ruby. Spinell *W.* Spinelle *H.*

Colour red, verging more or less on crimson or yellow; occurs in grains and crystallized; form, the regular octohedron, either perfect or replaced on the edges or hemitrope; structure lamellar, rarely very distinct; fracture flat-conchoidal; lustre splendent vitreous; scratches quartz.—Sp. gr. 3·7.—Infusible.

84·47 alumine; 8·78 magnesia; 6·18 chromic acid. *Vauq.*

α Pleonaste. Ceylanite. Zeylonit *W.* Spinelle Pleonaste *H.*

Occurs in small crystals; form, the octohedron, rhomboidal dodecahedron and its varieties; fracture flat-conchoidal; colour purple, blue, green, black; lustre splendent, resinous; scratches quartz, but not so hard as Spinelle.—Sp. gr. about 3·8.

β Automalite. Spinelle zincifère *H.*

Occurs in octohedral crystals; structure lamellar with joints parallel to the faces of the crystal; fracture uneven and splintery, with a vitreous lustre; colour dark bluish green, nearly opake; infusible.

42 alumine; 4 silex; 28 oxide of zinc; 5 oxide of iron; 17 sulphur. *Vauq.*

Sp. 9.

EUCLASE. Euclas *W.* Euclase *H.*

Occurs crystallized; form, a hexahedral prism variously terminated, and longitudinally striated; structure lamellar, with joints in two directions, rectangular and parallel to the axis of the prism; fracture conchoidal; lustre shining vitreous; reducible by a slight blow into lamellar fragments; harder than quartz; doubly refractive; colour pale greyish and yellowish green.—Sp. gr. 3·06.—Before the blowpipe it first becomes opake, and then melts into a white enamel.

35—36 silex; 18—19 alumine; 14—15 glycine; 2—3 oxide of iron. *Vauq.*

Sp. 10.

EMERALD. Schmaragd *W.* Emeraude *H.*

Occurs in grains and crystals; form, a low six- or twelve-sided prism, either plain or variously terminated; structure indistinctly lamellar, with joints parallel to the lateral and terminal planes of a six-sided prism; fracture conchoidal; lustre shining vitreous; colour pure green of more or less intensity; somewhat harder than quartz.—Sp. gr. 2·7.—Fusible with difficulty before the blowpipe into a whitish rather frothy glass.

64·5 silex; 16 alumine; 13 glycine; 1·6 lime; 3·25 oxide of chrome. *Vauq.*

α Beryl. Aquamarine. Edler Beril *W.*
Colour blue, yellow, and green, compounded in various proportions; crystals longer in proportion than those of emerald, and deeply striated longitudinally; more distinctly lamellar and harder than emerald.
68 silex; 15 alumine; 14 glycine; 2 lime; 1 oxide of iron. *Vauq.*

Sp. 11.
IOLITE. Dichroite *Cordier.*
Occurs crystallized or in irregular aggregated grains; form, a regular hexahedral prism or a pyramidal dodecahedron; structure indistinctly lamellar, with joints parallel to the lateral faces of the prism; colour violet or prussian blue, but when viewed by transmitted light, at right angles to the axis of the prism, brownish yellow; fracture uneven passing into conchoidal, with a shining vitreous lustre; translucent, passing to opake; scratches quartz.—Sp. gr. 2·56.—Melts with difficulty into a pale greenish grey enamel.

Sp. 12.
TOPAZ. Topaz *W.* Silice fluatée alumineuse *H.*
Occurs crystallized, in rolled pieces and massive; form, at first sight resembling a more or less oblique tetrahedral prism deeply striated; but on closer inspection exhibiting a six-, eight-, ten-, or twelve-sided prism with dissimilar terminations; structure lamellar, with joints at right angles to the axis of the prism; fracture small conchoidal; lustre shining vitreous; colour wine yellow of different tinges passing into colourless, also greenish, greenish blue, lilac blue, and crimson; scratches quartz.—Sp. gr. 3·5.—For the

most part pyro-electric with polarity; infusible, but when long exposed to the utmost force of the blowpipe becomes superficially glazed, and emits a few minute bubbles of gas.

50 alumine; 29 silex; 19 fluoric acid. *Vauq.*

47·5 alumine; 44·5 silex; 7 fluoric acid; 0·5 oxide of iron. *Klapr.*

α Pyrophysalite.

Occurs in roundish somewhat rhomboidal masses; structure lamellar with joints in one direction; splendent vitreous; fracture glimmering; colour greenish white; not quite so hard as quartz.—Sp. gr. 3·45.—Before the blowpipe it becomes white and opake and acquires a vitreous glazing, at the same time disengaging minute bubbles of gas.

Contains, according to Hisinger and Berzelius, alumine, silex, and fluoric acid.

Sp. 13.

Pycnite. Schorlaceous Beryl. Schörlartiger Beryll *W.* Silice fluatée alumineuse *H.*

Occurs crystallized in long hexahedral prisms, and massive composed of parallel prismatic concretions deeply striated and with transverse rents; structure imperfectly lamellar at right angles to the axis of the prism; fracture small and imperfectly conchoidal; lustre shining or glistening, resinous; colour yellowish, greenish, and redish white; translucent; very fragile; scratches quartz.—Sp. gr. 3·5.—Infusible.

60 alumine; 30 silex; 6 fluoric acid; 2 lime; 1 water. *Vauq.*

49·5 alumine; 43 silex; 4 fluoric acid; 1 oxide of iron; 1 water. *Klapr.*

Sp. 14.

CYANITE. Kyanit *W.* Disthène *H.*

Occurs crystallized and amorphous; form, a right or oblique compressed octohedral prism; structure lamellar with joints parallel to the planes of an oblique tetrahedral prism (of these joints only one is very distinct); structure of the amorphous, more or less curved lamellar passing into bladed; colour blue, pearl grey, and pale bluish green, of these the two former often occur together in spots or flamy stripes; lustre shining pearly; scratches glass, but at the same time yields to the knife.—Sp. gr. 3·5.—Infusible.

55·5 alumine; 38·5 silex; 0·5 lime; 2·75 oxide of iron. *Laugier.*

Sp. 15.

TOURMALINE. Schörl *W.* Tourmaline *H.*

Occurs crystallized and in rolled pieces; form, a six-, nine-, or twelve-sided prism (usually long) with dissimilar terminations; structure imperfectly lamellar with joints nearly at right angles to the axis of the prism; fracture more or less perfectly conchoidal; colour white, green, blue, brown, orange, black; generally muddy; lustre splendent, vitreous; scarcely so hard as quartz.—Sp. gr. 3.—3·1.—Pyro-electric, with polarity; fusible into a frothy pale yellowish grey glass.

Green Brasilian T.—40 silex; 39 alumine; 3·84 lime; 12·5 oxide of iron; 2 oxide of manganese. *Vauq.*

Black T.—40 alumine; 35 silex; 22 oxide of iron. *Klapr.*

α Common Schorl. Gemeiner Schörl *W.*

Occurs crystallized and in acicular parallel or diverging concretions; fracture granular uneven, and imperfectly conchoidal; lustre more or less glistening; colour black; fragile.—Sp. gr. 3·2.—Fusible into a blackish slag.

38 silex; 20 alumine; 20 lime; 19 oxide of iron and manganese. *Gerhard.*

β Rubellite. Siberite.

Occurs crystallized; colour violet.—Sp. gr. 3·1.—Infusible, but loses its colour and transparency.

42 silex; 40 alumine; 10 soda; 7 oxide of manganese and iron. *Vauq.*

43·5 silex; 42·25 alumine; 9 soda; 1·5 oxide of manganese and iron. *Klapr.*

Sp. 16.

GARNET. Grenat *H.*

Form, a rhomboidal dodecahedron, a solid with twenty-four trapezoidal faces, and with thirty-six, forty-eight, and sixty faces; harder than quartz; fusible into a black enamel.

α Almandine. Precious garnet. Edler granat. *W.*

Colour red mixed more or less with yellow and blue, generally with a slight smoky tinge; occurs crystallized, lamelliform, and granular; structure imperfectly lamellar, and rarely visible; fracture conchoidal passing into uneven and splintery; lustre more or less shining, resino-vitreous; transparent, translucent.—Sp. gr. 4·3.

35·75 silex; 27·25 alumine; 36 oxide of iron; 0·25 oxide of manganese. *Klapr.*

β Pyrope. Pyrop *W.*

Colour blood red, mixed with yellow; occurs in imbedded granular concretions; fracture conchoidal; lustre splendent, vitreous; transparent.—Sp. gr. 3·8.

40 silex; 28·5 alumine; 10 magnesia; 3·5 lime; 16·75 oxide of iron and manganese. *Klapr.*

γ Common garnet. Gemeiner granat *W.*

Colour redish, yellowish, greenish, and blackish brown; occurs crystallized and massive; fracture fine grained uneven; lustre glistening, resino-vitreous; more or less translucent.—Sp. gr. 3·7.

44 silex; 8·5 alumine; 33·5 lime; 12 oxide of iron. *Klapr.*

43 silex; 16 alumine; 20 lime; 16 oxide of iron. *Vauq.*

δ Melanite. Melanit *W.*

Occurs crystallized in the form of a polyhedron of thirty-six faces; black; opake.—Sp. gr. 3·7.

35·5 silex; 6 alumine; 32·5 lime; 25·25 oxide of iron; 0·4 oxide of manganese. *Klapr.*

ε Colophonite. Pech granat *K.* Grenat resinite *H.*

Lustre resinous.

35 silex; 15 alumine; 29 lime; 6·5 magnesia; 7·5 oxide of iron; 4·75 oxide of manganese; 0·5 oxide of titanium. *Simon.*

Sp. 17.

APLOME.

Occurs in rhomboidal dodecahedrons of a deep orange brown colour; structure lamellar very indistinct; fracture uneven and small-conchoidal; somewhat harder than quartz.—Sp. gr. 3·44.—Fusible into a blackish glass.

40 silex; 20 alumine; 14·5 lime; 14·5 oxide of iron; 2 oxide of manganese. *Laugier.*

It is probably a mere variety of Garnet.

Sp. 18.

CINNAMONSTONE. Kaneelstein *W.*

Occurs in splintery fragments and roundish grains of an orange brown colour; more or less transparent; fracture small-conchoidal; lustre vitreo-resinous; scratches quartz with difficulty.—Sp. gr. 3·6.—Fusible into a brownish black enamel.

38·8 silex; 21·2 alumine; 31·25 lime; 6·5 oxide of iron. *Klapr.*

Sp. 19.

AXINITE. Axinit *W.* Axinite *H.* Thumerstone *J.*

Occurs crystallized and in lamelliform concretions; form, a very compressed oblique rhomboidal prism, the alternate angles of which measure about 101½° and 78½°, the acute lateral edges of the prism are generally replaced; some of the crystals are not symmetrical, and these are pyro-electric like the Tourmaline; fracture small and imperfectly conchoidal, passing, in the more impure varieties, into splintery and fine grained uneven; colour violet, brown, greyish, or greenish; lustre splendent externally, internally more or less shining, vitreous; transparent or translucent; scratches glass; fragile.—Sp. gr. 3·2—3·3.—Fusible with ebullition into a greenish white glass, but on charcoal into a black glass.

44 silex; 18 alumine; 19 lime; 14 oxide of iron; 4 oxide of manganese. *Vauq.*

Sp. 20.

ANTHOPHYLLITE.

Occurs amorphous; structure lamellar, with joints parallel to the faces of a rectangular prism; colour brownish, with more or less of a pseudo-metallic lustre; hardness equal to that of glass—Sp. gr. 3·2.

62·66 silex; 13·33 alumine; 4 magnesia; 12 oxide of iron; 3·25 oxide of manganese; 1·43 water. *John.*

Sp. 21.

LEUCITE. Leuzit *W.* Amphigène *H.*

Occurs crystallized, and in roundish subangular grains; form, a solid bounded by twenty-four equal and similar trapeziums; structure obscurely lamellar, with joints parallel to the faces of a cube; fracture imperfectly and flat-conchoidal; lustre shining or glistening, vitreous; colour greyish, yellowish, or reddish white; more or less translucent; scratches glass with difficulty.—Sp. gr. 2·4.—Infusible.

53·75 silex; 24·62 alumine; 21·35 potash. *Klapr.*

Sp. 22.

FELSPAR. Feldspath *W.* Feldspath *H.*

Structure lamellar, with joints in two directions at right angles to each other; form, a four-, six-, or ten-sided prism, often hemitrope; scratches glass; yields with some difficulty to the knife.—Sp. gr. 2·4—2·7.—Fusible into a spongy glass or a white enamel.

α Adularia. Moonstone.

Occurs crystallized and massive; lustre on the natural joints splendent, almost specular, between vitreous and pearly; fracture imperfectly conchoidal, more or less shining; colour greenish white, often with nacreous or silvery spots; semitransparent.

64 silex; 20 alumine; 2 lime; 14 potash. *Vauq.*

β Common Felspar.

Occurs crystallized, massive, disseminated, granular; lustre on the natural joints, shining, between vitreous and pearly; fracture uneven passing into splintery, glimmering; colour white, yellowish, green, bluish, red; more or less translucent.

62·83 silex; 17·02 alumine; 3 lime; 13 potash; 1 oxide of iron. *Vauq.*

γ Disintegrated Felspar.

Includes the whole series of decomposition by which common felspar passes into porcelain earth. This decomposition seems to begin by impairing the lustre and hardness; and finishes by obliterating the structure; infusible.

Composition of the lamellar.

74 silex; 14·5 alumine; 5·5 lime. *Vauq.*

Composition of the earthy.

71·15 silex; 15·86 alumine; 1·92 lime; 6·73 water. *Vauq.*

δ Labrador Felspar.

Colour smoke grey, with spots of iridescent variable light, exhibiting blue, green, yellow, brown, and red colours, many of them pseudo-metallic; translucent; massive.

ε Compact Felspar.

Occurs crystallized, massive, disseminated; structure imperfectly lamellar; fracture splintery, compact; lustre glistening, glimmering; slightly translucent. Frits.

Sp. 23.

FETTSTEIN *W.* Pierre grasse *H.*

Occurs massive; natural joints parallel to the faces, and to the short diagonal of the base of a right rhomboidal prism; fracture uneven, with a greasy lustre slightly chatoyant; scratches glass; colour dark greenish grey.—Sp. gr. 2·6.—Easily fusible into a white enamel.

44 silex; 34 alumine; 4 oxide of iron; 0·12 lime; 16·5 soda and potash. *Vauq.*

Some of the compact Felspars and the fusible Jades will probably be found to belong to this species.

Sp. 24.

MICA. Glimmer *W.* Mica *H.*

Occurs crystallized, massive, and disseminated; form, a right rhomboidal, hexahedral, or parallelopipedal prism, mostly very short or tabular; structure perfectly lamellar, with joints in three directions parallel to the faces of a rhomboid; of these, only one, however, is very distinct; by sections in this direction lamellæ may be easily obtained of extreme tenuity, flexible, and very elastic: lustre shining, between pearly and resinous, often pseudo-metallic; yields easily to the knife, but scratches glass when the edges of the lamellæ are made use of; smooth, but not unctuous; sectile; fusible with some difficulty into an enamel when the flame is applied to the edges of the lamellæ.—Sp. gr. 2·6—2·9.

47 silex; 20 alumine; 13 potash; 15·5 oxide of iron; 1·75 oxide of manganese. *Klapr.*

48 silex; 34·25 alumine; 8·75 potash; 4·5 oxide of iron; 0·5 oxide of manganese. *Klapr.*

Sp. 25.

LEPIDOLITE. Lepidolith *W.* Lepidolite *H.*

Occurs massive, presenting an aggregate of small flexible scales, or more rarely of hexagonal plates; fracture splintery; the colour of the mass is lilac purple or pearl grey, but the individual scales are white, with a glistening pearly or silvery lustre; translucent; somewhat unctuous to the touch; yields to the nail.—Sp. gr. 2·8.—Before the blowpipe it readily melts into a clear semi-transparent white globule, which on the addition of nitre becomes purple.

54 silex; 20 alumine; 18 potash; 4 fluate of lime; 4 oxide of manganese; 1 oxide of iron. *Vauq.*

Sp. 26.

SCALY TALC. Erdiger talk *W.* Talc granuleux *H.*

An aggregate of minute scales of a greenish colour and a glimmering pearly lustre; friable; adheres to the fingers; unctuous; hardens by exposure to the blowpipe.

50 silex; 26 alumine; 1·5 lime; 5 oxide of iron; 17·5 potash, with a little muriatic acid. *Vauq.*

Sp. 27.

AGALMATOLITE. Talc glaphique *H.* Bildstein *W.*

Occurs massive; fracture splintery and imperfectly slaty, with a glimmering greasy lustre; colour pale greenish yellow mixed more or less with blue or brown; translucent; unctuous to the touch; yields with ease to the knife.—Sp. gr. 2·8.

54 silex; 36 alumine; 0·75 oxide of iron; 5·5 water. *Klapr.*

α

Colour redish white; fracture indistinctly splintery; nearly opake; very soft; sectile; very unctuous to the touch.—Sp. gr. 2·78.

62 silex; 24 alumine; 1 lime; 0·5 oxide of iron; 10 water. *Klapr.*

Sp. 28.

SOAPSTONE.

Colour milk white, greenish grey, and mottled with dull purple; occurs massive; fracture uneven splintery; translucent on the edges; yields to the nail; unctuous to the touch; cracks and falls to pieces in hot water; fusible into a white, somewhat translucent, enamel.

Sp. 29.

SPODUMENE. Spodumen *W.* Triphane *H.*

Occurs massive; structure lamellar, with joints in two directions parallel to the sides of a rhomboidal prism, the alternate angles of which are about 100° and 80°; lustre shining pearly; fracture fine grained uneven, with a glistening lustre; colour greenish white; translucent; scratches glass; easily frangible. —Sp. gr. about 3·2.—Before the blowpipe it splits, and at length melts into a greyish white transparent glass.

64·4 silex; 24·4 alumine; 3 lime; 5 potash; 2·2 oxide of iron. *Vauq.*

Sp. 30.

CHIASTOLITE. Hohlspath *W.* Macle *H.*

Occurs only crystallized in slender rhomboidal or sub-cylindrical prisms, composed of two distinct substances; the exterior part of the prism is of a greyish white colour, and varies in thickness, in some specimens being a mere shell; within this is a dark blue or black prism, exactly parallel to that by which it is inclosed. Frequently from each of the angles of the interior prism there proceeds a black line or thread bisecting the corresponding angle of the white prism, and often terminated by a small black prism. The white part exhibits a lamellar structure, has a slight glistening lustre, is translucent, and scratches glass.—Sp. gr. 2·94.—Before the blowpipe it fuses into a whitish scoria; the black part (which appears similar to the Clay Slate in which the crystals are imbedded) affords a black glass.

α Decomposing.

In this state the white part is soft, dull, opake, and very imperfectly lamellar.

Sp. 31.

GABBRONITE.

Occurs massive; fracture compact splintery; colour grey, with different shades of bluish and redish; translucent on the edges; scratches glass; melts with difficulty into an opake white globule.

Sp. 32.

WERNERITE. Arktizit *W.*

Occurs massive and crystallized in octohedral prisms, with tetrahedral pyramidal terminations; structure imperfectly lamellar, with joints in two directions at right angles to each other; colour greenish grey; lustre more or less shining, between pearly and resinous; translucent; softer than felspar, yields to the knife.—Sp. gr. 3·6.—Melts easily and with intumescence into a white enamel.

40 silex; 34 alumine; 16 lime; 8 oxide of iron; 1·5 oxide of manganese. *John.*

Sp. 33.

SCAPOLITE. Paranthine *H.*

Occurs crystallized, in single or laterally aggregated needles, or amorphous; form, a right octohedral prism, either plane or terminated by hexahedral pyramids; structure lamellar, with joints in two directions; fracture fine grained uneven; colour greyish and greenish white; lustre shining between resinous and pearly; hardness about equal to that of glass.—Sp. gr. 3·68.—Fusible with intumescence into a shining white enamel.

45 silex; 33 alumine; 17·6 lime; 1 oxide of iron and manganese; 1·5 soda; 0·5 potash; *Laugier.*

By decomposition it becomes soft, opake, and acquires a yellowish or dull red colour, with a nacreous or pseudò-metallic lustre.

53 silex; 15 alumine; 13·25 lime; 7 magnesia; 4·5 oxide of manganese; 2 oxide of iron; 3·5 soda. *Simon.*

Sp. 34.

MEIONITE.

Occurs in groups of small crystals or crystalline grains; form, an octohedral prism terminated by tetrahedral pyramids, the lateral and terminal edges of the prism are sometimes replaced; structure lamellar, with joints in two directions at right angles to each other, and parallel to the axis of the prism; fracture flat-conchoidal; lustre shining vitreous; colour greyish white, translucent, sometimes transparent; scratches glass; easily fusible with ebullition into a white spongy glass.

Sp. 35.

SOMMITE. Nepheline *H.* Nepheline *W.*

Occurs in small crystals and crystalline grains; form, a regular hexahedral prism, the lateral edges of which are sometimes replaced; structure lamellar, with joints parallel to the faces of the prism; fracture conchoidal; colour greyish or greenish white; lustre shining, vitreous; transparent or translucent; hardness about equal to that of glass.—Sp. gr. 3·2. —Fusible with some difficulty into a glass.

46 silex; 49 alumine; 2 lime; 1 oxide of iron; *Vauq.*

Sp. 36.

IDOCRASE. Vesuvian *W.*

Occurs crystallized in groups, or lining cavities, or massive; form, a short eight-, fourteen-, or sixteen-sided prism, with complicate flat terminations; fracture for the most part small grained uneven; colour orange, brown, green, and yellowish green; lustre brilliant, vitreo-resinous; scratches glass.—Sp. gr. 3·1 – 3·4. —Fusible into a yellowish translucent glass.

36·5—42 silex; 33—34 lime; 22·25—16·25 alumine; 7·5—5·5 oxide of iron; 0—0·25 oxide of manganese. *Klapr.*

Sp. 37.

PITCHSTONE. Pechstein *W.* Petrosilex resinite *H.*

Occurs massive, and in prismatic, lamelliform, and curved lamellar distinct concretions; structure sometimes slaty; fracture conchoidal passing into splintery; colour grey passing to black or bluish, or green, yellow, or red, mixed more or less with muddy blue and brown; lustre shining or glistening, resino-vitreous; slightly translucent; scratches glass.—Sp. gr. 1·64.—Fusible into a frothy enamel.

73 silex; 14·5 alumine; 1 lime; 1 oxide of iron; 0·1 oxide of manganese; 1·75 soda; 8·5 water. *Klapr.*

Sp. 38.

OBSIDIAN. Obsidian *W.*

Occurs in grains and sub-angular masses; fracture large and perfectly conchoidal; lustre shining vitreous; colour dark grey passing into greenish or brownish black, also smoke brown; transparent or nearly opake according to the intensity of the colour; scratches glass.—Sp. gr. 2·3.—Melts into a greyish or greenish glass.

Sp. 39.

PUMICE. Bimstein *W.*

Occurs massive: structure irregularly fibrous with elongated cells; lustre shining pearly; fracture uneven, glistening; colour greyish, yellowish, and light smoke grey; translucent on the edges; yields easily to the knife; harsh and rough to the touch; light, often supernatant; fusible into a grey glass.

77·5 silex; 17·5 alumine; 1·75 oxide of iron; 3 soda and potash. *Klapr.*

Sp. 40.

PEARLSTONE. Perlstein *W.*

Occurs in rather large sub-angular concretions, which are themselves composed of smaller roundish concretions, and these again of still smaller; surface of the concretions smooth, shining, and pearly; colour grey passing into greyish black, or red and brown; translucent on the edges; scarcely scratches glass; fragile, almost friable.—Sp. gr. 2·3.—Before the blowpipe it first swells, splits, and becomes white, then with some difficulty melts into a whitish frothy glass.

75·25 silex; 12 alumine; 1·6 oxide of iron; 4·5 lime; 4·5 potash; 4·5 water. *Klapr.*

Sp. 41.

CLINKSTONE. Klingstein *W.*

Occurs massive, with a thick and imperfectly slaty structure; fracture splintery passing into conchoidal or even; glimmering, almost dull; colour dark smoke grey, greenish grey, brownish grey; translucent on the edges; yields with some difficulty to the knife.——Sp. gr. 2·57.—Yields a metallic sound when struck with a hammer; easily fusible into a nearly colourless glass.

57·25 silex; 23·5 alumine; 2·75 lime; 3·25 oxide of iron; 0·25 oxide of manganese; 8·1 soda; 3 water. *Klapr.*

Sp. 42.

BASALT. Basalt *W.*

Occurs columnar, in thick concentric lamellar concretions, amorphous, and vesicular; fracture coarse grained uneven passing into large conchoidal and splintery; colour greyish, bluish, and purplish black; streak grey; dull, except from the casual lustre of imbedded foreign substances; opake, or nearly so; yields to the knife; difficultly frangible.——Sp. gr. about 3.—Easily fusible into a black glass.

44·5 silex; 16·75 alumine; 20 oxide of iron;

9·5 lime; 2·25 magnesia; 0·12 oxide of manganese; 2·6 soda; 2 water. *Klapr.*

Sp. 43.

WAKKE. Wakke *W.*

Occurs massive, either solid, cellular, or amygdaloidal; fracture even, earthy, passing into fine grained uneven; colour yellowish or greenish grey; nearly dull; opake; streak shining; yields more or less to the knife. —Sp. gr. 2·5 to 2·9.—Fusible into a porous slag.

α Iron Clay. Eisenthon *W.*

Colour redish brown; usually cellular or amygdaloidal; fracture fine earthy passing to conchoidal; dull; yields to the knife.

Sp. 44.

BASALTIC HORNBLENDE. Basaltische hornblende *W.* Amphibole *H.*

Occurs crystallized; form, a six-sided prism terminated at each extremity by a trihedral pyramid with rhombic faces, or sometimes terminated dissimilarly at each extremity; structure lamellar, with joints in two directions parallel to the sides of an oblique rhomboidal prism, the alternate angles of which measure $124\frac{1}{2}°$ and $55\frac{1}{2}°$; splendent, vitreous; fracture fine grained uneven, glistening; colour, black; opake; scratches glass.—Sp. gr. 3·25.—Melts with difficulty into a black glass.

47 silex; 26 alumine; 8 lime; 2 magnesia; 15 oxide of iron. *Klapr.*

Sp. 45.

COMMON HORNBLENDE. Gemeiner Hornblende *W.* Amphibole *H.*

Occurs in aggregated imperfect rhomboidal crystals, or in long flat prisms intersecting each other, or confusedly radiated, or massive; structure lamellar or bladed; lustre shining, either pearly or vitreo-resinous; colour dark bottle green approaching to black; when pulverized or bruised, greenish grey: yields pretty easily to the knife; very tough, is indented by the stroke of the hammer.—Sp. gr. 3·6—3·8.—Melts easily before the blowpipe into a greyish black glass.

42 silex; 11 lime; 12 alumine; 32 oxide of iron; 0·75 water. *Klapr.*

Sp. 46.

THALLITE. Pistazit *W.* Epidote *H.*

Joints in two directions parallel to the sides of a right tetrahedral prism, the alternate angles of which are about 114½° and 65½°; one of these joints is generally more obvious than the other; scratches glass with ease; before the blowpipe is converted into a brownish scoria, and by increase of the heat into a black enamel.

α Crystallized.

In six-, eight-, or twelve-sided prisms, variously terminated and longitudinally striated; colour yellowish, bluish, or blackish green; structure lamellar; lustre shining vitreous; more or less transparent.—Sp. gr. 3·4.

37 silex; 21 alumine; 15 lime; 24 oxide of iron; 1·5 oxide of manganese. *Vauq.*

β Zoisite.

Crystallized in oblique striated four-sided prisms, the obtuse lateral edges of which are rounded, and the terminations of the prisms incomplete; structure lamellar, with a pearly lustre; colour brownish or smoke grey; translucent.

45 silex; 29 alumine; 21 lime; 3 oxide of iron. *Klapr.*

γ Massive.

Structure bladed passing into acicular, either parallel or diverging; other characters as α.

δ Granular. Scorza.

In the form of yellowish green sand; dull; meagre; fusible into a black scoria.

43 silex; 21 alumine; 14 lime; 16·5 oxide of iron; 0·25 oxide of manganese. *Klapr.*

Sp. 47.

SMARAGDITE. Diallage *H.* Smaragdit *K.* Korniger Strahlstein *W.*

Occurs massive and disseminated; structure lamellar, fibrous-lamellar, or compact; lustre shining, sometimes silky; colour grass or emerald green; slightly translucent; yields to the knife, rarely so hard as glass.—Sp. gr. 3.—Fusible into a grey or greenish enamel.

50 silex; 21 alumine; 13 lime; 3 magnesia; the remainder oxide of chrome mixed with oxide of iron. *Vauq.*

α Bronzite.

Colour brown, with a pseudo-metallic lustre; structure fibrous lamellar.

60 silex; 27·5 magnesia; 10·5 oxide of iron; 0·5 water. *Klapr.*

Sp. 48.

AUGITE. Augit *W.* Pyroxène *H.*

Occurs crystallized, and in angular and round pieces; form, a compressed six- or eight-sided prism with dihedral summits; structure lamellar, with joints parallel to the two sides and to the greater diagonal of an oblique rhomboidal prism, the alternate angles of which are about 88° and 92°; fracture uneven passing into conchoidal; lustre more or less shining, resinous; colour blackish green mixed in various proportions with brown; translucent; scratches glass with ease.—Sp. gr. 3·2.—Fusible with difficulty into a black enamel.

52 silex; 13·2 lime; 10 magnesia; 3·3 alumine; 14·6 oxide of iron; 2 oxide of manganese. *Vauq.*

α Coccolite. Kokkolith *W.*

Colour greyish or bluish green; occurs in slightly coherent granular concretions; structure lamellar; lustre shining, vitreous. —Sp. gr. 3·3.—Infusible.

50 silex; 24 lime; 10 magnesia; 1·5 alumine; 7 oxide of iron; 3 oxide of manganese. *Vauq.*

Sp. 49.

SAHLITE. Sahlit *W.* Pyroxène *H.*

Occurs crystallized and massive; form, an octohedral prism with dihedral terminations variously modified; structure both of the crystallized and massive, lamellar, with joints parallel to the faces of an oblique rhomboidal prism, the alternate angles of which are about 87⅔° and 92⅓°; lustre shining and splendent, resino-vitreous; translucent on the edges; colour pale greenish grey; scratches glass.—Sp. gr. 3·2.—Infusible.

53 silex: 20 lime; 19 magnesia; 3 alumine; 4 oxide of iron and manganese. *Vauq.*

Sp. 50.

ACTYNOLITE. Strahlstein *W.* Actinote and Amphibole *H.*

Occurs in single crystals, but generally in wedge-shaped concretions composed of long acicular hexahedral prisms; also bladed or fibrous (often very finely so); to the touch singularly harsh, the fibres being very apt to penetrate the skin; lustre shining, between vitreous and pearly; of the finely fibrous, silky; more or less translucent or transparent; colour green, mixed in various proportions with grey or black, blue or brown.—Sp. gr. about 3·3.—Scratches glass; melts into a greyish enamel.

Analysis of the crystallized, from the Zillerthal.

50 silex; 19·25 magnesia; 9·75 lime; 0·75 alumine; 11 oxide of iron; 5 oxide of chrome; 3 water. *Laugier.*

Sp. 51.

TREMOLITE. Tremolith *W.* Amphibole *H.*

Joints in two directions parallel to the sides of an oblique rhomboidal prism; colour white with more or less of a greenish, bluish, yellowish, or redish tinge; scratches glass.—Sp. gr. 2·9—3·2.—Melts easily and with ebullition into a white enamel.

α Crystallized.

In compressed four-, six-, or eight-sided prisms with dihedral summits; longitudinally striated; structure lamellar with a shining pearly lustre; fracture uneven; semitransparent.

β Bladed.

Structure bladed, passing into fibrous; lustre pearly glistening.

γ Fibrous. Glassy Tremolite *J.* Glasartiger Tremolith *W.*
Structure fibrous with cross rents; translucent; lustre shining or glistening, pearly.
65 silex; 18 lime; 10·53 magnesia; 0·16 oxide of iron; 6·5 water and carbonic acid. *Klapr.* The carbonic acid probably implies the intimate admixture of Dolomite in the specimen analysed.

δ Asbestiform. Asbestartiger Tremolith *W.*
Structure finely fibrous; lustre glistening, pearly or silky.

Sp. 52.
CHRYSOLITE. Krisolith *W.* Peridot *W.*
Occurs crystallized and in angular and rolled pieces; form, an eight-, ten-, or twelve-sided, mostly compressed, prism with truncated pyramidal terminations; structure, indications of natural joints in one direction parallel to the axis of the crystal, and sometimes in a direction at right angles to the former; fracture conchoidal, with a splendent vitreous lustre; colour yellow, mixed more or less with green and brown; transparent; doubly refractive; scratches glass.—Sp. gr. 3·4.—Infusible.
39 silex; 43·5 magnesia; 19 oxide of iron. *Klapr.*
38 silex; 50·5 magnesia; 9·5 oxide of iron. *Vauq.*

α Olivine. Olivin *W.* Peridot granuliforme et lamelliforme *H.*
Occurs lamelliform and in granular concretions, sometimes very large; fracture im-

perfectly conchoidal, passing into splintery and uneven; semitransparent; when decomposing presents iridescent pseudo-metallic colours.—Sp. gr. 3·26.

50 silex; 38·5 magnesia; 12 oxide of iron; 0·25 lime. *Klapr.*

Sp. 53.

SCHILLERSPAR. Diallage metalloïde *H.*

Occurs massive and disseminated in serpentine; structure lamellar with joints in one direction; colour olive green with a shining pseudo-metallic lustre; yields to the knife.

Sp. 54.

HYPERSTÈNE *H.* Labrador Hornblende. Labradorische hornblende *W.*

Occurs massive and disseminated; structure lamellar, straight or curved, with joints parallel to the short diagonal and to the sides of a rhomboidal prism, the alternate angles of which measure 100° and 80°; colour dark brownish and greenish black with, usually, pseudo-metallic reflections of a copper red; opake; yields to the knife.—Sp. gr. 3·38.

54·25 silex; 14 magnesia; 2·25 alumine; 1·5 lime; 24·5 oxide of iron; 1 water. *Klapr.*

Sp. 55.

ASBESTUS.

Structure fibrous, more or less flexible; difficult of fusion.

a Amianthus. Amianth *W.* Asbeste flexible *H.*

Colour white or very pale greenish, olive green, rarely blood red; lustre shining, silky; structure finely fibrous; yields to the nail; somewhat unctuous to the touch; slightly translucent; occurs massive, in plates or small veins, or in threads.

59 silex; 25 magnesia; 9 lime; 3 alumine. *Chenev.*

β Mountain Cork. Bergkork *W.* Asbeste tressé *H.*

Structure finely fibrous, interlaced; occurs in thin flexible plates like leather (mountain leather), or in thicker less flexible flat pieces like cork (mountain cork); colour yellowish brown passing into white; slightly glimmering; yields to the nail; meagre to the touch; very light, generally supernatant.

γ Mountain wood. Berg holz *W.* Asbeste ligniforme *H.*

Occurs massive; structure, composed, like wood, of lamellæ more or less curved, and the lamellæ themselves formed of fine fibres; glimmering; meagre to the touch; flexible, yields to the nail; light, generally supernatant; fusible into a black slag.

δ Common Asbest. Gemeiner Asbest *W.* Asbeste dur *H.*

Occurs massive and capillary; structure parallel and curved fibrous, or bladed, the fibres scarcely flexible; lustre glistening, pearly; colour dull greyish green; somewhat unctuous to the touch; yields to the knife; fusible with difficulty into a greyish black slag.

Sp. 56.

Indurated Talc. Verhærteter Talc *W.*

Occurs massive; structure confusedly fibrous, passing into bladed and curved slaty; colour greenish grey; more or less translucent; lustre glistening, pearly; unctuous to the touch; sectile.

Sp. 57.

TALC. Gemeiner Talc *W.* Talc hexagonal et laminaire *H.*

Occurs in hexagonal plates, and massive; structure finely lamellar, the laminæ easily separable from each other; flexible; inelastic; very soft, yields to the nail; very unctuous to the touch; sectile; in mass, of an apple green or almost emerald green colour, with a shining pearly lustre, and translucent; in thin laminæ, of a dilute green or white, transparent and with a lustre often approaching to pseudo-metallic; before the blowpipe it whitens, and at length with difficulty affords a very minute globule of enamel.

61 silex; 30·5 magnesia; 2·75 potash; 2·5 oxide of iron; 0·5 water. *Klapr.*

Sp. 58.

STEATITE. Speckstein *W.* Talc steatite *H.*

Occurs crystallized and massive; the crystals are imbedded in the massive, and probably are pseudo-morphous, being in the forms of Quartz and of calcareous Spar; fracture splintery passing into uneven and conchoidal; colour grey, yellow, green, red, usually pale; dull, rarely glimmering; more or less translucent; streak shining; yields to the nail; not adherent to the tongue; unctuous.—Sp. gr. 2·6.—Hardens before the blowpipe, but is infusible.

59·5 silex; 30·5 magnesia; 2·5 oxide of iron; 5·5 water. *Klapr.*

64 silex; 22 magnesia; 3 oxide of iron; 5 water. *Vauq.*

Sp. 59.

JADE. Nephrit *W.* Jade *H.*

Occurs massive; fracture splintery; dull or glimmering; colour leek green passing into greenish white; translucent; somewhat unctuous to the touch; incapable of a bright polish; scratches glass, yields to the knife; difficultly frangible.—Sp. gr. about 3.—Infusible.

α Slaty. Beilstein *W.*

Structure slaty; fragments tabular; colour dark green passing into greenish grey; glistening; not quite so hard as common Jade.

β Jade ascien *H.*

Fracture splintery; colour dark green; very hard; susceptible of a high polish.

Sp. 60.

SERPENTINE. Serpentin *W.*

Occurs massive; fracture splintery passing into conchoidal; colour dark yellowish or blackish green, with a glistening resinous lustre; translucent; somewhat unctuous; yields easily to the knife; sectile; before the blowpipe it hardens and changes colour, but is infusible.

α Common Serpentine. Serpentine rock. Gemeiner Serpentin *W.*

Differs from the preceding in being less pure; colour green and yellowish brown, of various degrees of intensity, spotted and veined with red; almost dull; slightly translucent on the edges; hardness very various, sometimes scarcely yields to the knife, and then the fracture is small and flat-conchoidal.

Sp. 61.

POTSTONE. Topfstein *W*. Talc ollaire *H*.

Occurs massive; structure undulatingly lamellar and slaty; lustre glistening, pearly; colour greenish grey passing to leek green; slightly translucent; soft, often yields to the nail; unctuous; difficultly frangible.—Sp. gr. 2·8—3·0.—Infusible?

Sp. 62.

MEERSCHAUM.

Occurs amorphous; fracture fine earthy passing into flat-conchoidal; colour yellowish white; opake; dull; streak shining; yields to the nail; strongly adherent to the tongue.—Sp. gr. 1·6.—Infusible.

50·5 silex; 17·25 magnesia; 0·5 lime; 5 carbonic acid; 25 water. *Klapr.*

Sp. 63.

NATIVE MAGNESIA. Reine Talkerde *W*. Magnesie carbonatée *H*.

Occurs amorphous, tuberous and spongiform; fracture splintery, and large and flat-conchoidal; colour yellowish grey with spots and dendritic delineations of blackish brown; dull; nearly opake; yields to the nail; somewhat meagre; slightly adherent to the tongue; light; soluble in sulphuric acid, and affording crystals of sulphated magnesia.

33 magnesia; 30 carbonic acid; 8 silex; 0·5 lime; 1·5 manganese and iron; 20 water. *Wondraschek.*

Sp. 64.

CHLORITE. Chlorit *W*. Talc chlorite *H*.

Occurs crystallized and amorphous; form, a low hexahedral prism, or table, with natural joints at right angles to the axis of the prism; structure lamellar, with a shining lustre between pearly and resinous; colour blackish green; streak greyish green; opake; yields to the nail; rather unctuous.

α Common Chlorite. Gemeiner Chlorit *W.*
Amorphous; glistening; structure fine lamellar; fracture earthy.

β Scaly Chlorite. Chlorit erde *W.* Talc chlorite terreux *H.*
Composed of glimmering scaly particles, with a pearly lustre; friable or loose; before the blowpipe becomes black and superficially glazed.
26 silex; 18·5 alumine; 8 magnesia; 43 oxide of iron; 2 muriate of soda or of potash. *Vauq.*

γ Chlorite slate. Chlorit schiefer *W.*
Structure slaty passing into lamellar; glistening, resinous.

Sp. 65.
GREEN EARTH. Grünerde *W.* Talc zoögraphique *H.*
Occurs amorphous, or filling or lining cells in amygdaloid; fracture flat-conchoidal passing into even and earthy; colour greyish or bluish green passing into blackish green; dull, the streak glistening; yields to the nail; light.
53 silex; 2 magnesia; 28 oxide of iron; 10 potash; 6 water. *Vauq.*

Sp. 66.
DIPYRE. Schmelzstein *W.*
Occurs crystallized, and in the form of fascicu-

lated masses, easily divisible into slender acicular prisms; form, a slender octohedral prism; structure lamellar with joints parallel to the sides and to the diagonal of a rectangular prism; colour greyish or redish white; lustre shining vitreous; scratches glass.—Sp. gr. 2·6.—Slightly phosphorescent by heat; easily fusible with intumescence.

60 silex; 24 alumine; 10 lime; 2 water. *Vauq.*

Sp. 67.

SPINELLANE.

Occurs in small crystals; form, a rhomboidal dodecahedron, with the edges of the terminal pyramids replaced; colour dark brown; scratches glass; on exposure to the blowpipe it becomes white, and then melts with ease into a white frothy enamel.

Sp. 68.

HARMOTOME. Cross stone *J.* Kreuzstein *W.* Harmotome *H.*

Occurs in small crystals; form, a rather broad tetrahedral prism with rhombic pyramidal terminations; usually two crystals intersect each other so that their axes coincide; structure lamellar with joints in three directions, two of them oblique and one parallel with the axis; fracture uneven; colour greyish white; more or less transparent; lustre shining between vitreous and pearly; scratches glass.—Sp. gr. 2·3.—Before the blowpipe it exhibits a greenish yellow phosphorescence, and then melts with intumescence into a colourless glass.

49 silex; 18 barytes; 16 alumine; 15 water. *Klapr.*

Sp. 69.

PREHNITE. Prehnite *W. H.*

Occurs in small, single, or densely aggregated crystals; form, a low rhomboidal, hexahedral, or octohedral prism; structure imperfectly lamellar with joints in one direction parallel to the short diagonal of the rhomboid; colour pale, greenish or yellowish; lustre shining, pearly; more or less transparent; scratches glass with difficulty; pyro-electric; fusible with intumescence into a pale yellowish (blackish yellow?) frothy glass.

α Lamelliform. Koupholite *H.* Blättriger Prehnite *W.*

Occurs in small translucent lamellæ, of a yellowish white colour and glistening pearly lustre.

β Massive.

Occurs globular, mammillated, tuberous; structure divergingly bladed; glistening; translucent.—Sp. gr. 2·6—2·9.

43·8 silex; 30·88 alumine; 18·33 lime; 5·66 oxide of iron; 1·83 water. *Klapr.*

Sp. 70.

STILBITE. Zeolith *W.* Stilbite *H.*

Occurs crystallized, lamelliform, and in fasciculated needles; form, a rectangular prism, sometimes long, sometimes very short, (passing into lamelliform,) with tetrahedral summits, of which, two adjoining faces are more inclined on the axis of the prism than the other two; structure lamellar with joints in one direction, parallel to the axis of the prism; lustre glistening or shining, pearly; fracture uneven, nearly dull; colour whitish, grey, brown; transparent, translucent; yields easily to the knife.—Sp. gr. 2·5.—Exfoliates by the first impression of the heat; fusible with phosphorescence and ebullition into a white enamel; swells but scarcely gelatinizes by digestion in nitric acid.

62 silex; 17·5 alumine; 9 lime; 18·5 water. *Vauq.*

Sp. 71.

MESOTYPE. Zeolith *W.* Mesotype *H.*

Occurs crystallized; form, a rectangular prism, the lateral edges of which are sometimes replaced, terminated by tetrahedral pyramids, the planes of which are equally inclined on the axis of the crystal; structure lamellar with joints parallel to one of the sides of the prism, also at right angles to the axis, and parallel to the two diagonals of the prism; of these only the first is generally visible; lustre shining, pearly; fracture imperfectly conchoidal, between vitreous and pearly; colour white or greyish; transparent, translucent; yields easily to the knife.—Sp. gr. 2.—Pyro-electric with polarity; fusible with phosphorescence and intumescence into a spongy enamel; gelatinizes with acids.

α In divergent bladed concretions, or radiated acicular prisms.

50·24 silex; 29·3 alumine; 9·46 lime; 10 water. *Vauq.*

β More or less efflorescent, passing to pulverulent; not pyro-electric.

Sp. 72.

LAUMONITE. Lomonit *W.* Laumonite *H.*

Occurs crystallized; form, an octohedral prism with dihedral summits; structure lamellar with joints parallel to the axis and to the common base of a rectangular octohedron; transparent or translucent; scratches glass.—Sp. gr. 2·2.—Gelatinizes with acids; fusible with little ebullition into a white enamel; exfoliates by exposure to the air, forming var. α.

α

Opake, white; pearly; tender.

Sp. 73.

CHABASIE. Schabasit *W.*

Occurs crystallized; form, a cuboidal rhomboid, the alternate angles of which are about 94° and 86°, either perfect or with the obtuse lateral edges replaced, and otherwise modified; structure lamellar with joints parallel to the faces of the rhomboid; colour whitish and greyish white, sometimes pale red superficially; scarcely scratches glass; transparent, translucent.—Sp. gr. 2·7.—Easily fusible into a spongy whitish enamel.

43·33 silex; 22·66 alumine; 3·34 lime; 9·34 soda and potash; 21 water. *Vauq.*

Sp. 74.

ANALCIME. Kubizit *W.* Analcime *H.*

Occurs in single but generally in aggregated crystals; form, the cube either perfect or with each of the solid angles replaced by three triangular planes, or a solid composed (like some garnets) of twenty-four equal and similar trapeziums; structure, only slight indications of joints parallel to the faces of the cube; fracture, compact flat-conchoidal passing into fine grained uneven; lustre shining, between pearly and vitreous; colour pale grey, yellowish, redish brown; transparent, translucent; scratches glass.—Sp. gr. below 3.—Fusible with intumescence into a glass.

58 silex; 18 alumine; 2 lime; 10 soda; 8·5 water. *Vauq.*

α

Mammillated and amorphous.

β Sarcolite.

Colour flesh-red; crystallized in cubes, with each solid angle replaced by eight planes.

Sp. 75.

ICHTHYOPHTHALMITE. Fish-eye-stone *J.* Fischaugenstein *W.* Apophyllite *H.*

Occurs crystallized in right rectangular prisms variously modified, sometimes so compressed as to become tabular, in which case they are often cellularly aggregated; structure lamellar with joints parallel to the faces of the prism, but of these only the joints parallel to one of the lateral faces are very perceptible; lustre of these joints splendent pearly, and more or less iridescent; fracture fine grained uneven, glistening; colour white, often with a slight redish or greenish tinge; transparent, translucent; a little harder than Fluor Spar, and very fragile.—Sp. gr. 2·46.—Before the blowpipe it immediately exfoliates, and is fusible with difficulty into a white enamel; when pulverized it gelatinizes in nitric acid.

51 silex; 28 lime; 4 potash; 17 water. *Vauq.*
55 silex; 25 lime; 2·25 potash; 15 water. *Rose.*

α Massive.

White; structure finely lamellar, with a splendent pearly and iridescent lustre.

Sp. 76.

Sodalite.

Occurs crystallized and massive; form, a rhomboidal dodecahedron; structure lamellar with joints in two directions; lustre shining, resinous; fracture conchoidal, with a vitreous lustre; colour bluish green; translucent; yields with difficulty to the knife.—Sp. gr. 2·37.—Infusible, but acquires a dark grey colour.

38·52 silex; 27·48 alumine; 23·5 soda; 3 muriatic acid; 1 oxide of iron; 2·7 lime; 2·1 volatile matter. *Thomson.*

36 silex; 32 alumine; 25 soda; 6·75 muriatic acid; 0·25 oxide of iron. *Ekeberg.*

Sp. 77.

Melilite. Mélilite *H.*

Occurs in small crystals; form, a rectangular parallelopiped and a rectangular octohedron; colour pale yellow and orange; gives fire with steel; in small fragments it melts before the blowpipe without ebullition into a transparent glass; gelatinizes when pulverized and digested in nitric acid.

Sp. 78.

Lapis Lazuli. Azure-stone *J.* Lazurstein *W.* Lazulite *H.*

Occurs massive (rarely crystallized in rhomboidal dodecahedrons?); colour azure blue; fracture fine grained uneven with a glimmering lustre; nearly opake; scratches glass.—Sp. gr. 2·6—2·94.—Retains its colour in a low red heat, but before the blowpipe it melts into a greyish enamel; when calcined and pulverized it gelatinizes with acids.

Is often intimately mixed with Iron Pyrites, with compact Felspar, and Quartz, by which its hardness is increased.

Sp. 79.

LATIALITE. Haüyne.

Occurs massive, in grains, and in extremely minute brilliant crystals; colour indigo-blue, bluish green; fracture uneven, with a vitreous lustre; somewhat harder than Quartz; translucent, opake.—Sp. gr. 3·2.—Infusible; when finely pulverized it gelatinizes with acids.

30 silex; 15 alumine; 20·5 sulphate of lime; 11 potash; 1 oxide of iron; 5 lime, and an atom of sulphuretted hydrogen. *Vauq.*

Sp. 80.

CRYOLITE. Alumine fluatée alkaline *H.* Kryolit *W.*

Occurs massive; structure imperfectly lamellar with joints in three directions parallel to the faces of a rectangular parallelopiped; lustre glistening, vitreous; colour greyish white; translucent; softer than Fluor Spar.—Sp. gr. 2·94.—Before the blowpipe it at first runs into very liquid fusion, then hardens, and at length assumes the appearance of a slag.

24 alumine; 36 soda; 40 fluoric acid and water. *Klapr.*

21 alumine; 32 soda; 47 fluoric acid and water. *Vauq.*

Sp. 81.

WAVELLITE.

Occurs in fibres or acicular four-sided prisms diverging from a common centre, and either separated, or adhering laterally to each other composing hemispherical concretions of various sizes up to the bulk of a small hazel nut; also stalactitical; lustre glistening between silky and vitreous; colour yellowish white, greyish, greenish, bluish; translucent; harder than calcareous Spar.—Sp. gr. 2·7.—Infusible, but becomes white and opake. A fragment laid on a glass plate, a drop of sulphuric acid being added, slightly corrodes the glass.

Contains about 26 per cent. of water, the remainder being alumine, with a small portion of fluate of lime.

Sp. 82.

Datolite. Datholit *W.* Chaux boratée silicieuse *H.*

Occurs crystallized and massive; form, a ten-sided prism, of which two opposite solid angles adjacent to each base are replaced by triangular planes; fracture imperfectly conchoidal, with a considerable lustre between vitreous and resinous; colour greyish white; translucent; scratches glass (yields to the knife?).—Sp. gr. 2·98.—When exposed to the flame of a candle it becomes of an opake white, and may then be easily rubbed down between the fingers; before the blowpipe it intumesces into a milky white mass, and then melts into a globule of a pale rose colour.

35·5 lime; 36·5 silex; 24 boracic acid; 4 water. *Klapr.*

α Botryolite *H.*

Occurs in mammillary concretions, formed of concentric layers with a splintery fracture, or of very slender fibres.

Sp. 83.

Boracite. Boracit *W.* Magnesie boratée *H.*

Occurs in solitary crystals imbedded in Gypsum; form, a cube with its varieties; in these the parts corresponding to the diagonally opposite solid angles of the cube are dissimilar; natural joints scarcely perceptible; fracture uneven passing into imperfectly conchoidal; lustre glistening, between adamantine and vitreous; colour yellowish and greenish white; transparent; yields with some difficulty to the knife.—Sp. gr. 2·56.—Pyro-electric on all the solid angles, those that are diagonally opposite being one positive and the other negative; fusible with ebullition into a yellowish enamel.

83·4 boracic acid; 16·6 magnesia. *Vauq.*

α Translucent, or opake; softer than the transparent, contains a mixture of carbonate of lime.

Sp. 84.

GADOLINITE. Gadolinit *W.* Gadolinite *H.*

Occurs massive, and very rarely crystallized; form, seemingly, a ten-sided prism; fracture flat-conchoidal; lustre splendent or shining, resinous; colour greenish black; slightly translucent; scratches glass.—Sp. gr. 4—4·2. Affects the magnetic needle; decrepitates strongly, and the pieces that fly off glow like sparks; scarcely fusible except in extremely minute pieces; forms a stiff grey jelly when pulverised and digested in acid.

54·75 yttria, with a trace of manganese; 21·25 silex; 5·5 glycine; 0·5 alumine; 17·5 oxide of iron; 0·5 water. *Klapr.*

Sp. 85.

ALLANITE.

Occurs crystallized and massive; form, a rhomboidal prism, the alternate angles of which measure 117° and 63°; fracture small conchoidal; lustre shining, resino-metallic; colour brownish black, when pulverized greenish grey; hardness about equal to glass.—Sp. gr. 3·1—4.—Before the blowpipe it froths, and melts into a brown slag; it gelatinizes in nitric acid:

35·4 silex; 9·2 lime; 4·1 alumine; 25·4 oxide of iron; 33·9 oxide of cerium; 4 moisture. *Thomson.*

Sp. 86.

LAZULITE. Lazulith *W. H.*

Occurs massive, and in prismatic needles; structure imperfectly lamellar, with joints parallel to the sides of a rhomboidal prism; fracture granular uneven; lustre shining or glistening; colour light blue; opake; hardness nearly equal to that of Quartz; falls to pieces and becomes of a light grey colour before the blowpipe, but is infusible.

Sp. 87.

QUARTZ. Quarz *W. H.*

Occurs crystallized, diverging acicular, lamelliform, massive, and granular; structure rarely visible, sometimes indications of joints parallel to the faces of a rhomboid, the alternate angles of which are about 94½° and 85½°; form, the primitive rhomboid, a pyramidal dodecahedron either with or without an interposed six-sided prism, and of which last the alternate solid angles are sometimes replaced by rhombic faces; fracture conchoidal or uneven, with a more or less shining vitreous lustre; scratches glass, does not yield to the knife.—Sp. gr. 2·6. —Infusible; two pieces rubbed against each other are phosphorescent, and exhale an odour like that of the electric fluid.

Composed of silex, with one or two per cent. of moisture.

α Amethyst.

Colour violet, greyish white, greenish; occurs in single, or in obscure and laterally aggregated crystals, each crystal being composed of hexahedral pyramids heaped one on the point of another, and varying alternately in colour or transparency; also massive.

β Fat Quartz.

Massive; lustre greasy.

γ Milk Quartz. Milch-quarz *W.*

Colour bluish white, pearl grey, crimson, and rose red; occurs massive; lustre vitreo-resinous.

δ Spongiform.

Often supernatant.

ε Prasem.

Colour leek-green; glistening; lustre resino-vitreous. Is a mixture more or less intimate of Quartz with Actynolite or Thallite.

ζ Ferruginous Quartz. Eisenkiesel *W.*

Colour ochre yellow or red. Is a mass of small grains or crystals of Quartz intimately mixed with Oxide of Iron; harder than pure Quartz; when heated becomes magnetic.

Sp. 88.

Cat's-eye. Katzenauge *W.* Quarz-agathe chatoyant *H.*

Occurs massive and in loose pieces; fracture small-conchoidal passing into even, sometimes with indications of a lamellar structure; colour grey, greenish, brown, or redish, with a white chatoyant reflection of light; more or less translucent; lustre shining, vitreo-resinous; scratches Quartz.—Sp. gr. 2·6.—Infusible, but becomes opake and spotted by exposure to the blowpipe.

95 silex; 1·75 alumine; 1·5 lime; 0·25 oxide of iron. *Klapr.*

Sp. 89.

OPAL. Edler Opal *W.* Quarz-resinite opalin *H.*

Occurs forming small veins in clay porphyry; fracture conchoidal; colour milk white or yellowish, with brilliant changeable reflections of green, blue, yellow, and red; semitransparent; lustre shining, vitreous; scratches glass; easily frangible.—Sp. gr. 2·1.—Infusible, but becomes opake and decrepitates.

90 silex; 10 water. *Klapr.*

α Hydrophane.

Cream colour; nearly opake; by immersion in water it becomes semitransparent, and exhibits more or less the changeable colours of opal.

93·125 silex; 1·625 alumine; 5·25 water and inflammable matter. *Klapr.*

β Common Opal. Gemeiner Opal.

Colour white, green, yellow, red, without the brilliant reflections of the preceding; lustre inclining to resinous; semitransparent.

Analysis of the yellow, from Telkebanya.

93·5 silex; 1 oxide of iron; 5 water. *Klapr.*

γ Semi-Opal (when opake, Opal Jasper). Halb-Opal *W.*

Colours generally darker than of var. β; fracture large and flat-conchoidal passing to even; lustre glistening, resinous; translucent, opake; harder than the preceding varieties.—Sp. gr. 2·5.

Analysis of the brownish red, from Telkebanya.

43·5 silex; 47 oxide of iron; 7·5 water. *Klapr.*

Analysis of Menilite.

85·5 silex; 1 alumine; 0·5 oxide of iron; 0·5 lime; 11 water and inflammable matter. *Klapr.*

δ Wood Opal. Holz-Opal *W.*

Wood petrified by common or semi-opal; structure ligneous.

Sp. 90.

HYALITE. Müllerglas *W.* Quarz concrétionné *H.*

Occurs in small reniform or irregularly botryoidal masses, or lining the cavities of amygdaloid; generally full of minute cracks; fracture small and flat-conchoidal, with a shining vitreous lustre; colour pale yellowish or greyish; more or less semitransparent; scratches glass; fragile; light; infusible; in its external appearance bears a striking resemblance to gum arabic.

Sp. 91.

CHALCEDONY. Gemeiner kalzedon *W.* Quarz-agathe calcédoine *H.*

Occurs mammillated, stalactitic, in balls, in cubic pseudo-crystals, and as the petrifying matter of various organic remains; fracture even, fine splintery, and flat-conchoidal; dull, when passing into Quartz or Semi-Opal glimmering, in the former case the lustre being vitreous, in the latter resinous; colour bluish or greyish white; translucent; somewhat harder than Quartz; not very frangible. —Sp. gr. about 2·6.—Infusible, but becomes opake.

α Mochoa Stone. Mochs-stein.
Contains arborizations or vegetable filaments of a white, green, brown, purple, or black colour.

β Carnelian.
Colour blood red, flesh red, redish brown; fracture conchoidal; lustre glistening.

γ Sarde.
Colour orange yellow, passing into brownish yellow and blackish brown; by transmitted light approaching to blood red.

δ Jaspe-agate.
Colour white, red, yellow; opake; fracture conchoidal approaching to uneven.

ε Agate.
A mixture of two or more of the above varieties in alternate concentric lamellæ, exhibiting, when cut and polished, zones, angular lines like fortifications, &c.; or in angular fragments cemented by Quartz or Chalcedony, forming the Agate Breccia, or Fragment Agate.

ζ Onyx.
Two or more plates of either of the above varieties naturally cemented together. The most valued is Sardonyx, composed of milk white Chalcedony and Sarde.

η Chrysoprase.

Colour apple-green; not quite so hard as Chalcedony; before the blowpipe becomes white and opake.—Sp. gr. 3·25 ?

96·16 silex; 0·8 lime; 1 oxide of nickel; 1·8 water. *Klapr.*

Sp. 92.

PLASMA. Plasma *W.*

Occurs in angular pieces; colour a somewhat dull green, with yellow and whitish dots; fracture flat-conchoidal; lustre glistening; strongly translucent; somewhat harder than Quartz; infusible.

Sp. 93.

HELIOTROPE. Heliotrop *W.*

Colour dark bluish green, often with yellow and blood red spots; fracture imperfectly conchoidal; lustre glistening, somewhat resinous; more or less translucent; scratches Quartz. —Sp. gr. 2·6.—Infusible.

Sp. 94.

FLINT. Feuerstein *W.* Quarz-agathe pyromaque *H.*

Occurs in flat plates and tubercular masses, and forming the substance of certain marine organic remains; colour grey passing into greyish black, yellowish, and redish; fracture conchoidal; lustre glimmering; more or less translucent; easily frangible; scratches Quartz.—Sp. gr. 2·6.—Infusible, but whitens and becomes opake.

98 silex; 0·5 lime; 0·25 alumine; 0·25 oxide of iron; 1 water. *Klapr.*

97 silex; 1 alumine and oxide of iron; 2 water; *Vauq.*

Sp. 95.

HORNSTONE. Hornstein *W.*

Occurs in balls and tuberous nodules, cellular and massive; fracture splintery passing into conchoidal; dull or glimmering; more or less translucent; hardness scarcely equal to that of Quartz: the splintery very difficultly frangible; infusible.

α Woodstone. Holzstein *W.*
Wood petrified by Hornstone.

Sp. 96.

TABULAR SPAR. Tafelspath *K.* Schaalstein *W.* Spath en Tables *H.*

Occurs massive, in prismatic concretions; structure imperfectly lamellar, with indications of natural joints parallel to the sides of a slightly rhomboidal prism; fracture splintery; lustre shining, nearly pearly; colour greyish, greenish, yellow, and redish white; yields to the knife, often friable.—Sp. gr. 2·8.—Phosphorescent when scratched with a knife; when put into nitric acid it effervesces for an instant from a mixture of calcareous Spar, and then divides into grains; infusible.

50 silex; 45 lime; 5 water. *Klapr.*

Sp. 97.

FLUOR. Fluss *W.* Chaux fluatée *H.*

Occurs crystallized and amorphous; form, the octohedron, cube, rhomboidal dodecahedron, and cube with each of its faces replaced by a low tetrahedral pyramid; structure lamellar, with joints parallel to the faces of a tetrahedron; fragments often tetrahedral; colour very various, grey, yellow, green, violet, blue; lustre shining between pearly and adamantine;

transparent, translucent; yields to the knife; easily frangible.—Sp. gr. 3.1—3·2.—Phosphorescent by heat; before the blowpipe it decrepitates strongly, and then melts into a clear glass.

67·75 lime; 32·25 fluoric acid. *Klapr.*

α Compact. Dichter Fluss *W.*
Massive; fracture even passing to flat-conchoidal and splintery; lustre glimmering; translucent; harder than common Fluor; does not decrepitate.

β Chlorophane.
Phosphorescent by heat, giving out a bright green light.

Sp. 98.

APATITE. Apatit, Spargelstein *W.* Chaux phosphatée *H.*

Joints parallel to the sides and bases of a hexahedral prism; yields to the knife; infusible; soluble slowly and without effervescence in nitric acid.—Sp. gr. 3·1—3·2.

α

Occurs in short six- or twelve-sided prisms with plane terminations, and striated longitudinally; structure imperfectly lamellar; cross fracture uneven passing into small-conchoidal; externally splendent, internally shining, with a lustre between vitreous and resinous; colour white, green, blue, red, yellowish, variously mixed, and mostly pale; more or less transparent; phosphorescent by heat.

55 lime; 45 phosphoric acid. *Klapr.*

β

In six- or twelve-sided prisms with pyramidal terminations; not phosphorescent. Other characters as α.

γ Massive.

With a curved lamellar structure, or a finely granular earthy fracture, sometimes friable; colour yellowish and redish white; opake; phosphorescent; sometimes effervesces slightly from the casual admixture of carbonate of lime.

47 lime; 32·25 phosphoric acid; 2·5 fluoric acid; 0·5 silex; 0·75 oxide of iron; 1 water; 11·5 sand mixed with clay. *Klapr.*

Sp. 99.

GYPSUM. Gips *W.* Chaux sulfatée *H.*

Occurs crystallized in oblique parallelopipedal or hexahedral tables, each of the lateral faces of which is bevelled, or in octohedral prisms with oblique terminations, or lenticular; structure lamellar with very perceptible joints in one direction, and with two others less perceptible at right angles to the former, the whole being parallel to the faces of a right rhomboidal prism, the alternate angles of which measure about 113° and 67°; lustre shining, pearly; colour white, grey, yellowish, brownish, red, violet; more or less transparent; soft, yields readily to the nail.—Sp. gr. not exceeding 2·3.—Becomes pulverulent by the first action of the blowpipe, and then melts into a white enamel.

32·7 lime; 46·3 sulphuric acid; 21 water.

α

Massive, with a lamellar or bladed structure, often more or less curved.

β

Massive, with a granularly lamellar structure.

γ Fibrous.

Composed of slender or broad fibres, straight or curved; sometimes lamellar in one direction and fibrous in the other; lustre shining or glistening, silky, often chatoyant; semi-transparent.

δ Massive.

Fracture compact passing into fine splintery; faintly glimmering; translucent on the edges.

ε Earthy.

Earthy and dull, or scaly and glimmering.

Sp. 100.

ANHYDROUS GYPSUM. Muriacit *W.* Chaux anhydro-sulfatée *H.*

Occurs crystallized; form, a right rectangular or octohedral prism; structure lamellar, with joints parallel to the sides and diagonal of a right rectangular prism; lustre more or less shining, pearly; colour white, violet, bluish; transparent or translucent; doubly refractive; yields easily to the knife, but not to the nail. —Sp. gr. 2·95.—When exposed to the blowpipe it does not exfoliate and melt like common gypsum, but becomes glazed over with a white friable enamel.

40 lime; 60 sulphuric acid. *Vauq.*

41·75 lime; 55 sulphuric acid; 1 muriate of soda.

α

This mineral also occurs lamelliform, granularly foliated, divergingly bladed or fibrous, globular, contorted (pierre de Trippes), compact (Marmo bardiglio di Bergamo). It is often mixed with common salt, which greatly increases its fusibility.

Sp. 101.

GLAUBERITE.

Occurs crystallized; form, an oblique rhomboidal prism, the alternate angles of which measure $104\frac{1}{2}°$ and $75\frac{1}{2}°$, the lateral faces of the prism are striated; structure lamellar with joints parallel to the base; fracture imperfectly conchoidal; colour wine yellow; transparent; softer than calcareous Spar.—Sp. gr. 2·7.—Before the blowpipe it decrepitates, and then melts into a white enamel. In water it becomes opake, and is partly soluble.

49 dry sulphate of lime; 51 dry sulphate of soda. *Brongniart.*

Sp. 102.

CARBONATE OF LIME. Calcareous Spar. Chaux carbonatée *H.* Kalkstein, &c. *W.*

Occurs crystallized and massive; structure lamellar, with joints parallel to the faces of an oblique rhomboidal prism, the alternate lateral angles of which are 105° 5′ and 74° 55′; fragments rhomboidal; lustre more or less shining, between vitreous and pearly; colour very various; usually more or less transparent; doubly refractive; yields very easily to the knife.—Sp. gr. about 2·7.—Infusible before the blowpipe, but becomes caustic, losing by complete calcination about 43 per cent.; effervesces violently with acids.

57 lime; 43 carbonic acid. *Vauq.*

α.

In prismatic concretions or bladed, parallel or divergent.

β Fibrous. Satin Spar.
Structure finely and parallel fibrous, usually a little waved; lustre silky, chatoyant; translucent.

γ Stalactitic. Alabaster.
Occurs mammillated, stalactitic, fungiform, &c. or massive; structure finely and diverging fibrous or bladed; lustre pearly or silky.

δ Granular Limestone. Körniger Kalkstein *W.* Chaux carbonatée saccaroide *H.*
Massive; composed of coarse or fine crystalline grains, which are themselves lamellar; lustre glimmering; falls into sandy grains during calcination.

ε Common Limestone. Dichter Kalkstein *W.*
Massive; compact or granular (oolite); fracture splintery, large and flat-conchoidal, or earthy; slightly glimmering or dull; burns to quicklime without falling to pieces.

ζ Swinestone. Stinkstein *W.* Chaux carbonatée fétide *H.*
Massive; colour liver brown passing into blackish; gives out a fetid urinous odour when scraped or rubbed.

η Peastone. Erbsenstein *W.*
Massive; composed for the most part of distinct concretions which are themselves formed of thin concentric lamellæ; they vary in bulk from a small pea to a large hazel nut; are sometimes spherical, often more or less indented or flattened by mutual contact.

θ Chalk. Kreide *W.*
Massive; dull; fracture earthy; colour white or yellowish; stains the fingers more or less.

ι Agaric mineral. Berg milch *W.*
Whitish; dull; very friable, often disintegrated; stains the fingers.

κ Aphrite. Schaumerde *W.* Aphrit *K.*
White; scaly; friable; with a pearly or pseudo-metallic lustre.

λ Tufa. Kalktuff *W.*
Massive; structure cellular, porous or spongy; dull or slightly glimmering; light; often inclosing and incrusting various foreign substances.

Sp. 103.
ARGILLO-FERRUGINOUS LIMESTONE.

Occurs massive or in globular and spheroidal concretions (Ludus Helmontii); colour bluish or brownish grey; tougher than common limestone; burns to a buff colour; falls to pieces very imperfectly or not at all when slacked; fusible into a slag; effervesces violently with acids, but is only partially soluble.

Sp. 104.
MARL. Mergel *W.*

Occurs massive; compact or slaty; colour bluish grey passing into purplish red; falls to pieces on exposure to the air, and is then plastic with water; easily fusible into a slag; partially soluble in acids with violent effervescence.

Sp. 105.

SCHIEFER SPAR. Schieferspath *W*. Slate Spar *J.*

Occurs massive; structure coarsely lamellar passing into slaty, either straight or somewhat curved, or undulating; lustre more or less shining, pearly; colour white, greenish, or redish; translucent; yields easily to the knife; infusible; soluble with violent effervescence in acids.

Sp. 106.

ARRAGONITE. Arragonit *W*. Arragonite *H.*

In composition, in chemical properties, in double refraction, this substance appears perfectly to agree with Carbonate of Lime (Sp. 102); it differs however in the following particulars: Structure imperfectly lamellar and coarsely fibrous, with joints in two directions parallel to the axis of the prism, forming with each other alternate angles of about 116° and 64°; lustre, more or less shining, vitreous; yields to the knife, but scratches aclcareous Spar with great ease.—Sp. gr. 2·9.

α Coralloidal. Flos ferri.

In snow white branches, either smooth or incrusted with minute crystalline points.

β Acicular.

γ Massive.

Sp. 107.

CARBONATE OF LIME AND OF MAGNESIA. Bitterspath *W*.

Occurs crystallized in oblique rhomboids and in compressed hexahedrons; structure lamellar with joints parallel to the faces of an oblique rhomboid, the alternate lateral angles of which measure 106° 15′ and 73° 45′; fragments, in the rhomboidal varieties, rhomboidal; lustre brightly shining, between vitreous and pearly; colour greyish, greenish, wine yellow; more or less transparent; yields to the knife, harder than calcareous Spar.—Sp. gr. 2·48—2·88.—Infusible, but becomes soft, opake, and brownish; soluble slowly and with very little effervescence in cold muriatic acid, but more rapidly and with considerable effervescence in hot acid.

52—53 carbonate of lime; 45—42·5 carbonate of magnesia; 3 oxide of iron and manganese. *Klapr.*

α Dolomite. Dolomit *W.*

Occurs massive or slaty; structure finely granular, the grains themselves being lamellar; colour white or greyish; soft, generally friable and yielding to the nail.—Sp. gr. 2·8.

52 carbonate of lime; 46·5 carbonate of magnesia; 0·5 oxide of iron; 0·25 oxide of manganese. *Vauq.*

β Magnesian Limestone.

Occurs massive; differs in external characters from common limestone in having generally a granular sandy structure, a glimmering or even glistening lustre, and a yellow colour.

20·3—22·5 magnesia; 29·5—31·7 lime; 47·2 carbonic acid; 0·8—1·24 clay and oxide of iron. *Tennant.*

Brown Spar. Pearl Spar. Braunspath *W.*

See Sparry Iron Ore, Cl. II. Sp. 42.

Sp. 108.

WITHERITE.

Occurs very rarely crystallized, generally massive; form, a hexahedral prism terminated by hexahedral pyramids; the terminal edges of the prism and the points of the pyramids are generally replaced; structure of the massive, divergingly bladed passing into flat fibrous, with a shining somewhat resinous lustre; fracture uneven or splintery, glistening; colour yellowish or pale brownish white; highly translucent; yields easily to the knife. —Sp. gr. 4·3.—Before the blowpipe decrepitates slightly, and melts very readily into a white enamel; soluble with effervescence in diluted muriatic or nitric acid.

78 barytes; 22 carbonic acid. *Klapr.*

Sp. 109.

HEAVY SPAR. Schwerspath *W.* Baryte sulfatée *H.*

Occurs crystallized and massive; structure lamellar with joints parallel to the faces of a right rhomboidal prism, the alternate angles of which measure about $101\frac{1}{2}°$ and $78\frac{1}{2}°$; of these joints that parallel to the base of the prism is most obvious; lustre shining, between pearly and vitreous; colour white, yellowish white passing into wine yellow, redish passing into flesh red, greenish grey, bluish, blue; yields readily to the knife; rather fragile.—Sp. gr. 4·3—4·47.—Decrepitates briskly before the blowpipe, and by continuance of the heat melts into a hard white enamel; a piece exposed for a short time to the blowpipe and then laid on the tongue gives the flavour of sulphuretted Hydrogen.

67 barytes; 33 sulphuric acid. *Klapr.*

α Columnar. Stangenspath *W.*

In acicular prisms laterally aggregated into columns; white; lustre shining pearly; structure lamellar; translucent.

Often mistaken for white Carbonate of Lead: this latter however, beside other distinctive characters, has an adamantine lustre, a conchoidal fracture, and a much higher specific gravity.

β Granular. Körniger schwerspath *W.*

Occurs massive; structure finely granular, the grains themselves being lamellar; lustre glistening; white, bluish, or greyish.

90 sulphate of barytes; 10 silex. *Klapr.*

Heavy-Spar also occurs in concentric lamellar concretions, bladed and divergingly fibrous, splintery, compact and earthy.

Sp. 110.

STRONTIAN. Strontian *W.* Strontiane carbonatée *H.*

Occurs rarely crystallized, generally massive; form, an acicular six-sided prism terminated by low six-sided pyramids; structure of the massive, divergingly bladed, and coarsely fibrous; with a shining pearly lustre; fracture fine grained uneven, glimmering; colour pale green, greenish white; translucent; yields easily to the knife.—Sp. gr. 3·67.—Is infusible before the blowpipe, but becomes opake and tinges the flame of a dark purplish red; soluble with effervescence in muriatic or nitric acid.

69·5 strontian; 30 carbonic acid; 0·5 water. *Klapr.*

Sp. 111.

CELESTINE. Celestin *W.* Strontiane sulfatée.

Occurs massive and crystallized; structure lamellar with joints parallel to the faces of a right rhomboidal prism, the alternate angles of which measure 104° 48′ and 75° 12′; of these joints that parallel to the base of the prism is the only one which is very distinct; lustre, more or less shining, between pearly and resinous; translucent, transparent; yields pretty easily to the knife, harder than Heavy-Spar; colour white, more or less tinged with sky blue.—Sp. gr. 3·6—3·9.—Melts before the blowpipe into a white friable enamel without very sensibly tinging the flame; after a short exposure to heat it becomes opake, and has then acquired a somewhat caustic acrid flavour, very different from that of sulphuretted hydrogen which Heavy-Spar acquires in similar circumstances.

58 strontian; 42 sulphuric acid. *Klapr.*
54 strontian; 46 sulphuric acid. *Vauq.*

Sp. 112.

WHETSLATE. Wetzschiefer *W.*

Occurs massive; structure slaty; longitudinal fracture splintery; almost dull; colour greyish, yellowish, brownish, or muddy green; translucent on the edges; yields to the knife; somewhat unctuous to the touch.—Sp. gr. 2·7.—Before the blowpipe it becomes white, and acquires a vitreous glazing.

Sp. 113.

CLAYSLATE. Thonschiefer *W.*

Occurs massive; structure slaty; fracture sometimes compact; lustre more or less glistening between resinous and pearly; colour very various; generally opake; yields readily to the knife.—Sp. gr. about 2·7.—Does not adhere to the tongue; fusible into a slag.

Sp. 114.

INDURATED SLATE. Kieselschiefer *W.* Flinty Slate *J.*

Occurs massive; structure more or less slaty; fracture splintery passing to uneven and imperfectly conchoidal; dull or glimmering; colour various; more or less translucent hardness about equal to that of Quartz; infusible; often traversed by veins of Quartz.

α Lydian Stone. Basanite *Kirw.* Lidischer stein *W.*

Massive; not slaty; fracture passing to uneven and conchoidal; lustre glimmering; opake; colour black, sometimes greyish.

Sp. 115.

BLACK CHALK. Zeichenschiefer *W.* Drawing Slate *J.*

Occurs massive; structure slaty, glimmering; cross fracture earthy, dull; meagre to the touch, but fine grained; soils the fingers; colour greyish and bluish black; acquires a superficial glazing from the blowpipe.

Sp. 116.

SHALE. Schieferthon *W.* Slate clay *J.*

Occurs massive; structure slaty; colour grey passing into blackish, yellowish, and bluish; dull except from casual spangles of Mica; opake; meagre; usually yields to the nail.—Sp. gr. 2·6.—Fusible into a slag; disintegrates on exposure to the air, and by degrees becomes plastic.

Sp. 117.

PORCELLANITE. Porzellan jaspis *W.*

Occurs massive; structure slaty, sometimes obscurely so; longitudinal fracture large conchoidal, passing into uneven and earthy, with a glimmering lustre; colour grey and blue mixed more or less with red, also ochery yellow and greyish black; opake; scratches glass.—Sp. gr. 2·3.—Melts into a spongy semitransparent enamel. In many cases (perhaps in all) it is Shale indurated by the slow combustion of intervening beds of Coal.

Sp. 118.

TRIPOLI. Trippel *W.*

Occurs massive; fracture coarse earthy; dull; colour yellowish grey; generally yields to the nail; meagre and rough to the touch.

Sp. 119.

INDURATED CLAY. Fire clay. Stourbridge clay.

Occurs massive and in large compressed nodules; yields readily to the knife, but rarely to the nail; colour greyish white with a tinge of yellowish or bluish; fracture earthy granular; very refractory in the fire; by exposure to the air becomes soft, falls to pieces, and then becomes plastic.

Sp. 120.

CLAY.

Plastic when moist; more or less unctuous to the touch, and acquiring a polish when rubbed with the nail.

α Earthy. Common brick clay. Alluvial clay. Very plastic when pure, less so in proportion to the sand with which it is mixed.

β Slaty. Pipe clay. Potters' clay. Occurs slaty; yields to the nail; scarcely plastic; by exposure to the air disintegrates, and then becomes equally plastic as α.

γ Porcelain clay. See Felspar, Sp. 22.

Sp. 121.

PURE CLAY. Reine thonerde *W.*

Occurs in small reniform pieces; fracture fine earthy, dull; colour white; opake; soils slightly; yields to the nail; very fine but meagre to the touch; light; infusible.

Appears to be a somewhat impure Subsulphate of Alumine.

Sp. 122.

BOLE. Bohl *W.*

Occurs amorphous; fracture conchoidal, glimmering; colour red, semitransparent, yellowish grey, translucent on the edges, brown and brownish black, opake; yields to the nail; streak shining; adheres to the tongue. —Sp. gr. 1·4—1·2.—Breaks down in water; fusible into a slag.

Sp. 123.

LITHOMARGA. Steinmark *W.*

Occurs amorphous; fracture large-conchoidal passing into even and earthy; dull; colour white, flesh red, and bluish grey; yields to the nail; streak shining; unctuous to the touch; adheres strongly to the tongue; light.

Sp. 124.

FULLERS' EARTH. Walkererde *W.*

Occurs massive; structure obscurely slaty; fracture earthy, uneven, passing into flat-conchoidal; dull; nearly opake; colour yellowish grey mixed more or less with olive green; yields to, and receives a polish from, the nail; unctuous to the touch; in water falls to pieces, forming a smooth pulp; fusible into a brown and black porous slag.

Sp. 125.

CIMOLITE.

Occurs massive; structure obscurely slaty; fracture earthy, uneven; dull; opake; colour greyish white, often redish superficially; yields to, and receives a polish from, the nail; adheres to the tongue; sectile; tough and difficultly frangible.—Sp. gr. 2.—Infusible; in water it separates into thin slaty laminæ, which by trituration form a soft pulp.

63 silex; 23 alumine; 1·25 oxide of iron; 12 water and inflammable matter. *Klapr.*

CLASS IV.

SALINE MINERALS.

All the substances of this class are sapid, and soluble in water.

CLASS IV.

Saline Minerals.

ORDER I.

When dissolved in water afford a precipitate with carbonated Alkali.

Sp. 1.

SULPHATE OF MAGNESIA.

Occurs in fibres and spicular crystals, or rarely pulverulent; colour white; to the taste bitter and saline.

Sp. 2.

NATIVE ALUM.

Occurs massive with a very finely fibrous structure, and a silky lustre; or stalactitical, or pulverulent; colour white, yellowish white; to the taste sweetish, styptic, acidulous.

Sp. 3.

GREEN VITRIOL. Sulphate of Iron.

Occurs massive, often with a fibrous structure; stalactitical, or pulverulent; colour emerald green, often ochery and yellow externally; to the taste sweetish, styptic, and metallic.

This and the two former species are often intimately mixed.

Sp. 4.

BLUE VITRIOL. Sulphate of Copper.

Occurs massive; stalactitical and pulverulent; colour blue, often passing into bluish green;

to the taste nauseous, bitter, metallic; a portion dissolved in a drop of water and spread on the surface of iron immediately covers it with a film of copper.

Sp. 5.

White Vitriol. Sulphate of Zinc.

Occurs massive and stalactitical; colour yellowish white; to the taste nauseous metallic; is generally mixed with green and blue vitriol.

Sp. 6.

Red Vitriol. Sulphate of Cobalt.

Occurs stalactitical; colour pale rose red, more or less transparent; its solution affords, with carbonate of potash, a pale bluish precipitate which tinges borax of a pure blue colour.

Muriate of Quicksilver.

See Class II. Sp. 16.

ORDER II.

Do not afford a precipitate with carbonated Alkali.

Sp. 7.

Sassolin. Native Boracic acid.

Occurs massive; friable; composed of minute white pearly scales which adhere somewhat to the fingers; very light; to the taste slightly acerb and subacid; fusible with great ease into a transparent globule.

Sp. 8.

Natron. Carbonate of Soda.

Occurs massive, fibrous, in crusts, or efflorescent; colour grey; to the taste urinous and saline; effervesces violently with acids; is usually mixed with Common Salt and Glauber Salt in various proportions.

Sp. 9.

GLAUBERSALT. Sulphate of Soda.

Occurs usually efflorescent; colour white; to the taste cooling and saline.

Sp. 10.

NITRE. Nitrate of Potash.

Occurs in crusts and spicular crystals; colour yellowish white; to the taste cooling and saline; deflagrates when placed on a hot coal.

Sp. 11.

SAL-AMMONIAC. Muriate of Ammonia.

Occurs massive with a fibrous structure, in crusts, and in minute crystals; colour greyish white, when mixed with Sulphur yellowish; to the taste pungent and saline; when moistened and rubbed with Quicklime it gives out a pungent ammoniacal odour.

Sp. 12.

COMMON SALT. Rock Salt. Muriate of Soda.

Occurs massive, in large columnar or spheroidal concretions, or crystallized in cubes; structure obscurely lamellar; fracture uneven; lustre shining vitreous; colour white, grey, redish brown, brick red, also violet, sky blue, and green; transparent, translucent; yields to the knife.—Sp. gr. 2·14.—To the taste simply saline, like common table salt.

α Fibrous.

Structure rather fine and generally waved fibrous.

GLAUBERITE.

See Class III. Sp. 101.

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THE END.

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MATHEM.
SOCIETY