Plate 1.

1. Rock Crystal.

2. Amethyst.

3. Chalcedony.

4. Agate

H. Sowerby, del et lith.

F. Reeve, imp.

POPULAR

MINERALOGY;

COMPRISING

A FAMILIAR ACCOUNT OF MINERALS AND THEIR USES.

BY

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TO

SIR ALEXANDER CRICHTON, M.D.,

THIS

Elementary Work

ON A SCIENCE WHICH OWES SO MUCH TO HIS PATRONAGE

IS RESPECTFULLY DEDICATED

BY HIS OBEDIENT SERVANT,

THE AUTHOR.

PREFACE.

MINERALOGY has been less generally studied than the kindred departments of natural history, more from the want of elementary teaching, than from any lack of inviting interest in the subject. Inorganic substances do not, perhaps, awaken so ready a sympathy in the observer as the development of animal or vegetable life, with its varieties of form and function: yet an interest, almost equivalent to this, is presented in the study of their combinations and uses. The history and experimental analysis of mineral bodies are productive of valuable results to those who labour in the science with the aid of abstruse technical works, and many would, doubtless, be induced to turn their attention to the subject, if there were more and simpler opportunities of acquiring a knowledge of its first principles.

I have endeavoured, in the following pages, to treat of the science of Mineralogy in a popular and intelligible manner, foreshowing the difficulties in its acquirement, as well as expatiating upon its attendant pleasures. The mineral substances described are about three hundred in number, eighty of which are figured, comprising such as are most remarkable for their beauty, for their rarity, or for their useful application in the arts; and I have been careful to select those which are most easily accessible to the young collector.

The plates, executed by myself in lithography, represent the first attempt that has been made to illustrate minerals by that process. Few objects in natural history are more difficult to portray with pictorial effect, having little definition of form, whilst it is impossible for an artist to do justice to their transparency or metallic hues. The specimens figured have been selected chiefly from my own cabinet, but I am indebted for several to those of my father (Mr. G. B. Sowerby) and Mr. Wright. To my father I am also much obliged, for his care in revising the proof-sheets. To Sir A. Crichton and to Mr. Brooke my thanks are due, for the presentation of several interesting substances, which have been of great value to me in preparing the descriptions. Frequent recourse has been had in the compilation of this work to Alger's edition of Phillips's 'Introduction to Mineralogy,' and it only remains for me to refer my readers to that excellent treatise, for further information on the subject.

H. S.

70, Great Russell Street,
October 5th, 1850.

POPULAR MINERALOGY.

INTRODUCTION.

"Nor to the surface of enlivened earth,
Graceful with hills and dales, and leafy woods
Her liberal tresses, is thy force confined:
But to the bowelled cavern darting deep,
The mineral kinds confess thy mighty power.
Effulgent hence the veiny marble shines;
Hence Labour draws his tools; hence burnished War
Gleams on the day; the nobler works of Peace
Hence bless mankind, and generous Commerce binds
The round of nations in a golden chain."

Thomson.

The study of nature, in whatever direction it is pursued, has been found to be productive of so much gratification and instruction, that when once the delight that it affords has been tasted by the reflective mind, the study is rarely, if ever, relinquished. The interest taken in its pursuit continues, on the contrary, to increase in proportion to the increased knowledge that is acquired of the objects that engage the attention. Thus, the zoologist finds it a source of boundless pleasure and instruction, to watch the habits and economy of the beasts of the forest; to listen to the warbling of the varied feathered songsters that, perched on topmost bough, enliven the stillness of the morning air with their simple melodies; to observe the curious changes through which insect life must pass before the butterfly can flutter away its few short hours in unconscious splendour; or, robbing the ocean of her molluscous inhabitants, to investigate their anatomical structure, whilst their beautiful shelly coverings he arranges in his cabinet.

Thus, too, the botanist, the farther he advances with his delicate examinations into the structure and organization of the flowers that

> "Deck the valleys with unnumbered hues,
> And far around their fragrant sweets diffuse,"

becomes more and more deeply imbued with admiration of their exquisite beauty and infinite variety.

But, whilst the study of living nature is daily becoming more generally followed and appreciated by all classes of society, the science of Mineralogy has not enjoyed that degree of popularity to which it is entitled, by the very great attractions it possesses for all who delight to recreate their minds by the examination of the wonderful and beautiful productions of nature, and to investigate their various degrees of utility to mankind, in the progress of the arts, manufactures, and sciences. This may arise from a variety of causes, of which the most apparent seems to be *the absence of that life and the power of motion* which are the peculiar attributes of the animal and vegetable kingdoms, and which add such a charm to their study.

Those, however, who devote their leisure hours to the examination, even if merely superficial, of the mineral or inorganic productions of creation, will not fail to discover, that, though they possess neither life nor motion, nature, as if to compensate for these deficiencies, has bestowed upon them with a lavish hand all that can render them attractive to the eye or suggestive to the reflection; and has not only decked them in the most gorgeous tints, but has endowed them with so much gracefulness and diversity of form, that, in fact, their beauties are excelled by no other class of natural objects.

But mere beauty alone, though it might please for a time, would be insufficient to secure for them a permanent claim on the attention of the student of nature. We therefore find that, although their beauty is great, that quality sinks into insignificance when compared with their direct and vast utility as agents, which the perseverance and ingenuity of man has learnt to make subservient to his will, in carrying out the grandest and most elaborate mechanical designs that the human mind is capable of conceiving.

In another point of view, but little discrimination is necessary to perceive the importance of our science, very many of the elementary substances of which minerals are composed possessing medicinal properties, the judicious application of which, in the treatment of the infirmities of human beings, is an art only to be acquired by the most intense and unwearying course of study on the part of the medical practitioner, to whose skill and knowledge we entrust our lives.

The mineralogist, therefore, must not be satisfied with the mere pleasures of collecting and arranging in his cabinet a series of brilliant and well-selected specimens, attractive by their beauty or their rarity, though this is absolutely necessary to a correct knowledge of the appearance and form peculiar to different substances; nor must his main object be to excite the envy or the admiring praises of the friends to whom he takes a pride in exhibiting his collection; but, making himself acquainted with their composition and properties, their modes of crystallization, and the circumstances of their occurrence, his mind will become improved and refined by the contemplation of the perfection and invariability of the laws of nature, holding equally in subjection the organic and inorganic; and, by studying the uses to which these mineral substances have been or may be applied, he arrives at the true end and legitimate aim of all scientific inquiries.

DISTRIBUTION OF MINERALS.

"Rocks rich in gems, and mountains big with mines,
That on the high equator ridgy rise,
Whence many a bursting stream auriferous plays."

Thomson.

THE science of Mineralogy is most intimately connected with Geology; for, while the geologist explores the deep and dismal caverns formed in the crust of the earth, and disentombs therefrom the fossilized remains of gigantic beings, who, perhaps, sought in them a refuge from the overwhelming flood; and whilst he examines such portions of the stratified or unstratified rocks as have been laid open to view by the ravages of the elements during thousands of years, and builds thereon, as the result of his investigations, theories almost as magnificent and extensive as the convulsions of nature on which those theories are based; the mineralogist, less aspiring in his attempts, but perhaps for that very reason more certain to arrive at just conclusions, contents himself with analyzing and experimenting upon the substances which enter into the composition of those rocks, or which in veins traverse them. Whilst, therefore, the labours of the geologist are of essential service to the mineralogist, in supplying him with information concerning the localities and situations in which minerals occur, the latter, on his part, reciprocates the benefit by analyzing the various specimens found by the former in the course of his researches; and, by thus enabling him to become acquainted with their composition, and the different earths or metals that predominate, gives him the means of forming correct notions as to the respective ages of the rocks or strata of which they form part.

Though the geographical and geological distribution of minerals is an important and highly interesting subject in itself, it is one in which the finished mineralogist only can expect to be proficient. Yet it will not here be considered out of place, to take a superficial glance at the natural situations whence those brilliant groupings of crystals whose delicately-faceted planes reflect the light in every direction, those heavy massive specimens with bright metallic surfaces, those curious stalactites, and the great variety of amorphous substances that adorn our cabinets, are most usually derived. There are few, even of the uninitiated, who, when gazing upon them in their isolated beauty of form or of colour, do not feel some desire to learn the localities from whence they are brought, how they are obtained, and in what positions they are usually found.

Premising that we allude only to such specimens as are usually admitted into the collection, we will observe that the collector of minerals is indebted to the operations of the miners for a great proportion of his choicest and most illustrative examples. These men, in working out a metalliferous vein, or *lode*, as it is termed, occasionally open cavities which are filled with the most brilliant crystallizations of the metallic ores and other substances. Unfortunately for our science, these most frequently share the same fate as the general deposit in the mine, that would not be prized by the mineralogist. Bearing in mind, however, that it is of little consequence, for the purposes of smelting, whether the ore be crystallized or massive, and that in the latter form it is frequently much richer than in the former, whereas a specimen that shows distinctly the crystalline form of a substance is of great value in a mineralogical point of view, we cannot be surprised that the men who work in the mines, although forbidden to carry any of the product away, often find means to evade the search to which they are subjected before leaving the scene of their daily labours, and realize considerable sums by the sale of specimens. Sometimes, also, though these occasions are rare, a mineralogist obtains permission from the proprietor to descend into the mines and select specimens for himself; and here his greediness is beyond all bounds. A few years since, an enthusiastic friend of ours had this great favour bestowed upon him; and, making the most of his time, he industriously chipped away, fancying he discovered a new form in every specimen that he found, until his heap grew so large that the manager jocosely suggested that it would be more convenient for him to take the whole mine away with him at once, and break it up at his leisure.

The devastating volcano, too, furnishes its quota to enrich our mineralogical collections, and a great number of interesting substances are derived from this source: with this fact the poet seems to have been well acquainted.—

> "The fluid lake that works below,
> Bitumen, sulphur, salt, and iron scum,
> Heaves up its boiling tide. The labouring mount
> Is torn with agonizing throes. At once,
> Forth from its side disparted, blazing pours
> A mighty river; burning in prone waves,
> That glimmer thro' the night, to yonder plain.
> Divided there, a hundred torrent streams,

Each ploughing up its bed, roll dreadful on,
Resistless. Villages, and woods, and rocks,
Fall flat before their sweep. The region round,
Where myrtle walks and groves of golden fruit
Rose fair; where harvest waved in all its pride;
And where the vineyard spread its purple store,
Maturing into nectar; now despoiled
Of herb, leaf, fruit, and flower, from end to end
Lies buried under fire, a glowing sea!"

Mallet.

Even from the sky do we derive very valuable additions to our cabinets. In various parts of the world, rounded masses of a stony character, termed Meteorites, have been seen to fall, into the composition of which Iron, Nickel, and many other substances have been found to enter; and even masses of Native Iron of immense dimensions are known to be of similar origin. Specimens of these are of a high pecuniary value, and happy is that collector who possesses in great number fragments of Meteorites and slices of Meteoric Iron from different localities.

The beds of rivers and alluvial soil are frequently very rich in metallic substances, occurring in rolled masses and grains, that have been there deposited after the decay of the rocks in which they originally occurred. Of this there are many instances in our own country: for example, the streams of Cornwall produce Tin ore in abundance, and amongst this grains of Gold of considerable size have been found; also at Wicklow, in Ireland, a great quantity of Gold was found by the country people in a stream that runs over rocks of clay-slate. Diamonds and many other precious stones, too, are sought for chiefly in alluvial soil and in the beds of rivers and streams,—chiefly, however, in foreign countries.

There are, besides those enumerated, many other localities whence substances equally interesting to the student of mineralogy, though not so intrinsically valuable, may be obtained at so small a sacrifice of trouble, that he must be sadly deficient in the ardour of a naturalist who would shrink from it. Thus, in a bed of clay near Bristol, occur many splendid crystallizations of Celestine and of Quartz; on some parts of the shores of Scotland are found very handsome pebbles of Carnelian and Agate; at many of the railway cuttings near London, may be seen, imbedded in the clay, capital crystals of Selenite, or Gypsum; and even the internal cavities of common flint-pebbles are frequently lined with brilliantly crystallized Quartz, or with Chalcedony. In short, as is well observed by Phillips, in the preface to his 'Elementary Treatise,' "there is nothing in the mineral kingdom too elevated or too low for the attention of the mineralogist, from the substances composing the summits of the loftiest mountains, to the sand or gravel on which he treads."

From the preceding observations it will be seen that the arena in which the mineralogist may carry on his researches is by no means limited, and that in whatever direction he pursues his studies he will surely be well supplied with objects to engage his interest. In this certainty, however, he possesses a considerable advantage over the miner; for, though geology may point out to him the strata most likely to reward his search, that noble science has not yet attained the degree of perfection necessary to enable its votary to light with certainty upon the rich deposits of treasure concealed beneath the surface of the earth. Consequently, it often happens, that after years of laborious exertion have been expended in probing the earth for her riches, the speculation is found to be a failure; the works are stopped, the workmen are discharged, and the promoters of the scheme reduced to beggary. In other cases, the operations, though exceedingly promising at first in their results, are abandoned in consequence of the great flow of water from springs that are opened during the downward course of the boring machinery.

> "So wealthy mines, that ages long before
> Fed the large realms around with golden ore,
> When choked by sinking banks, no more appear,
> And shepherds only say, 'The mines were here.'"

The next few pages will enable the student to form some conception of the difficulties and dangers, as well as the pleasures, that attend the searcher after the hidden treasures of the earth.

COLLECTING MINERALS.

THE following account of a short journey amongst the Cumberland mountains, in search of minerals, was kindly furnished to us by Mr. B. Wright, of Liverpool, who has for many years been in the habit of personally collecting the mineral productions of those mountains, and through whose exertions many rare and beautiful minerals have been introduced into the cabinets of amateur collectors, which otherwise would probably have rested for ages in their dark security, unknown to the eye of science. On this occasion Mr. Wright acted in the capacity of guide to a gentleman well known in the mineralogical world, who, not content with the mere possession of a most splendid collection of minerals, was prompted by his enterprising mind to seek them in their native fastnesses amongst the mountainous scenery of Cumberland. As far as practicable, we shall relate the particulars of the journey in the words of Mr. Wright:—

"In the summer of 1847, a Mr. C., being desirous of visiting the localities of some of the rare Cumberland minerals and personally inspecting the mines, made arrangements with me to accompany him as guide. This, I must observe, is absolutely necessary to a stranger visiting this district, for, though solitude is, perhaps, preferable, if the object be merely to admire the splendid scenery of the place, a stranger in search of minerals might walk and search about for a very long time, and completely tire himself out, and would probably return as wise as he started as to the precise spots where minerals worth having were to be obtained, or the roads leading to those spots. A few days afterwards Mr. C. arrived at Liverpool, whence we took the rail to Penrith, at which place we hired a vehicle, and fairly started on our journey, Mr. C. promising himself a rich harvest as its result. Before we had reached half-way towards our destination, the night had far advanced, and the silence was unbroken, except by the hooting of the wood-owl and the flapping of the wings of the water-fowl, which inhabited the numerous lakes and pieces of water that we passed on our road. Taking our route by the River Caldew, and turning to the left, we came in sight of a small but compact village, called Hesket Newmarket. When we reached it, the hour was so late, that all of its inhabitants had retired to rest, and were buried in deep repose: not a voice was to be heard, nor the twinkling of a light to be seen. However, we had previously settled to remain at this village for the night, and now found that our long drive, and the cold winds that we had encountered, had not disposed us to alter our determination. Pulling up, therefore, at the first inn we came to, and knocking lustily at the door, the landlord soon made his appearance; and after his first drowsiness had worn off, we found him to be a very cheerful entertainer. Not less welcome was the supper he provided; and if Mr. C. had felt somewhat dispirited at the commencement of his trip, his meal, and the few hours of sleep of which he afterwards partook, under this hospitable roof, served to renew his ardour and to recruit his strength.

"Early next morning we proceeded on our journey to the mountains on foot, as horses or vehicles would have been of no service to us here. After walking some distance over hills and dales, we sat down to rest; and now we beheld a phenomenon, ordinary enough in itself, but which is seen among these beautiful mountains to the greatest advantage: I allude to the rising of the sun. Having watched it as it seemed gradually to emerge from the

German Ocean, and then burst upon our sight in all its brightness and gorgeous hue, we resumed our way, and, after toiling on for five or six miles, halted at the first mine.

"The entrances to the mines are much like doorways, four feet wide and seven feet high, rounded off at the top; the mine generally runs into the side of the mountain on a level, and these passages extend to very great distances. All the metal is drawn out on a railway, and all the operations of crushing, grating, washing, and smelting the ore are carried on outside. We did not, however, enter this mine, as there were others in which we expected to be more successful, but contented ourselves with examining what the miners had brought out, amongst which we found several interesting minerals, and even some which were unknown to us. This success gave Mr. C. renewed courage to proceed on his enterprise, which now, indeed, became necessary, as our difficulties and dangers increased. We now reached a very narrow footpath, which led us over stupendous and dangerous precipices. This footpath was made expressly for the miners to bring out the ore on the backs of asses and small ponies. I have seen as many as twenty or thirty, one after another in a line, as it is not possible for two to go abreast, the width of the path never exceeding two feet.

Having proceeded along this path some distance, we at length arrived at the mine called Roughtengill, which is well known to have been formerly worked by the Romans, whose mode of working differed from the modern, for they used to heat the rock, and then throw water upon it, which would burst it in many directions. I knew that we should most probably meet with some good things in this mine, and we therefore concluded to examine its interior, and, having prepared our lights to guide us whilst penetrating its depths, proceeded onwards. We found the sides and roof of the passage very jagged and rugged, as is often the case, but I cannot say that the lights of our candles were reflected back by a thousand crystals or stalactites, which Mr. C. had evidently expected; on the contrary, the surfaces around us had a very dirty and dull appearance, and the path was so deep in mud, that we had some difficulty in making any way. In order to enliven his spirits, Mr. C. commenced whistling, which, to my regret, I was compelled to check, as the miners are very superstitious respecting the practice of whistling in the mines, considering it a forerunner of some great evil.

"Before we had proceeded very far, our progress was entirely stopped by the falling-in of a portion of the roof, but, by dint of great exertion, we removed the soil, and rendered it passable. Having now travelled some two hundred and forty fathoms underground, our toil was in some degree repaid by the discovery of the first touching of the mineral vein, and Mr. C. at length had the satisfaction of seeing some fine crystallized *Arseniate of Lead* in its native place, adhering to the roof of the mine. Observing this, we went eagerly to work, and procured some capital specimens, though our great object was to obtain those rare minerals, *Brochantite, Cupreous Sulphate of Lead,* and *Caledonite.*

"Wending our way a further distance of a hundred and sixty fathoms, another difficulty presented itself, that was not quite so readily surmountable; the sides of the mine had given way, and entirely stopped the water from running in its natural course. We, therefore, began to clear away portions of the wood, stone, and soil, which arrested our progress; Mr. C., though I doubt if he had ever handled a pick before, working away with the greatest good humour and with such effect that we hoped our united exertions would in another minute have enabled us to proceed; but, in this, we were doomed to disappointment.

"The clearing away of the rubbish only gave vent to a large quantity of water that had accumulated behind it, and the obstacle being removed, out rushed the water with the greatest force, carrying everything before it. The suddenness of the outburst was such that I had the greatest difficulty to retain my footing, but, having somewhat recovered my surprise, I remembered Mr. C.; looking round, I observed that gentleman standing in water at least two feet deep, and in a perfect bewilderment of amaze, as his situation was not only exceedingly unpleasant, but entirely unexpected. Though my own position was anything but agreeable, I could not forbear laughing at the ridiculous figure both of us presented; but Mr. C. only replied by his reproachful looks. I then went on personally to the depth of four feet, but finding the water increasing in depth, and that it was impracticable to proceed further in our investigations, I returned and found Mr. C. standing in the same spot, and in the same attitude of astonishment. We then made the best of our way out, and retraced our steps, the evening having far advanced before we reached the village and our worthy landlord.

"The inconveniences to which Mr. C. had been subjected had not, however, damped his ardour. We, therefore, after partaking of a bountiful breakfast, started again, at an early hour, to renew our search. Taking a different route, we proceeded by Wood Hall, and, passing the park, took a westerly direction towards the mountains. We soon arrived at an extensively worked mine, called Sandbed; but here we found nothing of importance, except some good *Sulphuret of Zinc*, this being the only locality for that mineral in Caldbeck Fells. Our plan was now to visit Drigga, an ancient mine which had been worked for four centuries, as there we expected to reap a goodly harvest. My companion found that climbing the very steep sides of the mountains was a most fatiguing operation, and several times did we stop on our way, as much to admire the beautiful view around us, as for the purpose of rest or refreshment. From the height we had attained, the view was most extensive, comprising mountains, hills, valleys, moors, and plains, and even from one spot we gazed down upon the very pretty little village in which I was born.

"At last we arrived at Drigga, but here again were disappointed, for every bit of stone had been ground down to extract the ore from it. On we went, until we reached a small, but interesting mine, called Drygill, which lay between two stupendously high mountains. In our course hither, we had to pass over the edges of some dangerous rocks, and of course, as guide, I led the way, when my progress was arrested by hearing a lusty shout for help. I quickly turned round (though this was attended with some danger), and beheld poor Mr. C., who had lost his footing on our narrow path, sliding down towards the edge of a fearful precipice. A moment later, and he would have been beyond the reach of human aid, but, fortunately, my extended hand was in time to save him from his peril. Thence advancing along a narrow path, we came to the place where the miners were at work. Their dress consists of a flannel shirt and trousers, and wooden clogs well clamped with iron; on their heads they wear a red or blue worsted nightcap, presenting a rather uncouth appearance. Notwithstanding their appearance and roughness of manners, the liberal douceur with which Mr. C. presented them had the desired effect, and they displayed great kindness in showing us the most interesting parts of the mine, and the operations connected with it. We then examined a portion of the vein which breaks out to the light of day, and discovered some excellent specimens of the *Arsenio-phosphate of Lead*, in very fine and perfect crystals. This mine, and those in its vicinity, are, without doubt, the most productive in the mineral district of Cumberland, no less than thirty different substances being found in that locality.

"Descending then to the village with our spoils, which were not very weighty, we passed the night in rest, and early next morning Mr. C. departed for the metropolis, highly delighted with his two days' tour."

COMPOSITION OF MINERALS.

> "Almighty Cause! 'tis thy preserving care,
> That keeps thy works for ever fresh and fair:
> Hence life acknowledges its Glorious Cause,
> And matter owns its Great Disposer's laws;
> Hence flow the forms and properties of things;
> Hence rises harmony, and order springs.
> Thy watchful Providence o'er all intends;
> Thy works obey their Great Creator's ends.
> Thee, Infinite! what finite can explore?
> Imagination sinks beneath thy power;
> Yet present to all sense that power remains:
> Revealed in Nature, Nature's Author reigns."—*Boyse.*

COMPARATIVELY few of the minerals that afford so great a degree of pleasure to the collector in their acquisition and arrangement occur in a simple form, but, when analyzed, are found to be composed of two or more ingredients, often of opposite natures; and upon their nature and the proportions in which they are combined depend the characters of the substance which they compose. On this department of our subject it is neither within our limits nor our province to dwell at any length, more especially as we are strengthened by the consideration that, should we happily succeed in awakening in the intelligent mind a desire to pursue the study to its farthest bounds, the many excellent works already published will enable the student to proceed satisfactorily in his inquiries. Our intention is rather to point out the beauties appertaining to the science, and simply to indicate the methods of pursuing it, than to enter into elaborate details of the chemical processes by which the composition of a mineral is determined and the exact proportions of its ingredients ascertained. But in order that the beginner may understand the grounds upon which the arrangement of mineral substances is based, it will be necessary to notice the several sections into which minerals are divided, according to their chemical composition. As the order of arrangement proposed by Mr. Phillips is at once the most simple and the most natural, we shall notice, first, the Earths; secondly, the Alkalies; thirdly, the Acids; fourthly, the Metals; and lastly, the Combustibles.

The following is a list of the Earths that are found to enter into the composition of minerals, viz.:

Alumine.	Magnesia.	Thorina.
Barytes.	Silex.	Yttria.
Glucine.	Strontian.	Zircon.
Lime.		

It must be observed, that, though for our purposes it will be sufficient to treat of all these earths as simple bodies, they are all (with the exception of Silex, which is considered to be an acid) chemically proved to be metallic oxides.

Four of the earths enumerated, viz. Barytes, Lime, Magnesia, and Strontian, are termed Alkaline Earths, from their possessing some of the properties of the alkalies; the remainder are distinguished, when in a pure state, by their insolubility in water, and by their being fixed or incombustible in the fire.

Alumine is never found pure, but enters largely into the composition of many of the earthy minerals, amongst which we may mention all the varieties of Agate and of Garnet, and the different kinds of Clay. It is a principal ingredient of most of the precious stones, and, next to Silex, is the most abundant of all the earths.

Barytes is only found in combination with either carbonic or sulphuric acid, but is not by any means of common occurrence. It is the heaviest of all the earths, and is a deadly poison.

Glucine.—The only substances in which this most rare earth occurs are those valuable gems, the Euclase, Beryl, and Emerald, and the scarce mineral, Gadolinite.

LIME.—This earth has never been found pure, but is an ingredient of many of the earthy minerals, and occurs in the greatest abundance in combination with carbonic acid, of which all the interesting forms and varieties of Calcspar may be cited as examples; but a still more familiar instance of the occurrence of Carbonate of Lime is one that is endeared to every lover of the picturesque and beautiful, namely, the snow-white chalk cliffs of old England. The utility of Lime renders it the most important of all the earths to mankind, and consequently the most interesting to the mineralogist.

MAGNESIA most usually occurs in the form of a Carbonate, but combines also with several other acids, and is a principal ingredient of Serpentine, both precious and common. Its medicinal use is well known.

SILEX.—This is the commonest of the earths, and is said to enter into the composition of full two-thirds of all the earthy minerals known. It occurs almost pure in the numerous varieties of Quartz, Rock-crystal, Opal, Flint, and the sands of the sea-shore.

STRONTIAN is not an earth of frequent occurrence. It may be distinguished from Barytes, which it much resembles, by its giving a purple colour to flame, instead of yellow. It is never found pure.

THORINA, YTTRIA, and ZIRCON have only been found in one or two rare minerals, and have not been put to any use.

The Alkalies are four in number; they are chiefly distinguished by their solubility in water, and by their chemical power of neutralizing acids. They are Potash, Soda, Lithia, and Ammonia. These are never found in a pure state, nor do they enter into the composition of the metalliferous ores; but the three first are found in some of the earthy minerals, and the last combines only with two of the acids. They are all proved by Sir Humphrey Davy to consist of oxygen united to a base which is strongly suspected to be metallic. Potash, Soda, and Lithia are particularly valuable in a commercial point of view, for, combined with oils, they are used in the manufacture of a most useful domestic article known as *soap*.

The Acids that are found to enter into the composition of minerals are thirteen, viz.:

Arsenic.	Mellitic.	Phosphoric.
Boracic.	Molybdic.	Succinic.
Carbonic.	Muriatic.	Sulphuric.
Chromic.	Nitric.	Tungstic.
Fluoric.		

These take their names from their respective bases: thus, the base of carbonic acid is Carbon, that of molybdic acid is the metal Molybdena, that of the sulphuric is Sulphur, and so on; these bases being combined with oxygen or hydrogen, forming what are termed *acids*. The acids form, in conjunction with the earths, alkalies, or metals, those combinations to which the terms arseniate, carbonate, sulphate, &c., are, in mineralogical language, applied. Only three of these acids have been found to occur in a native state—these are the Sulphuric, the Carbonic, and the Arsenic. Many of the acids, when obtained by chemical processes in an isolated condition, are largely used for various manufacturing purposes.

We have thus noticed the different earths, alkalies, and acids which are found to enter into the composition of minerals, and have observed that on the various combinations of these elementary substances is based the most natural arrangement of the specimens in our cabinets. But these elementary substances are seldom found in an isolated state. More commonly we find two or more earths, an earth and an alkali, an earth and an acid, and so on, associated together. This will partly explain the divisions into which, taking Phillips for our guide, we have divided the descriptive portion of this work. For the rest we will quote Mr. Phillips's words.—

"As rocks are constituted chiefly of earths, and metals are principally found in veins, earthy minerals may be assumed to be of earlier origin than the metalliferous, and hence minerals appear to possess a claim to a somewhat *natural order of succession in our cabinets.*

"Thus, siliceous minerals are first described, because it is estimated that silex forms the largest proportion of the oldest and most abundant primitive rocks, and all earthy minerals of which silex is the largest ingredient are arranged under that head; beginning chemically with silex in its purest form, and proceeding to such as consist of that and another earth, as silex and alumine, then to those consisting of silex and lime, &c., and afterwards to such minerals as are chiefly constituted of three or more earths, terminating with the most compound.

"Next after those minerals which consist only of one or more of the earths, succeed those in which one or other of the alkalies is found; to these such of the acids as occur in the concrete state; then those minerals which are primarily constituted of one or more earths and an acid; after these, those consisting of an alkali and an acid; and finally, the very few in which an earth, an alkali, and an acid are combined together.

"The order of arrangement is, therefore, as follows :—

Earthy minerals.

Alkalino-earthy minerals.

Acids.

Acidiferous earthy minerals.

Acidiferous alkaline minerals.

Acidiferous alkalino-earthy minerals."

To these succeed the metals and metalliferous ores, and after these the combustibles.

Metals.—We have already observed that all of the earths, with one exception, that are found to be ingredients of mineral substances, are composed of oxygen united to a metallic base, and might therefore, with some degree of propriety, be arranged under the head of metals; nevertheless, the earths not being simple bodies, we shall find it much more convenient to treat of such as are considered to be simple metals as constituting a distinct section. The simple metals known to mineralogists are as follow :—

Antimony.	Chromium.	Iron.
Arsenic.	Cobalt.	Lead.
Bismuth.	Copper.	Manganese.
Cadmium.	Gold.	Mercury.
Cerium.	Iridium.	Molybdena.

Nickel.	Silver.	Tungsten.
Osmium.	Tantalum.	Uranium.
Palladium.	Tellurium.	Vanadium.
Platina.	Tin.	Zinc.
Rhodium.	Titanium.	

Many of these occur pure or nearly pure in a natural state; when two of them occur in combination with each other, they are termed a native alloy, but if combined with mercury, are termed an amalgam. They are all possessed of a peculiar lustre called *metallic*, and their weight, compared with other substances, is very great. They are capable of uniting with acids, are insoluble in water, and are generally good conductors of heat and electricity. They are all fusible, but the degree in which they possess this quality varies greatly; Platina, for instance, requiring the strongest possible degree of heat to melt it, whilst Mercury is not only fluid at the common temperature of our atmosphere, but continues so in a degree of cold much below that at which water itself becomes solid. Many of the metals possess the valuable property of malleability, and amongst these may be mentioned Gold, Silver, Copper, and Iron, which are malleable to a remarkable degree; others, such as Antimony, Bismuth, Titanium, and Manganese, are altogether destitute of that property, and are therefore termed *brittle*.

Although the question of the growth of metals is a most interesting one, no satisfactory conclusion has yet been arrived at on the subject. Some of the old theories are rather amusing, and are worth mentioning. Descartes asserted that metals were formed from the beginning of the world, and were ranged, by the laws of gravity, about the centre,—that they were afterwards corroded by the acid salts, and carried up with them by subterranean heat to various parts of the earth. Tournefort, the botanist, supposed that minerals as well as plants originally came from eggs, and that the largest rocks were at first only as large as grains of sand! Yalden's poetical allusion to the subject of the primary causes of the formation of metals is very beautiful.—

> "Through dark retreats pursue the winding ore,
> Search Nature's depths, and view her boundless store.
> The secret cause in tuneful numbers sing,
> How metals first were formed, and whence they spring;
> Whether the active sun, with chymic flames,
> Through porous earth transmits his genial beams;
> With heat impregnating the womb of night,
> The offspring shines with its paternal light:—
> Or whether, urged by subterraneous flames,
> The earth ferments, and flows in liquid streams;

Purged from their dross, the nobler parts refine,
Receive new forms, and with fresh beauties shine:—
Or whether by creation first they sprung,
When yet unpoised the world's great fabric hung:
Metals the basis of the earth were made,
The bars on which its fixed foundation's laid:
All second causes they disdain to own,
And from the Almighty's fiat sprung alone."

Whatever may be the true method and cause of the growth of metals, that they do grow, under certain circumstances, is not to be denied; and we may here quote the assertion of a practical observer (Mr. Wright of Liverpool) to whom we applied for information. "Minerals *do* grow. I opened a vein that had not been worked for two hundred years, and from which the ore had been well cleared out: I found that the sides of the vein had been replenished with the carbonate of lead in crystals of an inch in length, which, no practical man can doubt, have been formed since the period when the mine was worked." As each metal will be treated of at considerable length separately, we will conclude this brief notice by observing, in reference to metals and the metalliferous ores, that perhaps no division of the mineral kingdom is capable of exciting so great an interest in the mind of the mineralogist; not only because the detached specimens in his cabinet form its chief ornament, but because, from the time of their being raised from the deep earth in a rough and crude condition, to the period when, refined and fashioned by the skill of man, they assume the complicated form of some giant piece of machinery, the metals and their ores, during the progress of their transition, afford both physical and mental employment to many thousands of human beings. Metals, however, cannot be rendered available to the full extent in the advancement of our comforts unless much foresight and scientific knowledge are brought to the task.

> "With sober aim, to serious end,
> Be skill and industry combined:
> Man's work must ever end in failure,
> Unless it bear the stamp of mind:
> For this was man endowed with reason,
> This raises him above the brute;—
> The head must plan with care and thought
> Before the hand should execute."
>
> *Schiller's Song of the Bell.*

Combustibles.—The minerals placed in this division are different in character from either metals, earths, alkalies, or acids, and are all of a highly inflammable nature. Of these carbon and sulphur form the principal ingredients. The

Diamond is an example of carbon in its purest form; carbon also combined with hydrogen constitutes a gem still more valuable—the coal that is so necessary to our domestic happiness. It is the base of carbonic acid. Sulphur is found not only in a pure state, but is of common occurrence in metallic ores, forming the sulphuret of the metal. Several other minerals are also ranked amongst the combustibles, and will be mentioned in due order.

> "The lively diamond drinks thy purest rays,
> Collected, light, compact; that, polished bright,
> And all its native lustre let abroad,
> Dares, as it sparkles on the fair one's breast,
> With vain ambition emulate her eyes."—*Thomson.*

CHARACTERS OF MINERALS.

"Let no presuming impious railer tax
Creative Wisdom; as if aught was formed
In vain, or not for admirable ends.
Lives there the man whose universal eye
Has swept at once th' unbounded scheme of things,
Mark'd their dependence so, and firm accord,
As with unfalt'ring accent to conclude
That *this* availeth nought?—
Till *such exist*, let zealous praise ascend,
And hymns of holy wonder, to that Power,
Whose wisdom shines as lovely on our minds,
As on our smiling eyes his servant-sun."—*Thomson.*

The characters of minerals are divided into two sections, viz. physical and chemical. The former section comprises such characters as are readily observable by the eye or by some more or less simple mechanical experiment, whilst to the latter section belong those characters that require for their recognition the application of some chemical process or series of processes, often of a most complicated nature. On one or other of these divisions of character it is necessary that the mineralogist should found the arrangement of his specimens, in order that he may readily refer to any particular substance or individual that he may require. We will therefore proceed, in the first place, briefly to comment upon those characters included in the first-named section, of which the following is a list :—

Adhesion to the tongue.	Magnetism.
Colour.	Odour.
Double refraction.	Phosphorescence.
Elasticity.	Powder.
Electricity.	Specific gravity.
External form.	Streak.
Flexibility.	Structure.
Fracture.	Taste.
Frangibility.	Touch.
Hardness.	Transparency.
Lustre.	

Adhesion to the tongue may be observed in Lithomarge, and particularly in a kind of lamellar clay which is found near Paris, and is termed Adhesive Slate, from its possessing the property of adhering to the tongue. It is not a character of common occurrence.

The *Colour* of a substance, though it may add considerably to its beauty, is not a character upon which much dependence can be placed, as the hue of a mineral frequently depends upon the accidental presence of an ingredient in such small quantity as to be insufficient to alter the general characters of the mass. The numerous varieties of Quartz, for instance, present an infinite succession of tints to the eye, though their composition and form are identical. The colours of minerals are poetically attributed to the influence of the sun, an idea in which there may be some portion of truth, since it is well known that if a nearly colourless piece of Precious Opal be placed in a position to receive the sun's rays for some hours, it will frequently be found to have assumed the most brilliant play of colours.

"At thee the ruby lights its deepening glow,
And with a waving radiance inward flames.
From thee the sapphire, solid ether, takes
Its hue cerulean; and, of evening tinct,
The purple-streaming amethyst is thine.
With thy own smile the yellow topaz burns;
Nor deeper verdure dyes the robe of spring,
When first she gives it to the southern gale,
Than the green emerald shows. But, all combined,
Thick, through the whitening opal play thy beams;
Or, flying several from its surface, form
A trembling variance of revolving hues,
As the site varies in the gazer's hand."—*Thomson.*

There are, however, many minerals of which the colour is a distinguishing characteristic.

Double refraction is a character not frequently possessed by minerals. It is best shown in the transparent variety of Carbonate of Lime known by the name of Double-refracting spar.

Elasticity and *Flexibility*. If a piece of Mica be bent, it will, on being released, spring back to its former shape, and is therefore an example of elasticity; Talc, however, is only flexible, because, when bent into any form, it retains that form, instead of regaining its previous position.

External form and *Structure*. These two characters combined, form a distinct branch of the study of minerals, termed Crystallography. They are the most important of the physical characters, and the only ones upon which a physical arrangement of specimens could possibly be founded. The subject, however, is of such unbounded extent, that it would alone fill many a scientific and pleasing volume; and, indeed, whilst such a work as Brooke's 'Familiar Introduction to Crystallography' exists, it would be as useless as it would be presumptuous were we to attempt to do more than notice one or two of its principal features.

A crystal is a symmetrical solid, bounded by plane surfaces, and is composed of minute particles or molecules of a determinate form; acted upon by certain laws of attraction, cohesion, and polarity, these molecules, combined, assume the great variety of crystalline forms that are to be observed in mineral substances. Numerous, however, as these are, they are all said to be derived from some few simple forms, and are therefore termed *secondary forms*, whilst those from which they are derived are termed *primary forms*. The most simple form to which a substance may be reduced by cleavage, may therefore generally be termed its *primary form*, from which all the modifications presented by the crystals of the substance are derived.

Of these primary forms the following may be commonly seen in well-known minerals.

The *Tetrahedron* consists of four triangular planes. This form may be frequently seen in Blende, and in Copper-pyrites.

The *Cube* is contained within six square planes. Very perfect cubes of Iron-pyrites and of Fluor-spar can be easily obtained, as it is the most common form of those substances.

The *Rhombic Dodecahedron*, a crystal composed of twelve rhombic planes. Of this form the Common Garnet is a good example.

Of the *Octohedron,* which consists of eight triangular planes, there are three varieties, viz. the acute, the obtuse, and the regular octohedron. This last is the most general, and may be observed in Iron-pyrites, Spinel-ruby, and numerous other substances.

The *Hexagonal Prism* is the form of Beryl and of Emerald, and is the general form of Quartz, although its primary form is the rhomboid.

The *Rhomboid,* of which there are several varieties, may be observed in Double-refracting spar. The difference between this form and the cube will be readily seen if the two forms are placed next to each other; but we may observe that, of a rhomboidal plane, two of the angles are acute and two obtuse, whereas the four angles of a cubic plane are all similar.

All of these forms, however, though very distinct the one from the other, are said to *pass into* each other. This curious and interesting fact may be proved to the satisfaction of the learner in a practical and simple manner, by his procuring a piece of clay, or even potato, and, having formed therefrom a cube, let him proceed to remove all its corners, or *solid angles,* with as much regularity as possible. He will then have the cubo-octohedron, so termed because the triangular planes which are produced by the removal of the solid angles, are in reality the planes of the octohedron, which will be seen by gradually removing more and more of the corners, until the cube no longer appears, being replaced by a regular octohedron. With the same humble materials the manner in which the other forms pass into each other may be witnessed. In order, however, to become well acquainted with these most interesting transformations, a set of models of the crystalline forms and their modifications should be procured.

The dimensions of crystals are exceedingly various even in the same substances. Some of the crystallizations of Quartz, for instance, are so minute that they present to the eye only a confused mass of sparkling drusy appearance, while others, particularly Rock-crystal and Amethyst, attain an enormous size. In the British Museum may be seen a well-formed Rock-crystal upwards of a foot in length, and of proportionate diameter; others are known to exist of much larger size. The Irish Amethyst is usually found in very large crystals, some of them being more than eight inches in diameter. Crystals of Beryl, presenting the regular form of that mineral, have been found in America upwards of two feet in length; these immense crystals, however, are usually opake, or nearly so, the ordinary length of the transparent crystals not exceeding two or three inches. Again, perfect dodecahedrons of Common Garnet occur sometimes of very large dimensions—some we have seen measuring full seven inches in diameter; as in the former case, these very large crystals are opake. Many more instances of the occurrence of giant crystals might be mentioned; but those already enumerated will be sufficient to suggest the reflection, that the laws of nature are exhibited as perfect and universal in the crystallization of mineral substances, as in those operations of nature that are apparently of more general interest, or, at least, that are more generally understood; and that the regularity of those laws is as plainly to be observed in the most minute and the most gigantic crystallizations, as in the greater or lesser phenomena of the animal or vegetable kingdoms.

The *Structure* of a great number of substances, in addition to their regular crystalline form, permits of their being broken or split in various directions, so as to produce forms similar to the natural crystals. The surfaces thus obtained are termed cleavage planes, according to which the primary form of a substance is often ascertained. Take, for example, a rough piece or a crystalline cube of Fluor-spar, and placing it in a convenient position on the table, apply the edge of a common table-knife to the portion to be removed, tapping the back of the knife smartly with a light hammer: by this means the tetrahedron, the octohedron, and the rhomboid, may be produced. Blende, again, may be *cleaved* into a variety of forms, such as the rhombic dodecahedron, a rhomboid, an octohedron, and the tetrahedron. Iceland-spar, also, affords a capital illustration of structure, and may be cleaved into most perfect rhomboids.

Crystals have been said to bear the same relation to the mineral kingdom, as flowers do to the vegetable. Each gives a charm to its respective study, which is perhaps necessary to secure for it that degree of attention it deserves. Before we become complete enthusiasts in any one branch of science, we must see in it some beauty to attract us—some source of superficial gratification, to tempt us to explore its winding paths; and unless that gratification be constantly renewed, we are apt to become careless and apathetic in following them. But here we find no lack of beauty, of diversity of form, or of general superficial attractions. On the contrary, the more deeply we become initiated into the mysteries of crystallography, the more do we become enamoured of it, for we find, at every step, new and beautiful truths developing themselves, and hourly discover fresh paths strewed with new and brilliant flowers.

Electricity is a character that is possessed by a considerable number of substances, and by most of the metalliferous ores. In Amber it may be observed by rubbing the specimen on cloth, when it will attract a hair, if placed within a short distance.

The *Fracture* of a mineral is observed when the substance is broken in a direction across its natural cleavage plane. The surface thus presented is sometimes conchoidal, resembling a shell, sometimes splintery, uneven, even, or hackly and irregular.

Frangibility may be said to refer to the ease with which a mineral may be broken, which probably depends upon its peculiar structure, or the arrangement of its component particles.

The *Hardness* of one mineral compared with that of another, is a very useful test in assisting to ascertain its nature. The Diamond is perhaps the hardest mineral known; and amongst the softest are Bitumen, Steatite, and Selenite.

Lustre is of several kinds. The *metallic*, peculiar to pure metals; the *pseudo-metallic*, which may be seen in

Bronzite; the *adamantine*, observable in Corundum; the *pearly*, in Pearl-spar; the *silky*, in Malachite, Labrador Felspar, and Satin-spar; the *resinous*, the *waxy*, and the *vitreous*, the first seen in Amber, the second in Chert, the last in Glassy Actinolite.

Magnetism is possessed in a great degree by some of the ores of Iron, but by few other metals or minerals. In a variety of Oxide of Iron, called *Natural Magnet*, this property may be readily observed.

Odour, of various kinds, arises from certain minerals when struck, or breathed upon, or rubbed against each other; but this is not at all a frequent character.

Phosphorescence.—This is a distinguishing property of that variety of Fluor known as Chlorophane, which mineral, when heated, gives out a phosphorescent light of a most brilliant green colour. Bolognian stone (a variety of Heavy-spar) also exhibits phosphorescence in a great degree when heated.

Powder and *Streak.*—If a mineral substance be scratched upon its surface with a knife, a fine powder will sometimes be produced, of a colour peculiar to the mineral subjected to the experiment. The *streak* of a mineral means the colour of the mark it makes upon the paper. Few minerals possess this character.

Specific Gravity is one of the most important amongst mineralogical characters, and signifies the weight of one body in comparison with that of another of the same dimensions. Water being fixed upon as the standard with which to compare the weight of mineral substances, when the specific gravity of a mineral is given, it is always understood to be its weight compared with that of water. The first notion towards the method of ascertaining the specific gravity or relative weight of metals, was discovered by Archimedes, in the following manner. Philip, king of Macedon, having given a certain quantity of gold to an artizan, for the purpose of manufacturing a crown, suspected, when the crown was delivered, that his gold had been alloyed or adulterated, and offered a large reward to any one who could discover a plan for testing the fact. The philosopher Archimedes puzzled his brains for a long time to no purpose, until bathing one day, it suddenly occurred to him, that his body displaced a certain quantity of water, and that by calculating the weight of the water so displaced, the relative weight of the body that displaced it might be ascertained.

Taste and *Touch*.—Some few minerals, principally of a saline nature, may be known by their taste, though this is a somewhat unpleasant expedient to resort to; others have a very peculiar feel when handled, of which Soap-stone is an example.

Transparency.—This character varies greatly, even in the same substances. Some of the varieties of Quartz are beautifully transparent; for instance, Brazilian Pebble (Rock-crystal), which is used as a substitute for spectacle-glasses; whilst others are perfectly opake. In Tourmaline, too, the degree of transparency is exceedingly variable.

We have alluded thus at length to the *physical* or *external* characters of minerals, because those characters may be observed by the beginner in the science, who, without some such explanation, would probably be at a loss how to recognize even the commonest substances, although described with the greatest care and in the most simple manner. But the modes of investigating the chemical properties and composition of minerals are much more complicated, and, indeed, they require so much previous scientific knowledge, that few mineralogists of the present day are sufficiently proficient to undertake an accurate analysis of a substance. Whilst it will, therefore, be quite superfluous to describe the operations by which a knowledge of the elementary ingredients of a mineral is obtained, such simple experiments as will afford a satisfactory result to the learner, will be mentioned in that portion of the work which is devoted to descriptions of the various substances.

But there is one little instrument used in the chemical examination of substances, which every learner ought to procure, and without which but little progress can be made in the study of minerals. This is the blowpipe, and by its use many interesting observations are made. It is a very simple contrivance, consisting merely of a series of three tubes of progressive sizes; two of these are fitted together in a straight line, the third being fixed in at one extremity at an angle of ninety degrees. The larger extremity being placed in the mouth, the smaller end is applied to the flame of a candle or a lamp, and the object is now to produce a constant, steady stream of flame, which is brought to bear upon the mineral under observation. The art of producing this flame is somewhat difficult to attain, but, when once acquired, is very easy to practise. This first difficulty being overcome, the learner will have time to observe that the flame produced is of two colours, the inner portion blue, and the outer yellow. Now, the heat of the blue flame is greater than that of the yellow; it is, therefore, best that the substance to be acted upon should be first exposed to the lesser degree of heat, the effect of which, being observed and noted, the inner flame should then play upon it. As it is necessary that the heat should act uniformly upon the whole of the object exposed to its power, the size of such substance should not exceed the eighth part of an inch each way. A piece of charcoal is usually the most convenient substance upon which to examine a mineral by the blowpipe.

Some mineral substances will not fuse without the addition of a *flux*: that in most common use, to promote fusion, is Borax.

THE COLLECTION.

"The philosophic youth
To Nature's voice attends, from month to month,
And day to day, through the revolving year;
Admiring sees her in her every shape,
Feels all her sweet emotions at his heart;
While truth, divinely breaking on his mind,
Elates his being and unfolds his powers."

Thomson.

Whilst some seek for pleasure only amidst the gaieties of life,—in the "giddy mazes of the dance,"—in the exciting allurements of the theatre, or in the elevating pursuit of music in its different branches;—whilst others hope, on the contrary, by denying themselves all recreation, and devoting their whole time and thought to religious exercises, to obtain happiness in this world and peace hereafter; others, still paying due attention to moral and religious duties, and still enjoying a reasonable share of the gayer and lighter scenes of life, find a calm delight in following with thoughtful eye the progress of the arts and sciences, or in investigating the admirable phenomena which are presented by the wide field of nature. To such, works of this nature may be of service in directing attention to the paths by which their favourite pursuit may be followed, with the fairest prospect of attaining interesting results.

But, whatever may be the importance of any particular study in a scientific point of view, there can be little doubt that but few would be found willing to devote their leisure hours to attaining a knowledge of any branch of natural history, were it not for the interest that is inseparable from the acquisition of a collection of specimens to illustrate the subject to which the attention is given. The chief object of some, in forming this collection, is merely to obtain such a specimen of an object or a substance as will serve to make them acquainted with its characters, and to render the experience so gained subservient to the interests and advancement of their adopted science. These are comparatively few. More generally a science is taken up for the excitement and pride of possessing specimens which are either remarkable for their beauty or for their rarity, and the attainment of a *unique* is in this case a primary object, on which time and money are lavished in abundance. Accordingly, we find that the value of an object of natural history varies greatly, just in proportion to its scarcity. A high price is frequently given for a specimen, if but few others are known to exist in the cabinets of the curious, and an enormously high sum for an object supposed to be the only one of its kind in existence; but should its locality be ascertained, a supply is thrown into the market, and its value is depreciated to a mere fraction of what it formerly possessed: not because its beauty or its scientific interest has fled, but because it is no longer to be considered a rarity or a unique. This spirit of emulation is of considerable benefit in many ways, and, if it be an error, it is but an amiable weakness.

Let the actuating motive, however, be what it may, it is certain that a collection of specimens is absolutely necessary to those who desire to study a branch of natural history; we will, therefore, offer a few remarks, which we trust may be found of use during the charming occupation of assembling together, from all parts of the world, illustrative examples of the mineral substances that enrich the earth.

Choice of Specimens.—In the first place, we must earnestly recommend the tyro in mineralogy to start with the fixed determination of limiting the dimensions of his specimens. This will be found of great advantage, as it permits all the drawers of the cabinet to be of uniform depth; thus not only giving a neater appearance, but greatly facilitating the arrangement of substances. As to what that size should be, depends entirely upon the means and the taste of the collector, and we shall not presume, therefore, to dictate, but may observe that specimens measuring two or three inches in length, and proportionate breadth, will, if selected with discrimination, usually be found sufficiently large to illustrate both the beauty and characters of a mineral. It is, of course, impossible to obtain a good specimen of every substance of exactly the same size, as many are very rare, and others never occur of large dimensions at all. Of these we must be content with such specimens as can be procured, although they may not reach the size fixed on as the standard.

When choosing a specimen, considerable care should be exercised in selecting such a one as best exhibits the characters peculiar to the substance, particularly the crystalline form; and should many varieties of the same substance be known to occur, those should be preferred whose colour, transparency, &c., are most distinct. It is, also, frequently important to possess, for comparison, perhaps identical varieties, from different localities. In all possible cases, it is desirable that a portion of the *gangue,* or *matrix,* in which a substance is found, should accompany the specimen.

Frequently, a large and clumsy specimen may, by the aid of a hammer and a pair of cutting pincers, be reduced to a very neat and select one. This requires great dexterity, as an unpractised hand is very likely to destroy, by a misdirected blow of the hammer, the very portion whose preservation is most desirable. Previously to the commencement of operations, therefore, the structure of the substance should be minutely examined, so as to observe in what direction the blow would probably take effect. Those minerals which possess a lamellar structure may be easily divided in the direction of the laminæ, but with great difficulty in the contrary direction. But the greatest difficulty is experienced when the substance is in delicate and fragile crystals, occurring on a gangue of a hard and tough nature, as the first blow would cause the crystals to fall off, and yet make no impression on the gangue. In such a case, it is advisable to set the lapidary to work, who will, without much danger to the desired portion, separate therefrom the offending gangue. These suggestions, however, are perhaps unnecessary, as in most instances the dealer in minerals will have reduced his specimens as far as might be safely attempted.

The number of distinct species of minerals and their varieties is so immense, that even when the funds are ample, it must be a work of many years to form a collection whose number shall even approach to that which is known to exist. We would, therefore, advise the student first to direct his energies and resources to procuring one good average example of each distinct substance, rather than to accumulate a large number of varieties of one species, whilst others are neglected altogether. The varieties may be added as opportunity offers.

Another excellent plan for the beginner is to purchase a collection already prepared, containing fair specimens of most of the principal common substances, and so to form a nucleus, around which to gather any acquisitions that may afterwards become desirable by his increased knowledge. Such a collection might be obtained at a very moderate cost; the principal expense, and, let us add, the principal pleasure, would be experienced in adding to it such individuals as it did not contain, in consequence of their scarcity and costliness.

The Cabinet.—Before the learner has proceeded far in the accumulation of specimens, he will find it essential to procure a cabinet to contain them, and that without this his specimens would be an encumbrance and a source of annoyance instead of agreeable recreation. Scattered here and there,—in an odd drawer,—on the sideboard,—occupying every available table,—on the floor or the mantel-shelf,—we fear that the unconscious specimens and their delinquent owner would meet with but little sympathy or encouragement from those whose hearts were not so devoted to science as to quietly acquiesce in such an infringement of household regulations. Besides this, infinite damage would result to the homeless specimens themselves, which would certainly be subjected to the daily dustings and sweepings that seem indispensable to a well-ordered apartment, but which processes would probably tend to reduce a finely-pointed acicular crystal to an obtuse, a very obtuse, pyramid or prism.

The cabinet should be made of mahogany, *never of cedar*, because from that wood a resinous matter exudes, which, covering the specimens in the drawer, renders most of them in great part valueless. Many fine collections, both of shells and minerals, have been much damaged through being placed in cabinets made of cedar-wood ; it being almost impossible to remove the clammy covering without destroying the specimens.

Should our suggestions as to limiting the size of specimens be followed, the drawers of the cabinet may be made all of the same depth, which, in addition to facility of arrangement, gives to the structure a neatness of contour highly desirable in everything appertaining to science. The cabinet should be enclosed in folding-doors, both to prevent the entrance of dust, which would detract greatly from the beauty of the treasures inside, and to secure those treasures under lock and key from the deranging and injurious effects of curiosity and rough or inexperienced handling. A cabinet of minerals or other objects of natural history should always be sacred to its possessor, who would otherwise be deprived of one of his chief pleasures, namely, that of exhibiting its contents to those who can appreciate or who will admire.

To contain objects of natural history, few cabinets will bear comparison with those produced by Mr. William Edwards, of High-street, Camden-town, whose excellent workmanship, long experience, and moderate charges, we must, at the risk of appearing invidious, recommend to the patronage of those who require such services.

In order to prevent specimens from being damaged by collision with each other when in the drawers, various plans have been adopted. In some collections they are placed on pads of white silk, separated by thin strips of black wood. This plan is more adapted to large collections intended for the public gaze, as at the British Museum, than for a small private cabinet. Occasionally cotton-wool has been substituted for the white silk, but this is very objectionable, as, on a specimen being taken up, the wool will frequently cling to some projecting portion, and its removal will cause injury to its fragile structure.

The best plan, in reference to private collections, is to place the specimens in card trays, fitting closely into the drawer. These trays should be rather larger than the average size of the minerals, so that there may be a white margin between each individual, serving more completely to isolate one from the other, and, at the same time, adding greatly to the chaste *ensemble* of the drawer. For the same reason, the slip of paper on which the name of the substance is written should be smaller than the tray. The locality of each specimen should be carefully added beneath its name.

Besides these separate names accompanying the specimens, it is advantageous to fasten running numbers to them with gum, and to keep a catalogue of their names and localities, correspondingly numbered.

In concluding these introductory observations, which we trust have been found neither unnecessarily prolix nor concise, we must express our conviction that, however sanguine the anticipations that the young naturalist may have formed of the pleasing and instructive recreation to be derived from the study of minerals, they will not be disappointed, if the pursuit be followed with activity and ardour; but that he will in his own person realize the truth, that

> "Such experimentalists
> Exult in joys to grosser minds unknown,
> A wealth exhaustless, and a world their own."

We will now proceed to describe the different mineral substances which usually adorn the cabinet of the collector. Those which appear to possess the greatest general interest will be noticed at some length, and the mode of their manufacture, the principal variations assumed by them, and the several localities in which they occur, will be given when practicable. Other substances will be but slightly glanced at, in consequence of the limits fixed for this work. Others again, which are not likely, from their extreme rarity or the doubtful nature of their composition, to be met with or noticed by the beginner in mineralogy, will be entirely omitted.

The first to claim our attention will be the Siliceous minerals.

EARTHY MINERALS.

SILEX.

"Stowed bibulous above I see the sands,
The pebbly gravel next, the layers then
Of mingled moulds, of more retentive earths,
The guttered rocks, and mazy-running clefts;
That, while the stealing moisture they transmit,
Retard its motion, and forbid its waste.
Beneath the incessant weeping of these drains,
I see the rocky siphons stretched immense,
The mighty reservoirs of hardened chalk,
Or stiff-compacted clay, capacious formed."

Thomson.

THE minerals of which this earth is the principal constituent are well deserving of the first notice of the student; not only because their appearance in most of their varieties is extremely prepossessing, nor because, Silex entering into the composition of the oldest rocks, the age of the siliceous minerals gives them a claim to priority; but because these minerals are the most abundant of any that are known, and, therefore, are likely to be the first to find places in the cabinet of the learner. The varieties of colour and general appearance assumed by Quartz alone, for instance, are so numerous, that considerable vigilance must be exercised in selecting those most marked and peculiar, in order that the space in the cabinet may not be completely filled up by the former, to the exclusion of other equally interesting, though less abundant substances.

Mankind, however, has no reason to regret the abundance in which Silex exists; for if the substance be plentiful, its usefulness in supplying our necessities and luxuries is equally extensive. Silex is incombustible alone, but, mixed with an alkali and heated, it runs into glass. Were it not for this peculiarity of the commonest of earths, of what splendid and graceful ornaments, of what a multitude of useful and elegant manufactured articles, should we be deprived! Silex, too, is the principal constituent of many of the precious stones,—of the purple Amethyst, of the fire-flashing Opal, of the wine-red Garnet, of Agate, Jasper, and a host of others, which, by the exercise of the jeweller's art, are rendered worthy to adorn the apparel of the fairest portion of creation.

Turn we from this bright theme to one of a somewhat different character. Most of our roads are paved with granite, either in large and neatly-shaped blocks fitted closely together, or in small angular fragments strewed loosely upon the surface. Now, Granite consists of three distinct mineral substances, namely, Quartz (which is nearly pure Silex), Felspar, and Mica. It is evident that Felspar and Mica alone would form but sorry pavement for London's immense traffic, whereas, bound together, as it were, by the very durable Quartz, these three substances, of which Granite is composed, form roads which but seldom need repair, and which ages will not entirely wear away.

> "They still remain
> Amid the flux of many thousand years,
> That oft has swept the toiling race of men
> And all their laboured monuments away."

Bearing these things in remembrance, we cannot but admire the wisdom of that provision of nature, which has made Silex the most abundant of earths.

This earth, then, of which we have been speaking, forms the principal ingredient of the minerals which follow.

QUARTZ.

The numerous varieties of this mineral are composed almost exclusively of Silex, and occasionally some little water; but the peculiarities in the appearance of many of them are occasioned by the presence of substances differing from Quartz in character and composition. They are hard enough to scratch glass, do not yield to the knife, and are infusible before the blowpipe. When crystallized, the form of Quartz is a six-sided prism, terminated by six triangular planes, but the primary form is a rhomboid. The following are the principal varieties of Quartz.

Rock Crystal.—This term is applied to the large and transparent crystallizations of Quartz, of which substance they present the purest variety. The finest Rock crystals occur in Mica-slate at Dauphiné, in the Alps, grouped together in most magnificent masses; and from a capital though small specimen from this locality our illustration (Plate I. fig. 1) is taken. Exceedingly transparent crystals, also, are found imbedded in the Carrara marble; accompanying Brookite at Snowdon, in Wales; at Tintagel, in Cornwall; and in America, in Herkimer County, New York.

Very beautiful iridescent appearances are sometimes observable in Rock crystals, which are most generally produced from fracture in the specimen. They also frequently contain other substances imbedded in them, such as *Oxide of Iron, Titanium, Asbestus, Schorl,* &c.; and in the possession of Mr. G. B. Sowerby is a most remarkable Rock crystal, which encloses fine hair-like *Asbestus,* transversely arranged, and forms a perfect six-sided prism and pyramid, corresponding with the form of the crystal which contains it.

From the most clear and transparent specimens of Rock crystal are made glasses for spectacles, which are considered superior to those manufactured of glass.

Common Quartz.—The varieties of Quartz to which this term is applicable, differ from the preceding in being more or less opake. When crystallized, as we have already observed, they assume the form of the six-sided prism, which is occasionally terminated at both ends by a six-sided pyramid. Sometimes, too, these pyramids meet completely, so that, no portion of the prism being visible, the form of the crystal is a perfect dodecahedron with triangular planes. Mr. Wright collected many crystals of this form, and of a smoky hue, accompanying *Oligiste iron* in Cumberland; in which locality also occurs the pink variety of Double-pointed Quartz, so common in all collections.

An interesting instance, showing, that although the laws of nature are perfect, they are not only liable to considerable modification, but that accidental circumstances may produce such changes in the form of a mineral substance, that those who have not made these laws their study would scarcely recognize it, may be seen in *Babel Quartz*—so termed because its crystals appear at first sight to be composed of distinct hexagonal layers, heaped one upon the other, gradually diminishing in size as they approach the summit, and thus the *tout ensemble* bears some resemblance to the representations we have seen of the far-famed Tower of Babel. This appearance is owing to the regular process of crystallization of the Quartz being interrupted by a similar process which is crystallizing the Fluate of Lime into the cubes which are characteristic of Fluor-spar; for, though in the specimens of Babel Quartz we see only Quartz crystallized in cubic spaces, there is yet sufficient evidence that Fluate of Lime is the substance which formerly occupied those spaces, and that this crystallization of one substance against the other, prevented either from fairly developing the form peculiar to it.

Crystallized common Quartz occurs of almost every colour: at Haytor, in Devonshire, of a deep black hue, and generally opake; at Snowdon, very exquisite crystals occur, in which delicate milky clouds appear, and which hence are termed Milky Quartz; at Cairngorum, in Scotland, are found specimens of a rich wine-yellow colour, which, when fine, are used in jewellery under the name of

Cairngorums. But as it will not be possible to mention all the different colours observable in crystallized Quartz, we will content ourselves by alluding to several of those which are most distinct.

Smoky Quartz was long supposed to be peculiar to the Mourne Mountains in Ireland, where it was commonly found accompanying the very fine Beryls formerly pretty abundant, but now almost extinct in that locality. We possess, however, a good crystal of this variety, from Australia, and believe that it is also found in other localities.

Eisenkiesel is a variety of Quartz which occurs both crystallized and massive, and derives its ferruginous appearance and yellowish-red colour from the presence of a considerable proportion of iron. It is found in Bohemia, in Iron-stone veins in the Hartz, in Upper Saxony and Siberia. In England it occurs near Bristol; in Scotland, and in Ireland.

Amethyst.—This, the most beautiful variety of Quartz, derives its lovely purple tint from the admixture of a very small proportion of Iron and Manganese, but loses this colour by long exposure to heat. This mineral is largely used for the purpose of jewellery, and indeed we know of no other stone whose colour forms so splendid a contrast with that of the gold in which it is usually set. The finest stones for this purpose are brought from India, Siberia, and Spain. Most splendid cabinet specimens are brought from Bohemia, Transylvania, and from Oberstein in Germany, where it occurs lining agate balls of large dimensions. Those specimens which are but slightly tinged with colour are termed *Amethystine Quartz*. The crystal figured in Plate I. fig. 2, is from Brazil.

Capped Quartz.—This is a most interesting variety of crystallized quartz, whose peculiarity, as its name implies, arises from the summit of the crystal being *capped* by a larger crystal fitting closely upon it. The planes of the inner crystal are dull, and not polished like those of the outer. It is found in Cornwall.

The following are the principal varieties in which Quartz, when not crystallized, occurs :—

Avanturine consists of Quartz rock enclosing minute particles of Mica often of a golden hue, and, when polished, presenting a beautiful spangled appearance. The finest specimens of the red variety are from Spain, though these are said to be equalled by those found at Glen Fernat in Scotland, which are of a bluish-grey colour. It is by no means a common mineral.

Prase consists of dark green Actinolite enclosed in Quartz. It has been found in Scotland.

Cat's-eye.—This mineral, which is considerably valued, when cut and polished, as an ornamental stone, consists mainly of Quartz, but its beauty is owing to the fine silky fibres of Asbestus traversing it, presenting an appearance similar to the eye of a cat, whence its name. It is brought from Ceylon and from Malabar.

Hyalite is a glassy variety of Quartz occurring in a botryoidal form on trap or basaltic rock, the cavities in which are sometimes partially filled with this interesting mineral. It is occasionally tinged with a pale buff-colour, giving an appearance like gum arabic. From Mexico and Hungary are procured the finest specimens of Hyalite, which also occurs in the United States.

Rose Quartz.—So called in allusion to its delicate pink colour, which can only be compared to the "pure and holy blush of maiden modesty." This colour, supposed to be derived from Manganese, has been taken advantage of by the dishonest, and the stone, when cut and polished, has been sold for the Ruby. The most richly-tinted specimens are found in Bohemia, and a pale variety occurs amongst Granite in America.

Spongiform Quartz.—To this variety the Germans have given the name of Schwimmstein, from its property of swimming or rather floating upon water, by reason of its spongy cellular structure. It is sufficiently hard to scratch glass, and is remarkable for its extreme lightness. It contains a small proportion of Carbonate of lime. At St. Ouen, near Paris, it occurs in beds of Flint; also in Cornwall.

Flexible Quartz is of a granular structure, and occurs in thin layers near St. Gothard, and in Brazil. A reddish variety is also found near Whitby, in Yorkshire, which is very flexible. Its flexibility is supposed to be owing to the particles of *Mica* which traverse it.

Quartz also occurs *radiated, stalactitic,* and *arenaceous.* In this latter form it is so familiar to all lovers of the sea-side, as to need no description. The phrase "numerous as the sands of the sea-shore" is venerable for its antiquity, and is well calculated to lead the mind from the consideration of earthly things to those of a higher nature. But apart from this, who can hear the 'sea-shore' mentioned, without a thousand pleasing remembrances crowding upon his mind?—Again in fancy we are children, plying our little wooden spades as in days gone by,—rearing immense structures of sand,—transporting, by dint of great exertion, the largest blocks of chalk that we can carry from the foot of the cliff, and cleverly imbedding these in the walls of our fortress, thinking that we have succeeded in erecting a monument that shall withstand the strength of the waves, and still be visible on the morrow. Alas, the child is no more exempt from disappointment than the man; and on the morrow, when, in straw hat and belted pinafore, we visit the scene of yesterday's herculean labour, all we behold is a boulder or two of chalk in very different positions from those in which we left them. At a more advanced age, too, the delights afforded by a few weeks' sojourn on the sea-coast increase rather than diminish. The merry yachting parties,—the morning bath,—the early rambles in search of shells and fossils and sea-weeds, or chasing the crabs as they sidle along the sands; all these pursuits, though apparently trivial in themselves, are productive of no small amount of gratification.

But the grand source of delight of the sea-side is beautifully described by Mallet.—

"With wonder mark the moving wilderness of waves,
From pole to pole through boundless space diffused,
Magnificently dreadful! where, at large,
Leviathan, with each inferior name
Of sea-born kinds, ten thousand thousand tribes,
Finds endless range for pasture and for sport.

> "Adoring own
> The Hand Almighty, who its channelled bed
> Immeasurable sank, and poured abroad,
> Fenced with eternal mounds, the fluid sphere;
> With every wind to waft large commerce on,
> Join pole to pole, consociate severed worlds,
> And link in bonds of intercourse and love
> Earth's universal family."

Whilst these scenes, so productive of reflection to all, are particularly so to those who have devoted their time and thoughts to the study of animated nature, the mineralogist finds abundance of material for his cogitations and attention. Oxygen and hydrogen, the elements of which water is composed, are present in a vast number of mineral substances, and water is often an essential constituent of a mineral. The long range of precipitous chalk cliffs on the Dover coast, again, present a very familiar, though very perfect illustration of Carbonate of lime; and, imbedded therein, are found brilliant groupings of another very common substance, viz., Iron pyrites.

But the great objects of interest to the mineralogist presented on the sea-shore, are, the flint, which runs in layers between the chalk, and is also composed principally of Silex, and the sands on which he takes his morning glance at the newspaper. These two substances form the great proportion of all our manufactured glass; and with a short extracted notice of the manufacture of this highly beautiful and important article, we conclude our observations on the varieties of Quartz.

For the manufacture of glass two materials are absolutely necessary: these are, a siliceous earth and an alkali; Silex alone being infusible, but, mixed with an alkali, readily running into glass on the application of heat. This discovery was, according to Pliny, accidentally made. He relates that glass was first made of sand, found in the River Belus, in Galilee, and that the discovery originated in the following manner. A merchant-ship, laden with nitre, being driven upon the coast, the crew went ashore for provisions, and, dressing their victuals upon the shore, made use of some pieces of that alkali to support their kettles. By this means a vitrification of the sand beneath the fire was produced, which afforded a hint for the manufacture. (Rees's Cyclopædia.)

Common black flint makes very fine and clear glass. This is first heated, and then plunged into cold water; the heat whitens it, and the water causes it to split in every direction, and facilitates the grinding of it: but the cost of preparing this prevents its being commonly used. Sand is, therefore, almost the only substance now used in the British manufacture of glass. The fine white sand is the best for the purpose of making clear glass, and our glasshouses derive the principal supplies of this quality from Lynn in Norfolk, from Maidstone, and from the Isle of Wight. For green glass, the coarser sand from Woolwich is used.

The alkali, necessary to vitrify the siliceous matter, is derived from the ashes of many kinds of plants, amongst which are the fern, the bramble, bean-stalks, and many others: for though alkaline substances occur in a mineral state, they are not sufficiently abundant in England to be rendered available for this purpose.

Other ingredients, such as Oxide of Lead and of Manganese, are occasionally introduced, for the purpose of freeing the glass from any impurity of colour, and to render it more easily wrought.

The first operation is termed *fritting*: that is, the materials are subjected to gradual heat, the effects of which are to expel all moisture from the ingredients, and to cause a partial union between them. This partially vitrified matter is then thrown with iron shovels through a side opening into the furnace, the fire having been already raised to its greatest intensity. When the glass pots in the furnace are filled, the side opening is closed up with wet clay, excepting a small opening for watching the progress of the work. To this fierce heat the glass is subjected until it becomes perfectly refined, which usually occupies about forty-eight hours. It is then allowed gradually to cool, and becomes in a fit state for working.

Opal.

Opal, like Quartz, consists chiefly of Silex and water, but generally contains more of the latter than is found in Quartz. Of this mineral there are several distinct varieties, none of which are sufficiently hard to give sparks with steel, like most of the varieties of Quartz.

Precious Opal, or *Noble Opal*, is one of the most beautiful of gems, and in its polished state is so highly valued, that fine stones have frequently been sold at the same price as diamonds of equal size. The cause of the splendid flashes of red, blue, green, and yellow, which this mineral exhibits, is not fully understood, but they are said to be owing to the refraction of light in fissures dispersed throughout the mass. Whatever the cause, however, the effect is exceedingly charming, and may well account for its great value. It is translucent, its fracture is conchoidal, and its lustre vitreous. The most capital specimens in the matrix are brought from Czervenitza in Hungary; it also occurs in the Faroe Islands and in Saxony. A variety of a milk-white colour, with a faint shade of blue, has been obtained in specimens of considerable splendour from Honduras, in America.

Hydrophane, which is usually opake, possesses the remarkable property of becoming both transparent and iridescent when immersed in water. It adheres to the tongue, and is softer than Precious Opal, with which it occurs in the same locality and matrix: we consider it to be this latter substance in a state of partial decomposition. Hydrophane has been used as a gem. It contains some Alumine.

Fire Opal is one of the most splendid varieties of Opal, and is readily distinguished by its rich hyacinth-red and wine-yellow tints. From Ximapan, in Mexico, are brought the most brilliant specimens, where it was first discovered by Humboldt. It occurs, also, in the same localities as the Precious Opal, but is a rare mineral. A magnificent suite of specimens is deposited in the cases of the British

Museum. There is also found a glassy colourless variety of this mineral, in the same localities.

Common Opal occurs of various colours, but is usually more or less opake. One variety is termed Ferruginous Opal, from its containing a little Iron. Common Opal is abundant in Hungary, and is also found in Ireland and in Cornwall.

Wood Opal.—This is a truly interesting substance, as it becomes evident on inspection that what is now a mineral substance formerly belonged to the vegetable kingdom. In Wood opal may be clearly seen the concentric rings which indicate the age of a tree, as also what are termed by botanists the *medullary rays* of vegetable tissue, but, by some means, the whole mass has become impregnated with Silex, and presents all the characters of Opal. It occurs in Transylvania, Antigua, and Hungary; but the most beautiful specimens, of many different colours, are found in Van Diemen's Land, where whole forests of large trees have become thus petrified. To the geologist we must look for an explanation of this extraordinary phenomenon.

The minerals which will now be noticed have *Alumine* entering in a small proportion into their composition: their main ingredient is still, however, Silex. Amongst them we shall find many that are remarkable for their beauty, no less than for the general estimation in which they are held in ornamental jewellery. Some of these are mentioned in Darwin's fine poem, 'The Botanic Garden,' whence we extract the following quotation :—

> "Hence in fine streams diffusive Acids flow,
> Or winged with fire o'er earth's fair bosom blow;
> Transmute to glittering Flints her chalky lands,
> Or sink on ocean's bed in countless sands.
> Hence silvery Selenite her crystal moulds,
> And soft Asbestus smooths his silky folds;
> His cubic forms phosphoric Fluor prints,
> Or rays in spheres his amethystine tints.
> Soft cobweb clouds transparent Onyx spreads,
> And playful Agates weave their coloured threads;
> Gay pictured Mochoes glow with landscape-dyes,
> And changeful Opals roll their lucid eyes;
> Blue lambent light around the Sapphire plays,
> Bright Rubies blush, and living Diamonds blaze."

Flint.

This substance is so familiar to all, that, having already observed its use in the manufacture of glass, a description will be unnecessary. We may add, that its native place is in the upper bed of the chalk formation, where it occurs in flat tabular layers, which are sometimes miles in length, as at Dover. A variety of it, termed *Menilite,* derives its name from its locality, *Ménilmontant,* near Paris, where it occurs in irregular masses imbedded in Adhesive Slate. It differs from Flint in containing a small portion of inflammable matter. Its common colour is smoke-brown, but occasionally it is found of a pale stone-colour.

CHALCEDONY.

This mineral is so named, after the town of Chalcedon, in Upper Asia, where it was collected by the ancients. Alger, in his Boston edition of Phillips's useful work, has considered Chalcedony, in all its varieties, as a mere variety of Quartz. It is true that Silex is its chief ingredient, but, unlike Quartz, it also contains a considerable portion of Alumine. Further, Chalcedony is never found crystallized, for, although it occasionally assumes the cubic form, it has been ascertained that these cubes are *pseudomorphous,* an explanation of which term will be found at the conclusion of this work. It is but just, however, to state, that in the Museum of the Honourable East India

Company is a most interesting series of specimens from Aden (selected by the author, when assistant in that museum, from a larger collection), showing the transition, by gradual stages, of Quartz into Chalcedony. Some of these specimens exhibit the most fantastic contortions of form, as though they had actually been made to writhe under the intense heat to which they had, doubtless, been subjected in the volcanic district whence they were brought. Chalcedony is commonly semitransparent; it has a conchoidal fracture, and is harder than Flint. It occurs mammillated, botryoidal, and stalactitic, of which form splendid specimens were found in Trevascus mine, in Cornwall, the locality of the interesting example which we have figured (Plate I. fig. 3). The colour of this is pale brown, having a waxy lustre; but Chalcedony is found of various shades of white, grey, yellow, brown, green, and blue: beautiful specimens, tinged throughout with this last colour, in amorphous crystals, and covered all over with minute crystals of Quartz, have been brought from Hungary. Chalcedony is found in abundance in many parts of England and Scotland, and in the Faroe Islands. We have found very illustrative specimens lining hollow Flints in a sand-pit close by Lewisham: when thus found, it is covered with a bluish bloom, resembling that of the plum or grape.

The minerals which follow are considered to be varieties of Chalcedony.

Sardonyx is a very beautiful mineral, consisting of alternate layers of milk-white and rich brown Chalcedony. The brown layers are by the jewellers termed *Sard*, and the white, Onyx. Sardonyx is the substance of which many of the ancient cameos are made, and great ingenuity has been displayed in causing the white and brown portions of the stone to aid in giving effect to the subject illustrated on the cameo.

Plasma is translucent, and harder than Quartz. It is of a dark, dull green colour, which is supposed to be occasioned by the dissemination of Chlorite through the mass. It occurs principally in India and China, and is brought to this country in the shape of beads and other ornaments. According to Alger, occasional specimens are found amongst the ruins of Rome.

Heliotrope.—This resembles the preceding mineral in hardness and translucency, and also in its dark green colour, but differs from it, by having yellow or blood-red spots interspersed through the dark green, whence it has obtained the name of *Bloodstone*, and is of considerable value as an article of jewellery. It is found in Siberia, Iceland, and Bohemia, but the most valuable specimens are brought from the East, and consequently it is known among lapidaries by the name of Oriental Jasper. When well set in gold, Heliotrope makes a handsome and valuable ring.

Chrysoprase is sometimes of a dark, sometimes of a light, apple-green colour, and, being translucent, is a stone of such very delicate appearance, that it would scarcely be supposed that its toughness renders it exceedingly difficult to break. Its charming colour and other properties cause it to be highly esteemed by the jewellers, who usually cut it into a convex form, termed by them *en cabochon*. Chrysoprase consists principally of Silex, but contains also Lime, Magnesia, Alumine, Oxide of Iron, and Oxide of Nickel, to the presence of which last-named ingredient its pale-green colour is to be attributed. The only locality in which it has been found, is Kosemütz in Silesia, where it occurs in veins transversing Serpentine. It is to be regretted that this highly ornamental stone does not occur in our country, and in greater abundance; a large vase sculptured in Chrysoprase would form an elegant object of admiration.

Cacholong is an opake, milk-white variety of Chalcedony.

Its name is acquired from its being found near the river Cach, in Bucharia; it also occurs in Iceland, Greenland, and the Faroe Islands, where siliceous minerals greatly abound. We have also, in our cabinet, a specimen from India.

Carnelian.—This mineral is indebted for its name to its colour somewhat resembling that of flesh, though we should be sorry if our flesh were of quite so rich a tint. Phillips, however, informs us that the nodules of Carnelian which are found in the channels of torrents in Hindostan, are of a blackish olive-colour, passing into grey; and that these are first exposed to the sun for a few weeks, and then placed in earthen pots, and subjected to heat, which gives them the colours that render them valuable in jewellery, viz. the various shades of white, yellow, brown, or red. Carnelian is found in rounded pieces in Arabia, Siberia, Saxony, and other localities, and we possess some very small pebbles from Van Diemen's Land, of a brilliant red colour, which we are convinced have never been subjected to the colouring process above alluded to. It is stated that the finest antique cameos are made of this stone.

Agate.

The numerous varieties of Agate are so well known to those who delight to adorn themselves with polished specimens of Nature's works, set in brooches, rings, bracelets, ear-drops, necklaces, and the like, that it will be sufficient slightly to allude to those varieties which are most peculiarly inviting in their appearance. Agate is usually composed of several different minerals, from each of which it borrows some particular beauty, and thus combines in its own individuality all the colours of Chalcedony, Quartz, Amethyst, Carnelian, Jasper, Opal, and Heliotrope.

Ribbon Agate usually consists of parallel layers of several of these substances, and is found (which is the case with most Agates) in rolled pebbles, in Saxony and other localities. Our illustration (Plate I. fig. 4) is from a pebble of this variety from Scotland.

Moss Agate is a most beautiful and interesting stone, consisting mainly of Chalcedony, and presenting appearances exactly resembling moss spreading itself throughout the mass. Its colour is commonly brown, more rarely green, when the resemblance to a vegetable production is so exceedingly close, that the question will often occur to the mind, whether the dentrites in the Agate be not really a fossil Conferva or some such plant? On this subject Phillips observes, "Dr. M'Culloch has instituted a very ingenious inquiry into the nature of those vegetable appearances of different colours visible in the more transparent Chalcedonies, which are termed *Mocha*, and more particularly in those which are less so, termed *Agate*. Close observation, added to chemical experiment, induce the conclusion, that many of these appearances are owing to the existence in the stone of aquatic Confervæ; that these plants sometimes appear perfectly in their natural form and colour; in others they seem to be coated by oxide of Iron, which occasionally hides the form of the plant, and discolours it. Mosses, and some varieties of Lichen, have been observed; and occasionally Chlorite, which sometimes is so disposed as to represent a vegetable. A chrysalis, probably of a moth (?) was observed in an onyx Agate, in a ring in the possession of Earl Powis."

Against the experience of Dr. M'Culloch we should be sorry to offer an opinion, but we think the subject requires further investigation.

Mocha-stone is a most beautiful and valuable Agate, consisting of white Carnelian, with patches here and there of a deep brown colour and dentritic appearance. It derives its name from Mocha in Arabia, whence it is brought.

Brecciated Agate and *Fortification Agate* are both handsome varieties. The former consists of fragments of Ribbon Agate united together by Amethyst, and is found in Saxony. The latter, when polished, presents the appearance of a fortified place,—towers and turrets, drawbridges and bastions, mixed together but without much regard to the laws of fortification. It occurs at Oberstein, on the Rhine, and on parts of the Scottish shores, and from this locality is termed Scotch pebble.

Alger observes that "specimens recently brought from Nova Scotia will vie in beauty with any from the most noted European localities."

Very splendid cups and vases have been made of Agate, which name is said to be derived from the river Achates in Sicily, formerly celebrated for these pebbles.

"Thence will I go
To undermine the treasure-fertile womb
Of the huge Pyrenean, to detect
The Agate and the deep-entrenched gem
Of kindred Jasper.—Nature in them both
Delights to play the mimic on herself;
And in their veins she oft portrays the forms
Of leaping hills, of trees erect, and streams
Now stealing softly on, now thundering down
In desperate cascade, with flowers and beasts,
And all the living landscape of the vale.

> In vain thy pencil, Claudio, or Poussin,
> Or thine, immortal Guido, would essay
> Such skill to imitate,—it is the hand
> Of God himself, for God himself is there."—*Anon.*

Jasper.

The varieties of this mineral may be readily distinguished from those of Agate by their opacity, which is probably accounted for in some degree by the presence of a larger proportion of Iron. The most peculiar varieties are—

Common Jasper, which name is applied to such specimens as are of a uniform colour; yellow, brown, red, and occasionally green, are the colours which characterize it. It is hard and infusible alone. It is found in many parts of the Continent, in Cornwall, in Scotland, and in Nova Scotia.

Striped Jasper, as its name implies, is composed of alternate layers of different colours, which are usually parallel. This variety occurs principally in Siberia, in Saxony, and in our own country in Devonshire. It is frequently termed *Ribbon Jasper.*

Ruin Jasper is a very pretty variety, exhibiting, when cut and polished, peculiar markings which bear a great resemblance to ruined buildings.

Egyptian Pebble is found in rounded masses of a brown colour, in great quantities scattered over the surface of the sandy desert, eastward of Grand Cairo. When polished it has a very handsome aspect, showing irregular bands of brown of various shades, some of which approach to cream-colour, and others to a deep and rich brown, or occasionally black. This stone contains some Magnesia in addition to Silex and Alumine.

In addition to the foregoing substances, there are several others whose composition is so nearly similar, that they are usually placed in close proximity in the cabinet. These are *Hornstone*, one of the varieties of which is called *Woodstone*, and is in fact a fossilized wood; *Leelite*, a reddish-brown siliceous stone, of the same lustre and translucency as horn, found in Westmania; and *Siliceous Sinter*, generally of a pale grey colour, having a pearly lustre, and being of a light, brittle nature. Its chief interest arises from its being deposited by the hot springs of Iceland, around which it is found in great abundance. It consists chiefly of Silex, with a little Alumine and a trace of Iron.

Leaving now these minerals, whose composition and whose external characters are so nearly similar to each other, we come to substances which are very easily to be distinguished by a superficial examination, Silex being still by far the most abundant element in their composition.

Karpholite.

A pale straw-coloured substance, which is found in fibrous, diverging tufts on Granite, in the Tin mines of Schlachenwald, Bohemia. Besides Silex and Alumine, Manganese, Iron, Lime, Fluoric Acid, and water are found to enter into its composition.

Tabular-spar.

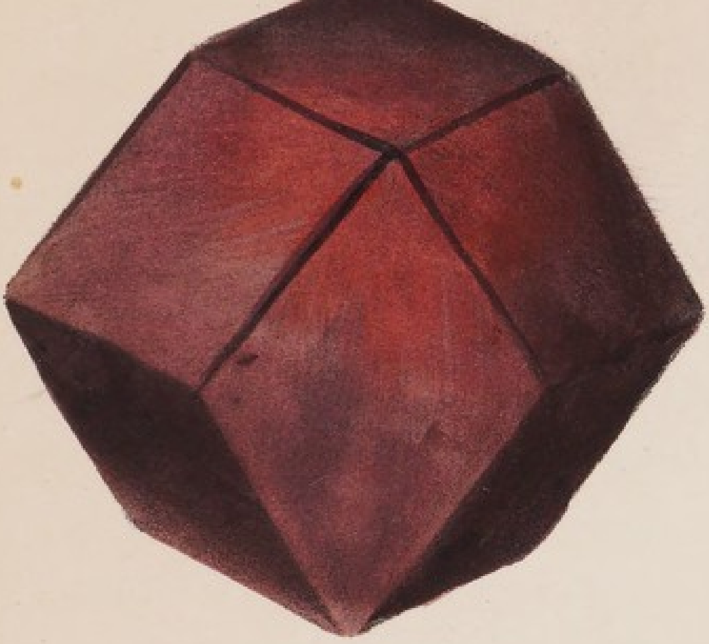
This mineral principally differs from Karpholite in containing no water, and in its colour, which is a reddish, greyish, or yellowish-white: and instead of its fibres being, as in that mineral, diverging and radiating, they are arranged nearly parallel with each other in the flat plates of which the entire mineral is composed. The only British locality with which we are acquainted is the rock on which Edinburgh Castle is erected, but it is also found accompanying Garnet, Fluor,and Silver in Finland, and in the United States. When scratched with a knife, or when heated, it is phosphorescent. —According to Brooke, its primary form is an oblique rhombic prism. The composition of *Jeffersonite* is nearly similar. *Bronzite* contains Magnesia as its next ingredient of importance after Silex. *Yenite* or *Lievrite* belongs properly to the Iron-ores.

The minerals which now come under our notice contain Silex as their principal constituent, Magnesia as the next abundant, and, in general, some proportion of Lime. The first which we shall describe of these substances is the only one which has been used as a gem, and is therefore, perhaps, possessed of the greatest amount of general interest; but we shall find many minerals amongst them well deserving our attention either for their beauty or for their usefulness.

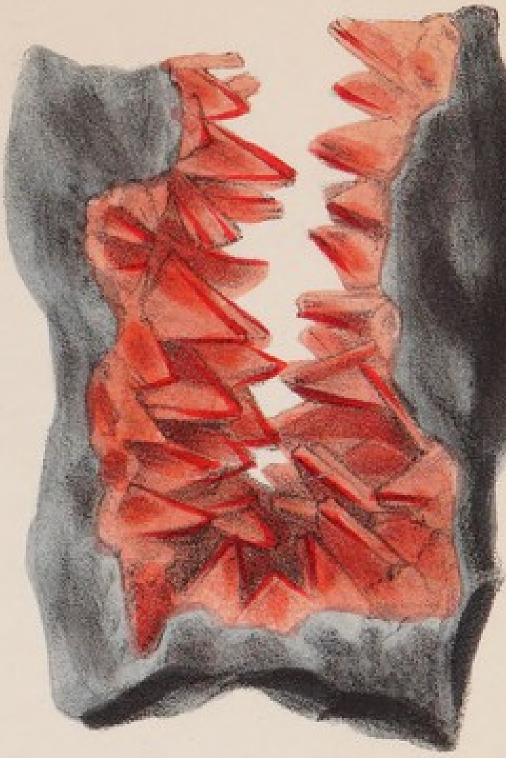
Garnet.

The primary form of all the varieties of Garnet is the rhombic dodecahedron, which form is represented in Plate II. fig. 5. It occurs of many shades of brown, red, black, and even green, and it is probable that these different colours are derived from the presence of foreign substances in minute proportions. The first variety which claims our notice is

Precious Garnet, or *Almandine.*—This is often transparent, and its rich red tint may be best observed by holding the specimen up to the light. The brilliantly crystallized



5. Garnet.



6. Heulandite.

8 Lapis Lazuli.

7. Stilbite.

Sowerby, del et lith.

F. Reeve, imp.

specimens usually seen in mineralogical cabinets are found at Ala in Piedmont, where they accompany *Alalite* or *Diopside* and crystallized *Talc*. The colour of these crystals varies from deep red to yellowish red, and they are usually found to present several modifications of the primary form. But the principal localities of that variety of the Precious Garnet which is so greatly valued as a gem, are Ceylon, Pegu, and Greenland, from which places most noble stones have been obtained for the purposes of the lapidary. The *Carbuncle* of the ancients is believed to be this stone.

Precious Garnet has been found in very perfect crystallizations in the United States, and Alger informs us that these, when cut and polished, are very beautiful gems. In New York it is found abundantly imbedded in black *Mica*. We also learn from the same authority that a large irregular mass was found in the same neighbourhood which weighed about sixty pounds.

Common Garnet differs from the precious in being usually opake, and therefore unfit for jewellery. Its crystals are sometimes of immense size; a perfect dodecahedral crystal from Norway, in the possession of the Geological Society, being full six inches in diameter. The most common substance in which Common Garnet is found imbedded, is

Mica-slate. It is found of a bright green colour, imbedded in pale green *Serpentine*, at Bissersk in Russia. Our figure represents a crystal of Common Garnet from Norway.

Pyreneite is found in minute though perfect dodecahedrons of an opake black colour, imbedded in *Mica-schist*, in the Pyrenees, whence its name is derived.

Grossular.—This is of a light olive-green colour, and, as is evident, derives its name from the Latin word *grossula*, a gooseberry. It is found in Norway and in Siberia, rarely in any other form of crystal but the *trapezoidal*, which form will be better comprehended by referring to Plate VI. fig. 22, a figure of *Analcime*, than by any description. *Grossular* is a rare mineral.

Aplome is a deep brown opake variety of Garnet found in Siberia, the Bannat, and Saxony.

Manganesian Garnet is found in Sweden, the United States, and elsewhere. As its name implies, it contains Manganese. Its form is the rhombic dodecahedron, and its colour deep hyacinth, or brownish-red.

Melanite is a perfectly opake black Garnet, occurring in crystals of about three-eighths of an inch in diameter, of the same form as the preceding variety, but with the edges of the dodecahedron replaced. It is found imbedded in *Lava* at Naples and Rome; in *Basalt* in Bohemia, and in Norway; and has also been found at Franklin, United States.

Colophonite is usually found in a granular form, the rounded grains of which it is composed being of a greenish, brown, or red colour. It is found in Norway, Piedmont, Ceylon, and in the United States.

Pyrope occurs in angular and rounded grains imbedded in dark green Serpentine in Saxony, Bohemia, and Ceylon. It is of a rich wine-red colour; and very fine specimens which have been found in Massachusetts, being cut and polished, are said by Alger to equal any from other countries.

Topazolite occurs in well-defined translucent dodecahedrons of a Topaz-yellow colour (whence its name) and occasionally olive-green. It is found upon *Mussite* at Mussa, in Piedmont. An amorphous variety is called *Succinite*.

Allochroite is the last, and least interesting variety of Garnet which we are called upon to notice. It is amorphous, of a dingy yellow colour, and opake,—contains a considerable portion of oxide of Iron, and is found in Norway.

Cinnamon-stone.

This is considered by some to be a variety of Garnet, to which it is, doubtless, very closely allied, yet its peculiar and handsome aspect renders us unwilling to call it a mere variety. Its colour is red, sometimes approaching to orange; rarely transparent, although we have seen some large grains from Ceylon, which were very nearly so, and which, being cut and polished, made admirable gems. Usually, however, it does not occur in single grains, but in large granular masses. It has been found in Sweden, but is generally brought from Brazil or Ceylon. Crystallized specimens of great brilliancy have been found in the United States.

Idocrase.

Of this beautiful mineral there are many varieties in colour, ranging from yellowish-brown to black, and often a bright green. The primary form is a four-sided prism, which is usually terminated by planes. This mineral is usually the production of a volcano; its crystals, for instance, lining the cavities of the masses of lava ejected from Vesuvius.

"Ætna roars with dreadful ruins nigh,
Now hurls a bursting cloud of cinders high,
Involved in smoky whirlwinds to the sky;

With loud displosion, to the starry frame,
Shoots fiery globes, and furious floods of flame;
Now from her bellowing caverns burst away
Vast piles of melted rocks in open day."—*Warton.*

The finest specimens of *Idocrase* come from Ala in Piedmont, the same locality as produces such brilliant groups of Precious Garnet. Large opake crystals, sometimes exceeding five inches in diameter, are found at Christiansand in Norway; and in the Fassa valley crystals of a sulphur-colour have been found.

PREHNITE.

This is composed of Silex, Alumine, Lime, Oxide of Iron, and water. Its colour is invariably a shade of green, of more or less intensity. Specimens of a beautiful apple-green colour were discovered at the Cape of Good Hope, by Colonel Prehn, in whose honour the mineral is named. Prehnite is found in France, in the Tyrol, and in America; with *Axinite* and *Asbestus* at Cornwall, near the Land's End; and is very plentiful in some parts of Scotland, where it usually occurs in botryoidal, globular concretions, composed of fibres which are often diverging. The Chinese precious stone called "*Yu*" is a variety of Prehnite.

Stilbite.

This mineral contains rather more than fifty per cent. of Silex, some Alumine, Lime, and water. Its primary form is a rectangular prism, which is usually terminated by a pyramid of four planes, which are placed on the angles of the prism. The crystals are of a lamellar structure, and may be readily split into thin plates, each crystal being generally composed of a number of smaller crystals, compressed together, and exhibiting a high lustre. Stilbite occurs of a deep red colour, in Dumbartonshire, Scotland, and in the Tyrol; but the most beautiful specimens, of a white colour, are brought from the Faroe Islands, and from Iceland, where it occurs on the *Double-refracting*, or *Iceland-spar*. At Poonah, in the East Indies, it is found in very fine crystallizations accompanying pale green *Apophyllite*, and is found of a flesh-red colour in America, accompanying *Chabasie*. The crystalline form of this substance is shown in our figure (Plate II. fig. 7), which is drawn from a specimen from the Faroe Islands.

Heulandite.

This resembles the preceding mineral so closely, that it cannot be easily distinguished. It contains a rather larger proportion of Alumine, and its primary form is an *oblique-angled* prism. Its colours are those of Stilbite, namely, white and red, and its structure is nearly similar. From Iceland have been brought most capital specimens, which are white, and possess a pearly lustre; and from Kilpatrick, in Scotland, is obtained the red variety, where it sometimes occurs with a fibrous variety of Quartz. Fig. 6, Plate II. is taken from a specimen of this variety, and exhibits its most common form. It was named by Brooke, in honour of Henry Heuland, Esq., the well-known mineralogist.

THOMSONITE.

Nearly allied, in point of composition, to these minerals, is *Thomsonite*, although, in consequence of its containing occasionally Soda as one of its ingredients, it has been placed by Alger amongst the Alkalino-earthy minerals. It is a white, shining, translucent substance, consisting of long slender columns, packed closely together, the crystals very rarely showing their terminations in the cavities of the mass. It is found only in Scotland, with *Analcime*.

In close proximity we find *Scolezite*, *Wernerite*, and *Zoisite*, for descriptions of which we must refer the learner to works of greater extent.

Epidote.

Of this mineral there are several varieties. Its most usual colour is a dark green, nearly approaching to black; its form is a quadrangular prism, which is variously modified; and Alger observes that the magnificent crystals from Arendahl, in Norway, and Normark, in Sweden, consist of concentric coats or layers, the exterior of which admit of removal, so that, out of a large imperfect crystal, one of smaller size, but more completely formed, may be produced with facility. *Epidote* occurs crystallized and granular; and one variety, termed *Manganesian Epidote,* of a purple-brown colour, has a fibrous appearance, occasioned by its association with *Asbestus.*

Axinite.

This is one of those minerals which, when once seen and known, will always be remembered by the learner. Its peculiar wedge-shaped crystals, of a rich brownish-purple tint, serve to fix it in the memory more than the most elaborate description. It was first brought from Oisans, in Dauphiny, but has many other localities. It is found at Botallack, in Cornwall, from which place, although its crystals are not to be compared for brilliancy with those from Dauphiny, very good specimens, in well-defined crystals, have been obtained. It is a very rare mineral in America.

Lapis Lazuli.

This most beautiful substance has great claims on our attention, for from it is extracted the finest blue pigment which is known, and this is done without any difficult chemical operations. By the lapidary it is, also, highly prized, as being a substance from which choice ornamental works may be produced with comparative ease in working. It generally occurs massive, very rarely in the form of the rhombic dodecahedron (for which form see the figure of Garnet). This mineral ought, perhaps, to have been noticed amongst the Alkalino-earthy minerals, as it has been found to contain a proportion of Soda and Potash, in addition to its earthy constituents, viz., Silex, Alumine, Lime, and Magnesia; Oxide of Iron and Sulphuric Acid, also, enter into its composition. Its blue colour varies in intensity, and is sometimes of a greenish tinge. It usually is found in rolled masses, but occasionally is seen disseminated in a kind of granite rock with Iron pyrites. From

Bolivia and Chili fine specimens have been brought, but the finest are from China, Persia, and Siberia. Fig. 8, Plate II. represents a specimen from Persia, and the pigment procured from the stone is used in colouring the figure.

The method of preparing this beautiful and durable colour, which is known by the name of *Ultramarine,* is very simple, and will be interesting to the painter as well as to the mineralogist.

To separate the earthy matter, the Lapis Lazuli is first heated to redness, and then suddenly quenched in cold water, which process, being repeated several times, reduces the stone to an almost friable state. It is then ground down with a few drops of water, in an iron or agate mortar, until it becomes a perfectly impalpable powder. The stone being thus prepared, the next operation is to place certain quantities of linseed oil, turpentine, rosin, and gum mastich in a clean vessel, and warm them over the fire. These ingredients are kept constantly stirred, until they are completely melted and incorporated together in a thick adhesive mass. A portion of this mixture is then taken and melted, and is poured into a clean mortar, which has previously been warmed, it is then ready to receive the pulverized *Lapis Lazuli,* which is sprinkled upon its surface, and, by continued beating with the pestle, becomes incorporated with it. Some warm water being then added, the beating with the pestle is repeated, and in a short time the water becomes charged with the blue colouring matter. The water, thus coloured, is then poured off into a clean glass, and, being allowed to stand for a few days, the colour subsides to the bottom of the glass in the form of a deep blue powder, which is *Ultramarine.*

SLATE.

Although the varieties of this substance are not remarkable for their beauty, and are consequently more frequently to be found in the cabinet of the geologist than in that of the mineralogist, a short notice of some of them may be found useful, if not entertaining. Considering, too, that on framed slabs of this substance our youthful minds were first trained to the processes of addition, multiplication, subtraction, and division, necessary to a correct knowledge of the value of money, we feel that no apology is needed for introducing the few particulars we have collected.

At Angers, in France, occurs the most valuable repository of slate which is known; and so extensive is it, that the whole town is built and covered with this material, for those blocks which will not readily split into roofing slate, are used in building. England possesses many quarries whence good slate for the purpose of roofing is procured, viz., at Cornwall, Devon, North Wales, Yorkshire, Cumberland, and Westmoreland. The most extensive slate-quarries in Great Britain are at Bangor, in Carnarvonshire, where there is a railroad formed from the quarries to the sea for the conveyance of the slate, which is sent to various parts of the world. In Cumberland it occurs in a lofty mountain, near the lake of Buttermere, some 2,000 feet above the level of the lake. Here, in consequence of the difficulty of access, the workmen lay in a week's provision, and sleep in temporary huts on the summit of the mountain, where they are frequently, during the winter, involved in clouds or blocked up with snow. The slate is conveyed down a zigzag path cut in the rock, on sledges, one man attending to prevent accidents during its descent, and to carry back the empty sledge on his shoulders.

Slate rocks are frequently intersected by veins of Quartz, and of various metals, such as Lead, Cobalt, and Silver; and in Cornwall the Tin veins sometimes pass through a bed of slate.

"When the blocks of slate have been drawn from the quarry, if they are left for some days exposed to the sun or open air, they lose what is called the *quarry water*, and then become hard and intractable, and can only be used as building stone. Frost produces a singular effect on these blocks: while frozen they may be broken with greater ease than before, but, if thawed rather quickly, are no longer divisible; yet this quality may be restored by exposing them once more to the frost."

Slate that is used for roofing should of course be impervious to the water; there are consequently several methods of ascertaining its quality and fitness for the purpose. The most simple is as follows. The slate is placed perpendicularly in a tub of water, about half a foot deep, and allowed to remain for twenty-four hours. It is then examined, and should it be found to have drawn water not more than half an inch above the surface of the water in the tub, it is considered to be good slate; but should it be saturated with water up to the very top, it is a spongy defective slate.

From a variety of slate termed *Alum-slate*, which occurs in great abundance at Whitby, in Yorkshire, nearly all the Alum of commerce is obtained.

Another variety is called *Drawing-slate*, from its leaving a black mark upon paper; it is sometimes used for sketching, and is found in France, Spain, and Italy.

Lydian stone is a variety of slate used for trying Gold and Silver upon, by a comparison of colour.

Clay.

We have observed of the Slates, that though not very attractive to the admirer of beauty, they are still highly interesting on account of their great usefulness; and the same remark will equally apply to the subjects mentioned under the above head. Amongst the Clays we shall find many varieties useful for some purpose or other, but none are more so than the common clay of which bricks are fashioned. As, however, this variety is not usually admitted into the cabinet, and as the process of brick-making is universally understood, we shall not occupy our space by a description of it, but shall mention one or two distinct varieties of a rather more attractive appearance.

Adhesive Slate is a variety of Clay which splits into thin layers when dry, and derives its name from the property of imbibing moisture, causing it to adhere to the tongue when placed upon it. This is the substance in which the variety of Flint called Menilite is imbedded.

Fuller's-earth is in daily use by servants, for the purpose of removing grease from floors—a property which it possesses in a considerable degree.

Lithomarge in its different varieties is almost the only one of these substances which is found in the cabinet. This occurs of a yellowish-white, grey, blue, or red colour, sometimes in alternate stripes of red and white, when, were it not for its softness and friability, it would bear a distant resemblance to Ribbon Agate. It is found in Saxony, Cornwall, and other localities.

As, however, it will be quite superfluous even to mention, in a work of this kind, all the different varieties of *Clay*, we will content ourselves by quoting Darwin's poetical description of the manufacture of china and other ware from the peculiar kinds of Clay.—

"Hence ductile clays in wide expansion spread,
Soft as the cygnet's down, their snow-white bed;
With yielding flakes successive forms reveal,
And change obedient to the whirling wheel.
—First China's sons, with early art elate,
Formed the gay teapot and the pictured plate;
Saw, with illumined brow and dazzled eyes,
In the red stove vitrescent colours rise;
Specked her tall beakers with enamelled stars,
Her monster-josses, and gigantic jars;

Smeared her huge dragons with metallic hues,
With golden purples and cobaltic blues;
Bade on wide hills her porcelain castles glare,
And glazed Pagodas tremble in the air.
  "Etruria! next beneath thy magic hands
Glides the quick wheel, the plastic clay expands;
Nerved with fine touch, thy fingers (as it turns)
Mark the nice bounds of vases, ewers, and urns;
Round each fair form in lines immortal trace
Uncopied Beauty and Ideal Grace."

One of the greatest, if not the chief, inducement to the contemplation of the natural productions of the earth, is found in the succession of new and beautiful varieties of form or of colour which they present, serving either to prolong or to awaken anew the interest taken in them, and the desire to become acquainted with their peculiarities. In the mineral kingdom this kind of pleasing allurement is not wanting, and we shall find that, although the composition of the minerals we are about to notice is nearly similar to that of the preceding substances, their external aspect of colour and of form is very different.

Bidding farewell to the *Slates,* and wishing a pleasant week's residence in their lofty abode to our friends the quarrymen of Cumberland; resigning, too, into the hands of the bricklayers and earthenware manufacturers the uninviting Clays; we now claim attention for a series of substances likely to be more attractive to the collector, though not quite so extensively useful.

Harmotome.

This mineral occurs in crystals of considerable size at Strontian, in Argyleshire, and at Andreasberg, in the Hartz; it is also found in Norway and at Oberstein. Its form is a flat, four-sided prism, terminated by rhombic planes, the crystals occasionally crossing each other: this is best shown in the specimens from the Hartz. It is composed of Silex, Alumine, Barytes, and water, is of a greyish-white colour, and has a somewhat pearly lustre.

Augite.

Also known by the name of *Pyroxene*. This substance occurs crystallized and granular, and in several shades of green, white, brown, and black. It is hard enough to scratch glass; and before the blowpipe runs into a dark-coloured glass. The earths which it contains are Silex, Lime, Magnesia, and Alumine, and in addition small proportions of Oxide of Iron and Manganese. Augite is met with in the produce of volcanoes, but it certainly existed in the rocks before their being subjected to volcanic action. It is found in Norway, in America, and in some parts of Scotland and of Wales. There are several minerals that are considered to be varieties of Augite: amongst these we may mention *Diopside,* a transparent, pale green, or nearly colourless crystallized substance, found with the Precious Garnets of Ala, in Piedmont, whence it is sometimes termed *Alalite*; *Sahlite,* so called from its habitat, the Silver mines of Sahla, in Sweden, is a dark green substance, occurring in prisms of four or eight sides: identical with this is the *Baikalite,* from the Lake Baikal, in Siberia. *Coccolite* is a granular substance of various shades of green and bluish-green, found in Norway, America, and other localities.

Hornblende.

The varieties of this substance, and also the remainder of the minerals arranged under the head of *Siliceous Minerals,* contain Silex as their chief ingredient, Alumine in the next proportion, Lime, and Magnesia. It must be borne in mind, however, that this gives but a general idea of their constitution, the proportions varying in each different substance, and even in different individuals of the same substance. Other ingredients also enter in larger or smaller proportion into their composition.

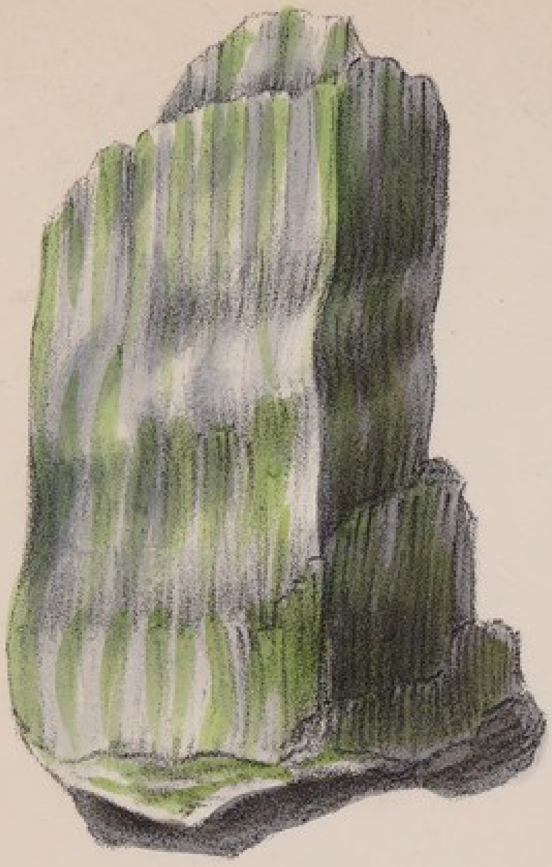
Hornblende is found crystallized in distinct prisms, but more frequently these are aggregated together. Its colour is a bottle-green, approaching more or less to black; and it is generally opake. Before the blowpipe it melts into a brilliant black glass. It is found in almost every country, but more particularly in the repositories of Magnetic Iron in Norway and Sweden, in Bohemia, in Greenland, and in the cavities of Vesuvian minerals. Alger informs us that it occurs in highly brilliant crystals of a hair-brown colour, at Edenville, New York; and that specimens of great beauty are also found at Franconia, and at Chester, Massachusetts.

Tremolite, so named from the Valley of Tremola, where it was first discovered, occurs of a white, yellowish, greenish, or reddish tinge, and we possess specimens of a bright ultramarine blue colour, which is probably owing to the presence of copper. It presents a structure of delicate crystalline fibres, which occasionally are diverging or radiating from a point. It is translucent, hard enough to scratch glass, and exhibits phosphorescence either by the application of heat or friction. At St. Gothard, in Switzerland, it is found of a beautiful white silky lustre, imbedded in *Dolomite*, where it is also occasionally found of a dark green colour. It has many other localities.

Actinolite.

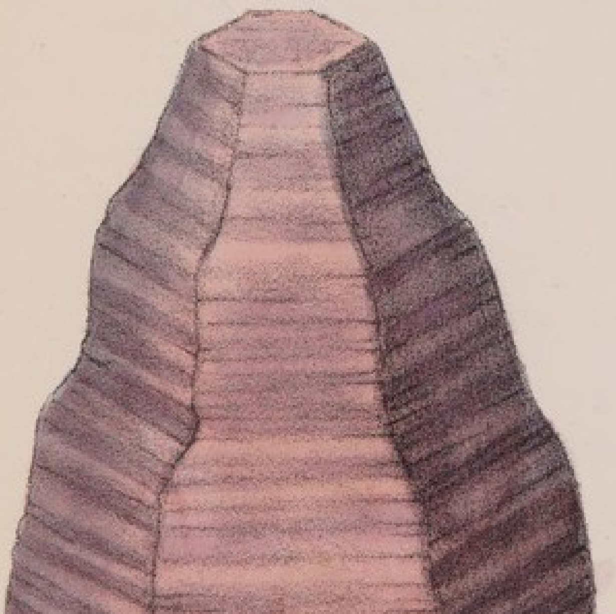
This is a substance so peculiar in its appearance, that it is difficult to consider it a mere variety of *Hornblende*, and we will, therefore, notwithstanding its similarity of composition, treat it as a distinct species, more especially as there are several varieties of this beautiful mineral. It occurs crystallized, asbestiform, and glassy.

Crystallized Actinolite is of a dark green colour, excepting where fractures exist in the crystal, which at those points exhibits a very bright green colour. This appearance we have endeavoured to show in our illustration (Plate III. fig. 9). The form of the crystal is a six-sided prism, but two of the planes are generally so narrow in proportion to the other four, as to give the appearance of a prism of only four planes: these crystals, which are found imbedded in a pale green Silvery Talc at Zillerthal, in the Tyrol, cross the Talc in every direction, but we are not aware that they have ever been found terminated by planes.

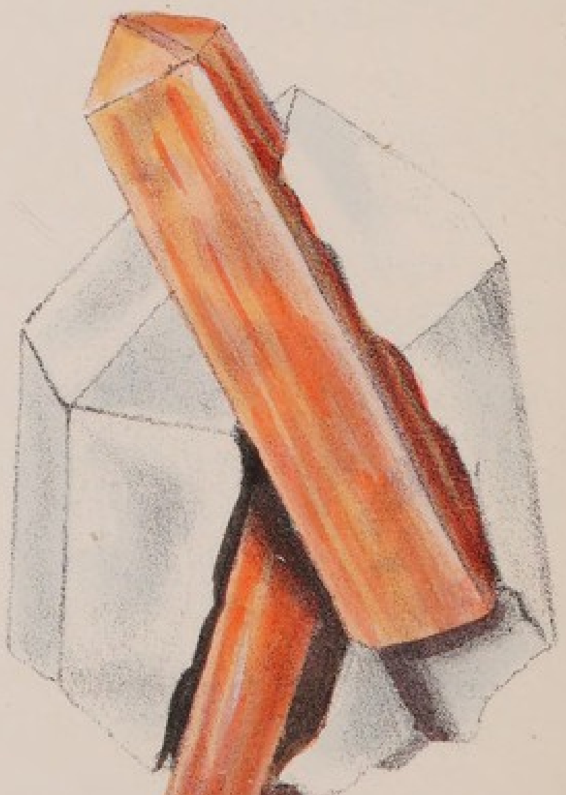


10. Asbestus.

9. Actinolite.



11. Corumdum.



12. Topaz.

Sowerby, del et lith. F. Reeve imp.

Asbestiform Actinolite so much resembles Asbestus, that they are with difficulty distinguished the one from the other. This variety of Actinolite is of a greenish-brown colour, and melts before the blowpipe into a yellowish-brown opake glass.

Glassy Actinolite differs from the preceding variety, in possessing a vitreous or pearly lustre, and in being translucent and very brittle. It is sometimes of a delicate pale green, and sometimes of a dark leek-green colour. It is found in Wales, in Scotland, and in America. This mineral requires the greatest care in handling, as it is extremely brittle, and its glassy fibres are so fine that they readily enter the skin, occasioning considerable irritation and pain.

Asbestus.

Asbestus derives its name from a Greek word signifying *imperishable*, given in consequence of the great difficulty experienced in fusing or melting it. Our drawing (Plate III. fig. 10) represents a specimen of *Common Asbestus*, which occurs in fine fibres packed closely together, of a beautiful silky texture. These fibres are flexible, and may with ease be pulled away from the mass; if this be done gently, and the filaments not quite separated, they present the appearance of wool, or the down of a bird. Common Asbestus occurs most frequently in Serpentine in Scotland, Anglesey, and in Cornwall. In colour it varies from white to green; and a handsome variety of a deep blue colour is occasionally brought from South Africa, but is not by any means common.

Amianthus occurs in extremely long and slender fibres, which are flexible and elastic in a high degree, and of a white colour, presenting in the mass a satiny appearance. Phillips says that it is found in Savoy in the longest and most beautiful fibres; that of Corsica is less beautiful, but so abundant that Dolomieu used it for packing his minerals. It is found also in many parts of Scotland, and in the United States; in fact, its geographical range is not very limited. It is this mineral which, by the ancients, was woven into a kind of incombustible cloth, in which they enveloped the bodies of the dead previously to consuming them by fire, in order that their ashes might be preserved free from other mixture. This proves that a knowledge of the properties of minerals was of some value in former times.

In Scotland, a variety of Asbestus is found, which is termed *Mountain leather*, from its resemblance to that substance. It occurs in flat, flexible pieces, and when these are very thin it is termed *Mountain paper*. Another variety, which is so light as to swim on water, and which greatly resembles cork in appearance and colour, is found in Norway, Saxony, Spain, and Scotland. This is termed *Mountain cork*.

Hypersthene.

This interesting substance is of a dark brown or greenish-black colour, massive, and of a lamellar structure. When fractured it exhibits a peculiar lustre, almost metallic, sometimes of a greenish, or of a copper-red colour, observable only in one direction. Fine specimens produce a very good effect when cut and set as jewels. It is found in rolled masses on the coast of Labrador, also in Newfoundland, Greenland, and America.

ALUMINE.

"Hence through the genial bowels of the earth
Easy may fancy pass; till at thy mines,
Gani, or Raolconda, she arrive,
And from the Adamant's imperial blaze
Form weak ideas of her Maker's glory.
Next, to Pegu or Ceylon let me rove,
Where the rich Ruby (deemed by sages old
Of sovereign virtue) sparkles even like Sirius,
And blushes into flames."

Having noticed all the most important and interesting substances whose chief ingredient is the earth *Silex*, and observed that in many of them the earth *Alumine* forms, also, a considerable ingredient, we shall now proceed to notice a series of minerals which contain *Alumine* in the largest proportion, and the other earths in smaller quantity. Amongst these minerals we shall find several that are of great beauty and value as gems. This earth occurs in a nearly pure state in

CORUNDUM.

The Diamond is the only mineral which possesses a greater degree of hardness than Corundum, one of whose varieties, the Sapphire, takes rank next after the Diamond as a gem. The varieties of Corundum are *Sapphire*, *Oriental Ruby*, *Emery*, and *Common Corundum*. The primary form is an acute rhomboid. We will first describe the last-mentioned variety, next Emery, and then the two first varieties.

Common Corundum.—This, from its hardness, has received the name of Adamantine spar. The common form of its crystal is a six-sided prism, which may be readily fractured in the direction indicated by the transverse striæ, shown in our figure (Plate III. fig. 11). This figure is taken from a crystal from India, lent to us for the purpose by Mr. Wright. It occurs of almost every colour, usually opake, but occasionally somewhat translucent. It is a very abundant mineral in India, where it is found of all shades of brown and red; some specimens are of a pale green colour, others of a deep purple. In Piedmont it occurs imbedded in white Felspar, and in some parts of America is found of a deep blue shade; and the Corundum of China is occasionally black. It is used in the East Indies for polishing steel, and cutting and polishing gems. Diamond-powder is, however, more frequently used in Europe, on account of the greater rapidity with which it works.

Emery is a fine granular variety of the preceding, occurring in rolled masses in Italy and Spain, and near Schneeberg, in Saxony, with Talc-slate. Emery-powder, being spread and fixed by some glutinous matter on to sheets of paper, is a very useful article of domestic economy in Europe, being employed in cleaning and polishing steel. It has, also, been used in cutting and polishing many gems.

Sapphire.—This beautiful gem is either of a deep indigo-blue colour, when it has been called by lapidaries the *male Sapphire*; or of a pale tint, almost colourless, called by them the *female* or *water Sapphire*; and specimens of the latter variety have sometimes passed for the Diamond. Sapphire is not acted upon by acids, but becomes electric when rubbed: before the blowpipe, with borax, it slowly melts into a colourless glass. The value of a good Sapphire weighing ten carats is fifty guineas; but if it weigh twenty carats, its value is much greater in proportion to its weight, being then worth two hundred guineas. Some Sapphires exhibit a very beautiful appearance, termed *chatoyement,* from its resemblance to the eye of a cat; others reflect the light in such a manner as to give the appearance of a brilliant star of six rays, and are termed Asterias, or

Star-stones. These varieties are very highly esteemed by the lapidaries.

One of the most beautiful blue Sapphires known to be in existence, is that preserved in the collection of the Museum of Natural History at Paris—it weighs 132½ carats; and in the Jardin des Plantes was one valued at £3,000 sterling.

Sapphires are found in the sand of rivers, particularly at Ceylon and Pegu; they are also found in Bohemia, France, Switzerland, and Portugal. Alger states that a beautiful blue Sapphire is met with in Sussex County, United States, the finest specimens being found loose in the soil, with Hornblende or Felspar. The same author mentions several other localities for Sapphire in the United States. At Expaillie, in France, where Sapphires occur with iron sand, they are gathered at the time when the rivulet happens to be nearly dry. The men employed are furnished with a kind of tray and a linen bag, and go up the rivulet till they arrive at small depressions where the water has remained stationary; these they enter, and fill their trays with the sand of the bottom, which they wash and stir with their hands under water, till the lighter particles are carried off, and the fragments of Sapphire remain.

Oriental Ruby.—The only difference between this and the blue Sapphire is the colour, which in Oriental Ruby is either blood-red or rose-red : this difference in colour causes a corresponding difference in value; a perfect Ruby, above three carats and a half in weight, being more valuable than a Diamond of equal weight; and, compared with the blue Sapphire, we have said that a Sapphire weighing *ten* carats is worth fifty guineas, but a perfect Ruby weighing *six* carats is worth above a thousand guineas. It will be easily understood, therefore, that perfect, deep crimson-red Rubies above that weight are but seldom found, and when they are, the monarchs of those countries in which they are found will not suffer them to be carried away from their territories if they can possibly prevent it. Two large Oriental Rubies are said to have belonged to the King of Visapur, one of which weighed above fifty carats, and was valued at sixty thousand francs, and the other, weighing seventeen carats and a half, was, in consequence of its greater purity, valued at seventy-five thousand five hundred and thirty francs! Feuchtwanger says—

"The King of Pegu and the monarchs of Siam monopolize the fine Rubies, as the sovereigns of the peninsula of India have done the Diamonds. The finest Ruby in the world is in the possession of the first: its purity is a proverb, and its worth, even compared with gold, is inestimable. The Subah of the Divan is, also, in possession of one an inch in diameter, and the Empress Catherine of Russia possessed one of the size of a pigeon's egg."

Alger observes, "Probably the most splendid Oriental Ruby in the United States is that now in possession of Colonel George Bomford, of Washington city. It was originally purchased at the cost of about 7,000 dollars, in Paris, by Mr. Barlow, whilst acting as American minister at the court of France."

In former times the Ruby, Sapphire, and other gems were esteemed of great value in medicine, which idea, it is needless to observe, has long since been exploded; but, in order to give some conception of the notions then entertained, we cannot forbear quoting the following passages from a work published in the year 1567, entitled 'A Greene Forest; Wherein may be seene first the most sufferaigne Vertues in all the whole kinde of Stones and Metalls,' &c. This work is arranged alphabetically, "so that a Table shall not neede," and is compiled by "John Maplet, M. of Artes, &c.; entending hereby y^t God might especially be glorified; and the people furdered."

In this work we are informed that Asterites (our Star-stone) "is a gem: but white, keeping close within it selfe light, and sheweth it forth but little, even as the Starre doth; but to hym that beholdeth it thoroughly, it sheweth him the Sunnes manifolde reflexions."

"The Sapphir is skie coloured or blew, like to the skie in the most faire weather. It is one of the noblest and royall sorts amongst all gemmes, and most meete to be worne onely upon Kings and Princes fingers." "It is good (if it be not otherwise ouerlaide) to the eiesight, and nothing in the whole worlde doth more recreate or delight the eies than the Smaradge and Sapphir doe."

The account given, however, of the Ruby is much more marvellous: it is as follows:—

"The Rubie is a stone which of some is supposed to be found in the Crabs heade, most commonly red, yet notwithstanding sometimes found in yealow colour. It auaileth against the biting of the Scorpion and Weasell, if it be applied thereto plaister like."

DIASPORE.

In addition to the earth Alumine, this mineral contains some water and oxide of iron. It is found in masses consisting of laminæ of a shining pearly lustre, and of a brown colour; rarely crystallized in the form of a doubly oblique prism. It is hard enough to scratch glass, and before the blowpipe fuses into a colourless glass. It has only been found in the Ural Mountains, and is a rare substance; but from Hungary has lately been brought a distinctly crystallized white mineral, named *Stephanite*, which is, doubtless, a variety of Diaspore, and is also extremely rare.

Turquoise.

This is also known amongst mineralogists by the name of *Calaite*. About half its quantity is Alumine, and the remainder consists of phosphoric acid, oxides of copper and iron, and water. It is an opake substance, of various shades of colour, ranging from sky-blue to apple-green. The Persian Turquoise occurs in alluvial clay, and is found on sale in most of the cities of Persia, being valuable for many ornamental purposes, and, when highly coloured, being much esteemed as a gem. We are informed that the Persian king retains for himself all the most richly-coloured varieties. Some specimens of Turquoise were brought by Mr. Cuming from the Philippine Islands.

From the ancient author before quoted, we extract the information he gives us concerning Turquoise.—

"The Turches or Turcois is in colour airelike or like to the Heauens, and looketh cleare also as sayth Cardane. It is called a Turches for that it is onely found in Turkland or amongst the Turkes. This hath such vertue and hid maner in working, that it supporteth and sustaineth, being worne in a ring, a man from falling of his horse, and is saide of the above saide Author to receyue the daunger of the fal it self, and to breake and burst in sunder, rather than the man should fall and miscarie."

Into the composition of the substances we shall next notice, viz., *Kyanite*, *Staurolite*, and *Topaz*, the earth Silex is found to enter as well as Alumine, but only in secondary proportion.

Kyanite.

This substance occurs in long four-sided prisms of a blue colour; two of the edges of the prism, however, being generally replaced by planes, the six-sided prism is the form most usually observed: these prisms have seldom or never terminations by planes, and they will readily split longitudinally. This circumstance will serve to distinguish Kyanite from Sapphire, which it in colour somewhat resembles, as a crystal of Sapphire will split with ease only in a transverse direction: besides this, though Kyanite is nearly as hard as glass, it is much softer than any of the varieties of Corundum. Kyanite occurs of a very fine colour, imbedded in Mica-slate, at St. Gothard, associated with Garnet, Staurolite, and Quartz; in the Tyrol, and in South America; and in some parts of the United States, of an exceedingly rich and beautiful colour: at Chesterfield particularly fine crystals are found of the gigantic dimensions of two feet long and two inches wide. Alger says, that when in sufficiently large masses, of a fine blue colour, and transparent, this mineral is cut and polished as an ornamental stone, bearing some resemblance to Sapphire; but we should imagine, from the ease with which it is split into thin laminæ, it could not be very generally used for that purpose.

Rhætizite is a variety of Kyanite, found in the Tyrol, occurring in sharp thin blades aggregated together, of a yellowish or red colour.

Staurolite.

The form of this mineral is the same as that of Kyanite, and it is found at St. Gothard accompanying that substance, the fine reddish-brown colour of the Staurolite contrasting splendidly with the light-blue Kyanite, the crystals of each substance often running parallel with each other: those of Staurolite, however, are very frequently terminated very perfectly. The crystals of this substance often intersect each other at right angles, presenting the form of a cross, from which circumstance its name was given, being derived from the Greek, signifying *cross-stone*. It is sometimes called *Grenatite*, in allusion to its usual colours, resembling those of common Garnet.

Topaz.

The constituents of this very beautiful mineral are the two earths already indicated, and fluoric acid. It is found either in rounded pieces or crystallized, its primary form being a rhombic prism, which is usually terminated by various planes and modifications. It occurs of many different shades of bluish or greenish white, yellow, and red, and is mostly transparent in a great degree. Alone, before the blowpipe, it does not fuse, but with borax slowly melts into a transparent glass. The Diamond is about seven times as hard as Topaz.

From Aberdeenshire have been obtained some of the most magnificent crystals of Topaz of a fine sky-blue colour. Topaz is found in Cornwall, in small crystals, which are generally colourless, and in Ireland, where it accompanies Smoky Quartz, Beryl, Mica, &c. Saxony produces crystals of a pale yellow colour; those of a rich yellow or red colour are brought from Brazil to this country, usually in detached crystals, but rarely imbedded in their native clayey earth. We have chosen for our figure a splendid specimen, consisting of two fine crystals imbedded in a crystal of Quartz, which is rather transparent: this is a Brazilian specimen. (Plate III. fig. 12.) Topaz is only found at one locality in the United States, which is Trumbull, in Connecticut.

Feuchtwanger informs us that the Grand Mogul possesses a polished Topaz, which was purchased for 60,000 dollars: but it is by no means so valuable a gem as many others. Still it has been thought worth while to give an artificial colour to them, which is done by the application of heat.

Topaz exhibits its possession of the property of electricity in a remarkable manner and degree.

Pyrophysalite is considered a variety of Topaz. It occurs in crystals of large size at Finbo in Sweden, of a pale bluish-green colour, and when heated gives out a phosphoric light.

Continuing still our examination of the earthy minerals, and taking them still in order according to the proportion in which the different earths compose them, we must give a passing notice of a very interesting substance named ALLOPHANE.—This is composed of Alumine, Silex, and water, making a *Siliciferous Hydrate of Alumine*; of which combination, from amongst several substances, we choose Allophane as an instance. It generally occurs of a botryoidal, or grape-like form, and is commonly of a pale buff tint, but is sometimes of a beautiful cobalt-blue colour. It has been found in Thuringia, Derbyshire, and St. Helena.

And now another gem presents itself before us, whose appearance is so delicate, that, although aware that others of greater value and more gorgeous hues are awaiting our inspection, we cannot pass it by. This is

CHRYSOBERYL.

Its colour is a pale yellowish-green, showing occasionally an opalescent bluish-white light. It is found crystallized, but more commonly in small rolled masses accompanying *Topaz* in Brazil, and together with *Rubies* and *Sapphires* in the rivers of Ceylon. At Haddam, in Connecticut, Chrysoberyl is found in granite in the form of six-sided tabular prisms, occasionally joined together in a star-like aggregation. According to the analysis of Arfwedson, this substance consisted of Alumine, Silex, and Lime; but Seybert, an American mineralogist, has since analyzed it, and found that it contained no Silex, but did contain the rare earth Glucine, a result in which he is corroborated by Thomson: it ought, therefore, in strictness to be placed with the Emerald and Beryl, which both contain that earth.

Alexandrite.—This is a variety of Chrysoberyl, of great value, which has been recently discovered in the Ural Mountains, and from Alger's Edition of Phillips we extract a short description of its peculiarities.—

"These gems possess a peculiar *dichroism*, which is not changed by exposure, *per se*, to the action of the blowpipe, appearing, when the light falls upon them, of a beautiful leek or emerald-green colour, and when it passes through them, of a deep raspberry-red or violet. This peculiarity is so remarkable that those who witness it in the evening, when the crystal is brought in the dark to a flame, will doubt by daylight the identity of the specimen, when it shows the rich green colour. Von Worth's experiments show that *Oxide of Chrome* is the colouring substance to which the phenomena above referred to, and observed so strikingly in no other stone, are owing."

"The name Alexandrite was given to distinguish this variety from the common Chrysoberyl of Ceylon, and because of its discovery on the day of the Emperor's majority. Besides, it has the two principal colours of the Russian Empire—*green* and *red*."

Spinelle Ruby.

This very interesting mineral occurs in the form of an octohedron, and is of various shades of red. It is composed principally of Alumine and Magnesia, with some Silex and Oxide of Iron. It scratches Quartz easily, but is not so hard as the true Ruby, from which its crystallization sufficiently distinguishes it. Spinelle ruby is found in the sand of rivers in Ceylon and Pegu, accompanying Zircons, &c. Though inferior in richness of colour to the true Ruby, yet when of a certain size it is much valued as a gem; for when a Spinelle ruby weighs more than four carats it is valued at half the price of a Diamond of the same weight.

Hitherto we have spoken only of the red variety, but Spinelle also occurs of other colours. In Sweden is found a pale blue variety imbedded in *Calcareous spar*, in octohedrons of considerable size, and of the same colour in the United States, where also black and dark green crystals of very large size have been found, some of which are full sixteen inches in diameter. A pale rose-red octohedron, four inches round at the base, has been obtained at Franklin, United States.

Pleonaste.—This term is now generally applied to the shining black crystals which are found in the cavities of substances of volcanic origin. From Vesuvius very beautiful specimens have been obtained.

IOLITE.

This bears also the name of *Dichroite*, derived from two Greek words signifying *of two colours*; it is of a purplish-violet colour, but, when viewed in a particular direction, appears to be of a brownish-yellow tint. It has a vitreous lustre, and is hard enough to scratch Quartz. Its principal locality is Arendahl, in Norway.

MAGNESIA.

The earthy minerals of which this is the chief ingredient are but few in number. Combined with carbonic acid it is of more frequent occurrence, but is comparatively a rare earth. Its medicinal virtures are familiar to all.

Hydrate of Magnesia.

In this substance Magnesia is found combined only with water, and is therefore termed a *Hydrate*. It occurs in plates or large scales aggregated together, these being of a pale greenish or bluish-white colour, and having a pearly lustre. The best test for this substance is to subject it to the action of muriatic, nitric, or sulphuric acid, either of which will entirely dissolve it. It usually occurs in veins traversing *Serpentine* (which mineral we shall presently notice), and is found in the Serpentine rocks near New York, in one of the Shetland Islands, and in Greece.

To the same series belongs the gem *Chrysolite*, composed of Magnesia, Silex, and other ingredients in smaller proportions. The best specimens, which are of a bright yellow colour, are brought from the Levant.

OLIVINE.

This is generally considered to be a variety of *Chrysolite*, but we are inclined to think it worthy of being noticed as a distinct species. There are two varieties of Olivine. The one is found abundantly in lava, basalt, and other volcanic rocks: this is generally of various shades of olive-green, and occurs in granular masses or in crystals of considerable size, whose primary form is the rectangular four-sided prism. The other variety is of a brownish straw-colour, and is remarkable for being found imbedded in the *Meteoric Iron* of Atacami, Peru. Of this Iron we have figured a polished slice in Plate X., showing the manner in which the Olivine is enclosed in it.

CONDRODITE.

An interesting mineral, composed of Magnesia, Silex, Oxide of Iron, &c. It assumes no crystalline form, but occurs in irregularly-shaped grains imbedded in a white crystalline Limestone, and in company with capital crystals of nearly black Spinelle, at many localities in the United States. In colour it is yellow, or of various shades of brown.

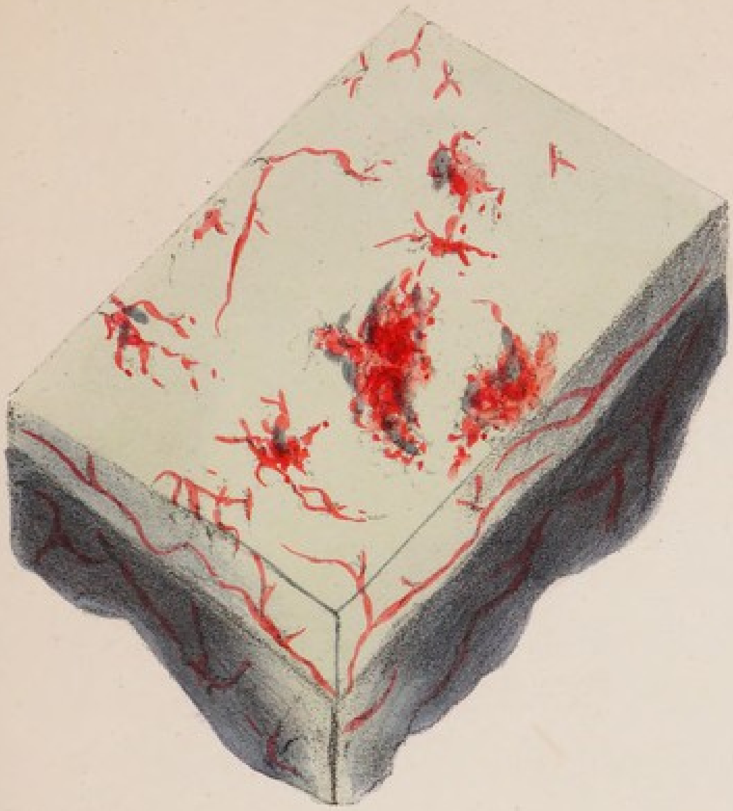
Serpentine.

Of this mineral there are many varieties in point of colour, but two only are allowed to be distinct, viz. *Precious Serpentine*, which occurs of various shades of green and yellowish-green, and is translucent and of uniform colour; and *Common Serpentine*, whose colours are mostly a mixture of brown, dull-green, and red, and which is opake. Serpentine is generally so soft as to be readily scratched by the knife, but the precious variety is softer than the common. It is composed principally of Magnesia and Silex. In Scotland it has many localities, and is very abundant; in America there are several places where the precious variety is found. Plate IV. fig. 13 represents a polished specimen, the lower part of which is dark-coloured *Common Serpentine*, while the pale-coloured portion, which is embellished by beautiful filagree markings of a bright red colour, is *Precious Serpentine*.

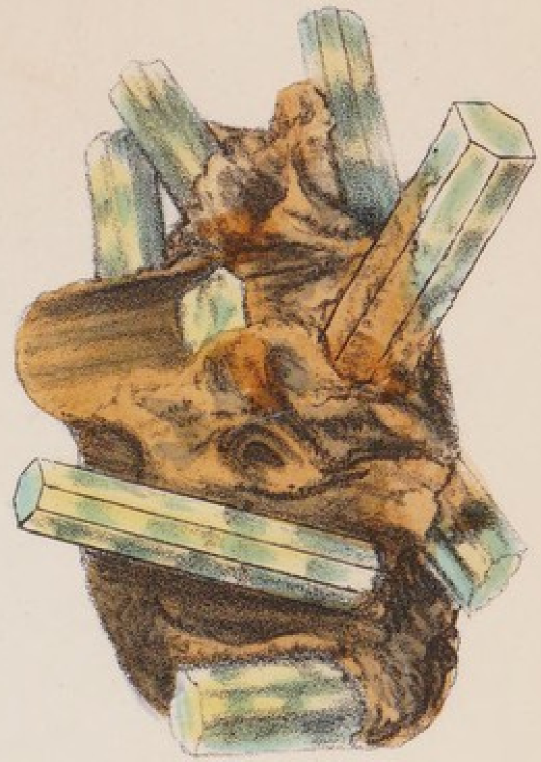
ZIRCON.

This is one of the rarest of earths, and enters into the composition of only three minerals, which it chiefly constitutes: these are *Zirconite*, *Hyacinth*, and *Jargon*, the two last being only varieties of the first.

Plate IV.



13. Precious Serpentine



15. Beryl.

14. Zircon.

16. Emerald.

H. Sowerby, del et lith.

F. Reeve, imp.

Zirconite.

Zirconite is composed of the earth Zircon, Silex, and a little Oxide of Iron, which is probably the colouring matter. The primary form of all the varieties is an octohedron, but the general appearance of the form it most usually assumes is shown in Plate IV. fig. 14. In colour it is of a reddish-brown, generally somewhat translucent, and is harder than Quartz. Magnificent crystals, occasionally as large as a walnut, are found imbedded in Felspar at Miask in Siberia, in Greenland, and in Norway. Our specimen is from Siberia.

Hyacinth is commonly found in rolled masses and grains in the sands of rivers in Auvergne, Transylvania, Bohemia, and Ceylon. It is of various shades of red, and has been cut and polished as a gem, but seldom occurs even of a moderate size free from flaws, and is therefore not much valued. But by exposure to heat, it loses its colour, and then bears so close a resemblance to the Diamond, that it has often been sold by the French jewellers as a real Diamond of inferior quality.

Jargon occurs in very small transparent grey or yellowish crystals in the sands of some of the Ceylon rivers, together with Sapphire and other precious stones.

GLUCINE.

Like the preceding earth, Glucine is found in very few minerals. Of Chrysoberyl (already noticed), of Euclase, of Beryl, and of Emerald only it is a chief ingredient, but the beauty of these will well compensate for their paucity of number.

EUCLASE.

This rare mineral occurs in transparent light green crystals of great brilliancy, and is composed of Silex, Glucine, Alumine, and the Oxides of Iron and Tin. It was first found in Peru, and has since been brought from Brazil. Very little is known of this substance, good specimens of which are seldom found in the cabinet of the beginner. The name *Euclase* is derived from the Greek, signifying *easily broken*, in allusion to the ease with which it may be fractured in one direction.

BERYL.

This is one of those gems that has a peculiar claim on our notice, for it is found frequently mentioned in Holy Writ. In the description of the tabernacle and of the breast-plate made for the high priest to officiate in, we find that—

"They set in it four rows of stones: the first was a Sardius, a Topaz, and a Carbuncle; this was the first row.

"And the second row, an Emerald, a Sapphire, and a Diamond.

"And the third row, a Ligure, an Agate, and an Amethyst.

"And the fourth row, a Beryl, an Onyx, and a Jasper: they were inclosed in ouches of gold in their inclosings."

Beryl is composed of Silex, Glucine, Alumine, Lime, and Oxide of Iron. It occurs commonly in the form of a hexahedral prism, and is frequently terminated by a single flat plane. In colour it assumes various shades of yellow and blue, and is transparent more or less. The crystals are sometimes of immense size, having been met with more than a foot in length, but they seldom exceed two inches. The largest crystals were brought from Acworth, in the United States, but these are now very seldom to be met with. It is found in *Granite* in Ireland, also in Siberia, China, France, and Brazil.

Mallet, the old author before quoted, says of this gem—"Berill is a stone rare, but not so precious, for it alone groweth in Indie: it is founde greene like to the Smaradge. It is first found also raw and rude without eyther good looke or pleasant shewe, but afterwards it is better polished of them in Indie, and they used to polish in maner and forme of Angle or Corner, to the intent that through y[e] dulnesse of his own colour, this maner might shewe some glittering, the light hauing his staye in euerie eche corner: There is also another kind of Berill, which of the Greeke worde is called Golden Berill, as sayth Diascorides, whose interchanged greene colour resembleth almost the wan and yelow colour of golde. They say that this being borne aboute a man, and being put now and than to his eies, kepeth a man out of perill of his enimies."

EMERALD.

This truly noble gem differs from Beryl only in its colour, which may be described as green, but such a green as is unsurpassed, almost unequalled, throughout the whole range of nature, and is totally inimitable by the art of man. This colour it owes to the presence of a small proportion of the Oxide of Chrome; in other respects its composition is the same as that of Beryl, with which substance it is also indentical in its crystalline form, the six-sided prism. The form of the Emerald, as well as the general appearance of its matrix, we have succeeded in exhibiting in our figure (Plate IV. fig. 16), but the colourer's stores contain no pigment sufficiently brilliant to do justice to its gorgeous hue.

Emerald occurs in most splendid crystals in a vein of Magnesian Limestone near Santa Fé de Bogota, in Granada, which is the locality of the specimen we have figured. From this place crystals have been brought exceeding two inches in length and breadth, perfectly clear from flaws. One of these, a perfect hexahedral prism, in the possession of the Duke of Devonshire, is three inches long and about one inch in diameter; another, from the same place, cost £500. The ancients are by some believed to have been acquainted only with a much less pure variety, which was found in Upper Egypt; if, however, the stone which they called *Smaragde* be identical with our Emerald (and this there is every reason to believe), it would appear from the following quotation, that the stone with which they were acquainted was not wanting in purity.

"The Smaradge hath his name of his excellent and fresh greene colour. For euerie thing that is grassie greene, is properly called in Greek *Smáron*. It passeth both the leafe and bough of any tree or plant in this his colour, and in this poynt alone triumpheth, neyther is the sunne by his sunne beames any let or hinderance to this his show. There is no greater refection to the eies than the sight of this. It being polished and dressed, sheweth a man his lively image, whereupon the valiant Cæsar had no greater delight, than in looking on this, to see his warriours fight, and to behold in the Smaradge which of them went best to worke, and was moste actiue.

"This stone, sayth Cardane, serueth to divination, and to tell of a certaintie, things to come, or otherwise. For that that shall come to passe, it will neuer let it sinke or slip out of minde, and that that shall not, it easily suffereth the minde to forget."

Magnificent crystals of Emerald have lately been found in Siberia, imbedded in Mica-slate; a twin crystal from this locality, in the Imperial Collection at St. Petersburg, measures seven inches long and four broad, and weighs about four pounds and a half! But the largest Emerald on record is described as of the size of an ostrich's egg: this was in the possession of the inhabitants of the valley of Manta, in Peru, where, when the Spaniards arrived in the country, it was worshipped as the *goddess* or *mother* of Emeralds, and the small ones, that were brought as offerings, the priests designated the *daughters*.

Emerald is one of the softest of the precious stones, and consequently one of those which give least trouble to the lapidary, who generally cuts it in thick tables with small facets surrounding the border. Most gems, when set, require a foil of suitable tint placed beneath them, to help out the colour, but a fine Emerald requires no such assistance.

YTTRIA.

The only earthy mineral that contains Yttria is *Gadolinite,* in which substance it is combined with Glucine and Alumine. This earth is also found in some of the ores of the metals *Cerium* and *Columbium.*

Gadolinite.

Its usual mode of occurrence is in small irregularly-shaped masses imbedded in the Granite of Sweden and Greenland. These masses are of dull exterior, but internally are black and shining. It is named after Professor Gadolin, its discoverer.

With this mineral we conclude our notice of the *Earthy Minerals,*—those which consist only of one or more earths in combination together, but into whose composition, as a general rule, neither Alkalies nor Acids have been found to enter. In a former page we have given a list of the earths known to mineralogists, but it will be found that, although we have concluded our description of the earthy minerals, several of these have not been included. The reason of this is that Lime, Barytes, and Strontian, the earths omitted, occur only in combination with Acids or Alkalies, and will, therefore, be alluded to under their respective headings.

In our search after the most interesting, rare, or beautiful substances, the learner's imagination will have accompanied us over the greater part of the earth, and in the course of these rambles we have picked up (alas! in imagination only) not a few of the most valuable of gems. To some extent we have been enabled to make ourselves acquainted with their peculiarities, their value, the modes of their occurrence, and the methods of collecting and of working such of them whose uses have been discovered by mankind. Let us now again impress upon the mind of the learner, that without some knowledge of these particulars, a collection of minerals would be but of little comparative value; the gems would still display the same lovely colours, it is true, but their beauty of appearance would soon cease to interest, whilst a knowledge of their localities and of their uses makes them a continual source of attraction, particularly to those whose means or whose occupations allow them to travel through different countries, and to examine their natural productions. And be it remembered that there is no country on the face of earth which does not produce minerals of some kind: some districts are more productive than others, and few, indeed, are so barren but that the industrious collector may find something to interest his attention.

In the next series of minerals will be found but few, if any, that have been honoured by man with the title of *gem*; and this is explained by the fact that those substances that are composed only of earthy matter are generally greatly superior in point of hardness to those in which an alkali is found to enter, and therefore more fit for the jeweller's purposes. There are, however, in the following series, many very beautiful minerals, and several of considerable use to man.

ALKALINO-EARTHY MINERALS.

All the minerals of this division contain the earth Silex as their chief constituent, and other earths in smaller proportion; with these is combined the alkali *Potash*, or *Soda*, or both: in some few the alkali *Lithia* is found together with other alkalies, and, in one mineral, *Petalite*, is the only alkali combined with the earths.

In the following substances Potash is the only alkali.

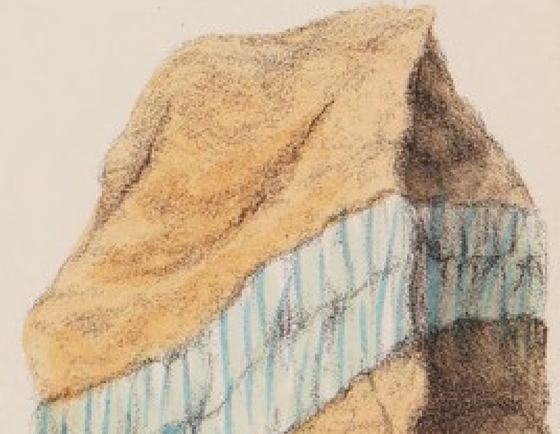
Mica.

This name is derived from the Latin, signifying *to shine*, a property which, in all its varieties, it possesses. Mica is composed of Silex, Alumine, and Potash. It occasionally is seen in its primary form, a rhombic prism, but commonly in six-sided crystals, which may be easily divided transversely into laminæ, or leaves; sometimes, though rarely, it is found in long radiating blades, and at others in irregularly-shaped grains. This is one of the three substances that are essential to form Granite, viz., Quartz, Felspar,

17. Mica.

18. Apophyllite

19. Felspar.



20. Talc.

H. Sowerby, lith.

F. Reeve, imp.

and Mica; it is, therefore, considered to be a mineral of very ancient formation. Mica is of various shades of white, yellow, green, brown, and black: that of Vesuvius (for it is also a very abundant volcanic production) is sometimes of a rich red-brown, when viewed in one direction, and in the other is almost colourless. Mica is found in almost every country; some of its principal localities are America, Siberia, Switzerland, Norway, Bohemia, Aberdeenshire, and Cornwall, from which latter locality the dark-brown coloured specimen which we have figured was brought. (Plate V. fig. 17.)

In some parts of Russia, Mica is found in masses of immense size, which, being split into plates, is used instead of glass in the Russian ships of war, as it is less liable to be broken by the concussion of the air during the discharge of artillery. Another kind, which is found in Transylvania, is used there instead of window-glass. The popular name for this kind of Mica is *Talc*, from which mineral it may be readily distinguished by its being both flexible and elastic, whereas Talc is flexible only (see page 40).

Some localities in the United States furnish specimens of gigantic size, sheets more than two feet in diameter being not uncommon in the coarse granite of Acworth, and plates of nearly equal dimensions having been found, together with Rubellite and Green Tourmaline, at another locality.

Leucite.

This was the first mineral in which the presence of Potash was discovered, in addition to which it contains Silex and Alumine. Its crystalline form is termed *trapezoidal*, which form is shown in our figure of *Analcime*. These crystals occur imbedded in rock of volcanic origin in many parts of Italy, and so abundant a substance is it that the road from Frascati to Rome is partly covered with it. In colour it is of a dirty white or grey, and very little translucency is observable in it.

Andalusite.

So named from Andalusia, in Spain, whence it was first brought. In composition it is nearly the same as the preceding substances: it occurs in the form of a rhombic prism, and in masses of columnar structure; is of a reddish or grey colour, and is found, in addition to its original locality, at Forez in France, in Scotland, and in the United States, and is also very plentiful, and finely crystallized, in one or two parts of Ireland.

Apophyllite.

The composition of this mineral is Silex, Lime, Water, and Potash. Its primary form is a regular four-sided prism, which in some specimens is terminated by four rhomboidal planes, placed on the angles of the prism, as shown in our figure. The most ordinary colour of Apophyllite is a greyish-white, but specimens from the Hartz are of a beautifully delicate rose-colour, and very transparent; and from Poonah, in the East Indies, are brought magnificent specimens, of a pale-green hue, accompanying crystallized White Heulandite and other minerals. Most noble specimens also occur in Greenland, Iceland, and the Faroe Islands. In America Apophyllite is a rare mineral, but has been found at one locality, in the form of the prism, terminated at both ends by a flat plane, a form which has also been found in Ireland. We have figured a specimen of rose-coloured Apophyllite from the Hartz.

Scaly Talc

Occurs in minute silvery scales aggregated together, of a white or yellowish-green colour. It contains Silex, Alumine, Lime, and Potash. It forms a mass which is very friable and greasy to the touch, adheres to the fingers, and gives out a clayey or *argillaceous* odour when breathed upon. Found in Piedmont, Saxony, and Bohemia. We believe it has also been found in Cornwall.

Haüyne.

This is found in minutely granular masses of a pretty blue colour, and in dodecahedral crystals, which are translucent. It occurs in Italy, and in the volcanic Mica of Vesuvius. In composition it is nearly the same as Felspar. Haüyne is so named, in honour of the Abbé Haüy, the celebrated French mineralogist.

Felspar.

Of this mineral there are several very beautiful varieties, whose composition is similar. Silex, Alumine, Lime, and Potash are the essential ingredients, and if other substances are present, as will occasionally be the case in some of the varieties, that presence is accidental, and in such very small proportions as not to affect the general characters of the substance.

Common Felspar is sometimes translucent, but more commonly opake, or translucent only on the edges. Its form is a doubly oblique prism, which sometimes exhibits many curious modifications. It occurs of a yellowish-white, blue, green, or red colour, and is the commonest of all substances with the exception of Quartz and Iron. A beautiful apple-green variety is found only in the Ural Mountains, Siberia, and is termed *Amazon-stone.* Plate V. fig. 19 represents a detached crystal of common Felspar, from Bodenmais, in Bavaria.

Glassy Felspar occurs generally in semi-transparent crystals, of a greyish or yellowish-white colour, which have the appearance of being cracked in various directions, and exhibit a vitreous lustre. It is found at Drachenfels on the Rhine, in Italy, Hungary, and in Scotland.

Labradorite was first found on the coast of Labrador by the Moravian missionaries, but beautiful varieties of it have since been brought from Norway, Siberia, and a few other localities. Its peculiarity consists in its gorgeous iridescence. Held to the light in different positions, it displays the most splendid changes of colour,—from sapphire-blue to emerald-green,—from deep violet to gold-yellow,—from crimson-red to brown, and so on through all the colours of the rainbow. This property caused the stone to be highly valued in the time of

Catherine II., when snuff-boxes made of it were sold for fifteen hundred rubles. The Labrador variety is, however, by no means a rare mineral, though good specimens from other localities are scarce.

Adularia, or *Moon-stone*, derives the latter title from the *chatoyant* reflection of light which it exhibits when held in a particular direction, and still more beautifully when cut and polished. It is generally of a milky or greenish-white colour, and is translucent. The finest specimens of this variety are brought from St. Gothard, and these are sometimes a foot in thickness: very capital specimens are also found in Ceylon.

Sun-stone is a variety of the preceding, and is sometimes termed *Avanturine Felspar*, from its being interspersed with minute particles of flesh-red Mica, which reflect a peculiarly handsome tint. This is found in Norway.

Besides these varieties, Felspar is found in amorphous sky-blue masses at Krieglach, in Styria: *Cleavelandite*, a crystallized substance, found at Snowdon in Wales, and other places, is also a variety of Felspar.

Talc.

This substance always occurs in plates, or laminæ, which are easily separated from each other, and are flexible, but not elastic. Sometimes these laminæ form a six-sided prism, derivable from the primary form, a rhombic prism. Talc occurs of many shades of yellowish or bluish white and green, is translucent, greasy to the touch, and is so soft as to yield easily to the nail, a character that serves, together with its non-elasticity, to distinguish it from Mica, whose hardness is much greater. In Piedmont, crystallized dark-green Talc is found associated with the Precious Garnet of that locality. In the Tyrol many fine varieties of Talc abound, amongst which that of a pale apple-green is conspicuous: and from Unst, one of the Shetland Islands, Talc of the same colour is brought. Talc is found in several different tints in Cornwall, a specimen from which locality, of a delicate bluish-green colour, we have chosen to figure, in order to show the curious manner in which the leaves or scales of the substance are sometimes arranged. Talc consists chiefly of Silex, Magnesia, and Potash.

Green Earth.

This substance, which is considered to be a variety of Talc, being very similar in composition, is met with in small masses, or lining the cavities of amygdaloidal rocks, wherever they occur. Its colour is bluish-green. When it is of a good clear colour, it is made use of by painters.

Soapstone.

This is so named, because of its feeling extremely unctuous between the fingers, exactly like a piece of soap. It is found massive, of a grey or yellowish colour, and when first raised it may be kneaded like dough, but hardens by exposure to the air, in consequence of losing part of its moisture. We are not aware of its being found anywhere but in Cornwall. At Swansea, in Wales, it is extensively used in the manufacture of porcelain. It consists of Silex, Magnesia, and Potash.

Steatite is a variety of Soapstone, and also derives its name from a Greek word signifying *soap*, in allusion to its greasy feel. It consists of the same ingredients as the preceding, with the addition of Alumine, and is somewhat harder. Steatite most commonly occurs in *Serpentine*, in beds or veins; but at Freyberg, in Saxony, it is found in Tin veins, where it is accompanied by Mica, Asbestus, Quartz, and Silver. It is also found in Norway, Sweden, France, North America, and in Scotland. "The white varieties, or those that become so by calcination, are employed in the manufacture of the finest porcelain: other varieties are said to be used for fulling. The Arabs, according to Shaw, use Steatite in their baths instead of soap, to soften the skin; and it is confidently asserted that the inhabitants of New Caledonia either eat it alone, or mingle it with their food. Humboldt says, that the Otomaques, a savage race inhabiting the banks of the Oronoko, are almost entirely supported during three months of the year, by eating a species of Steatite, which they first slightly bake, and then moisten with water."

Potstone, another variety of Soapstone, has, as far back as the time of Pliny, been formed into vessels of various kinds, whence it derives its name. It is found in Lombardy, in Norway, Finland, and Greenland.

Agalmatolite.—This variety is found of various colours, most usually of a greenish or brownish tint. This, like the Steatite, is as soft as clay when first exposed to the air, but soon becomes hardened. A variety occurs in Cornwall, and in China, of a flesh-pink colour, which is taken advantage of by the Chinese, in forming it, when in a soft state, into little grotesque groups of figures, the only form in which it has been received from that country. It is also found in Transylvania and in Wales.

The following substance consists of the same ingredients as Soapstone, but in different proportions. These ingredients are Silex, Alumine, Magnesia, and Potash.

Chlorite.

Chlorite derives its name from the Greek, signifying *green*, a dark tint of which is its usual colour. It occurs crystallized in six-sided prisms, which readily divide in a transverse direction into thin laminæ; but it is most commonly seen in masses of granular or scaly structure, and is usually brought from the Tin veins of Cornwall.

Killinite.

This mineral contains the earths Silex, Alumine, and Lime, the alkali Potash, and the oxides of Iron and Manganese in minute proportions. In structure it is lamellar, and in colour a dull light-green. It is only found at Killiney near Dublin, whence it has received its name.

Next come those minerals whose alkali is Soda. The first in this series is *Eudyalite*, which contains, besides

Silex and Lime, the rare earth Zircon: after this follow a number of minerals, containing, in addition to their alkali, the earths Silex, Alumine, and Lime.

MESOTYPE.

Of this mineral, which is sometimes found crystallized in four-sided prisms, terminated by four or more planes, there are several varieties: amongst others the fibrous, and the pulverulent, which are termed *Mealy Zeolite*. The fibrous variety consists of minute crystals, aggregated in a radiating or star-like form, the centre being often much harder and more compact than the surrounding part. The crystals of Mesotype are generally of a greyish-white colour, and are occasionally transparent. This is a very abundant mineral, occurring in Lava and Basalt: it is found in Iceland, Ireland, Scotland, the Faroe Islands, the Tyrol, North America, accompanying Analcime in the trap-rocks of the Isle of Skye, and in many other localities.

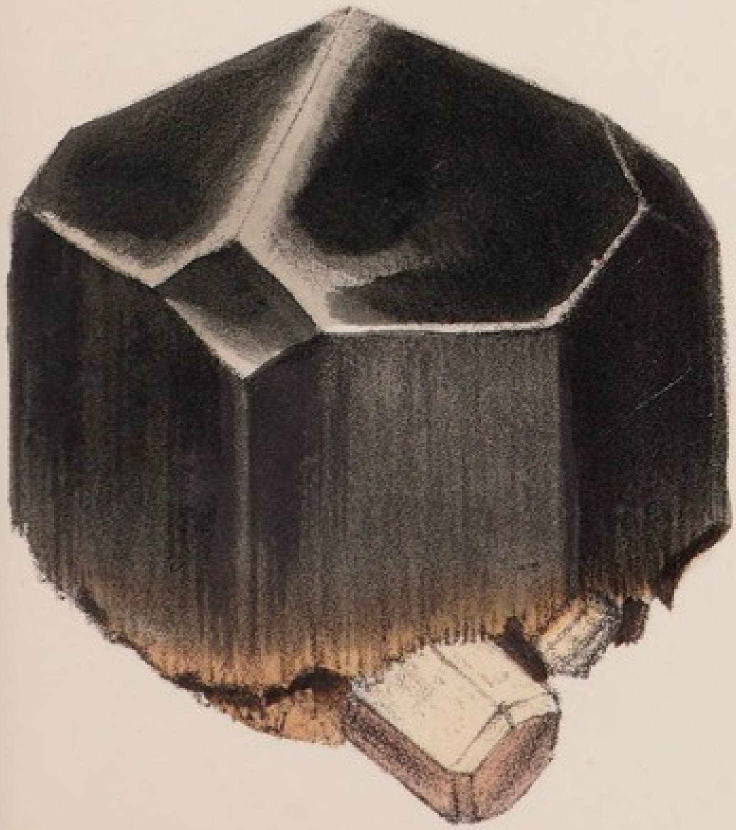
Needle-stone, or *Mesolite*, is a variety of Mesotype, occurring in long, slender prisms, of the same form and colour as that substance.

Natrolite is so named from its containing Natron. It is one of the prettiest varieties of Mesotype, and we have consequently selected it for figuring (Plate VI. fig. 21). It occurs in mammillated masses, which, when broken, present a fibrous structure: these fibres radiate from a centre and are of a pale-buff tint, with a darker tint disposed in concentric rings around the centre. It is found at Hohentwiel, in Swabia.

Amongst these minerals that are distinguished by containing Soda as their only alkali will be found *Sommite*, a Vesuvian mineral, of the same form as Phosphate of Lime, from which it may be known by its greater hardness, and by not exhibiting phosphorescence when heated; *Sodalite*, a light green substance of very rare occurrence; *Spinellane*, only found in one locality; *Lythrodes*, a massive reddish-brown substance, so named from its spotted appearance when newly broken; *Clinkstone*, a dark greenish or grey-coloured mineral of a massive and slaty structure, which, when struck with a hammer, gives a ringing metallic sound, and has consequently received its name; *Lava* and *Basalt*, which are substances rather for the attention of the geologist than the mineralogist; and besides these the following minerals, which are nearly identical in composition, deserve more particular mention.

21 Natrolite.

24. Lepidolite



23. Tourmaline.

22. Analcime

H. Sowerby, lith. F. Reeve, imp.

ANALCIME.

Of the general appearance and crystallization of this substance, our illustration (Plate VI. fig. 22) will give a tolerable idea. The form of the crystal is trapezoidal, and this is derived from the primary, a cube, by each of the solid angles being replaced by three planes, which replacement being complete, none of the planes of the original cube remain visible, and the result is a crystal consisting of twenty-four planes: each of these planes is bounded by four unequal sides.

Analcime is generally of a whitish-grey colour, but is occasionally pink or reddish—sometimes transparent, at others, opake. The most perfectly clear crystals are brought from the Cyclopean Islands; but Scotland produces the largest and finest specimens, of the form represented in the figure. In America it is a rare mineral.

PITCHSTONE.

This mineral occurs of a vast variety of colours,—blue, red, green, yellow, brown, black; but these colours are very seldom bright. Sometimes it occurs of variegated colours, but these are also dull, and the substance being opake, renders it not a very attractive mineral. It is hard enough to scratch glass, and by exposure to a strong heat is sometimes converted into a substance like Pumice. It is found in Scotland, Ireland, and other localities.

We have hitherto, under the head of *Alkalino-Earthy Minerals*, alluded to those which contain, in addition to their component earths, only one alkali, either Potash or Soda: into the composition of those minerals which follow, both of these alkalies are found to enter. The first of these, which, with its varieties, will engage our consideration, is a mineral which owes its origin to volcanic eruption.

> " Ætna roars with dreadful ruins nigh,
> Now hurls a bursting cloud of cinders high,
> Involved in smoky whirlwinds to the sky;
> With loud displosion, to the starry frame,
> Shoots fiery globes and furious floods of flame:
> Now from her bellowing caverns burst away
> Vast piles of melted rocks in open day."
>
> *Warton.*

It is not difficult to imagine, when we reflect upon the tremendous power of such a body of fire as is contained within the crater of a volcano, that the minerals derived from such a source are produced by the melting of the different strata through which the fire must pass before bursting upon the surface of the earth; we shall, therefore, naturally expect to find the same ingredients in volcanic minerals as in others of different origin. This is indeed the case; for though there are many minerals that are never found except in volcanic countries, and that are undoubtedly produced only by volcanic agency, the elementary ingredients of such minerals are not different from those of substances whose modes of occurrence seem to indicate that volcanoes had nothing to do with their production.

Obsidian.

This substance consists of Silex, Alumine, Lime, Oxide of Iron, and the alkalies Potash and Soda. It is never found in a crystalline form, but occurs in beds or layers, and in masses and grains of various sizes. In general appearance it bears a very great resemblance to glass of a coarse texture, and some of the specimens from the Lipari Islands look exactly like the slag from glass-houses; like glass, it has a conchoidal fracture. In colour, Obsidian shows some variety, being of a dark green in some specimens, in others of a grey tinge, and occasionally of a perfect black : sometimes, too, it is of a pale-grey colour with dark bands, either curved or straight, running parallel with each other; and rarely it presents a beautiful bloom upon its surface. It is commonly opake, or translucent only on the edges, but thin fragments are sometimes transparent; and we have seen, in the Hon. East India Company's Museum, a specimen of Obsidian from Aden, which is of a pale-green colour, and very transparent, but there are some doubts as to this specimen being a natural production.

Obsidian is found of great beauty in Iceland, Siberia, Mexico, and many of the South Sea Islands; but the most beautiful variety with which we are acquainted is found in New Spain. This presents a resplendent *chatoyant* appearance, and is generally of a dark-green colour, with bands of black, but, held in a particular direction towards the light, seems to be covered with innumerable brilliant specks of a golden hue.

Marekanite is only found in grains of the size of a pea, but irregular in form, consisting of thin concentric layers, and being of a pearly-white lustre. With these grains are found masses sometimes an inch in diameter, and of a reddish-brown colour, occasionally striped, and generally opake. These two varieties occurring in the same locality and mixed together, might occasion some doubt as to which is the true *Marekanite*; but the difference of structure and colour decides the point. In the determination of some minerals, the name is of assistance, but in the present instance the name is equally applicable to one as to the other variety, both, as before observed, being found together at Marekan, in the Gulf of Kamtschatka.

Several substances may be mentioned in this place, their composition very closely resembling that of Obsidian. The first of these is *Scapolite,* which occurs in four-sided prisms, the angles of which are sometimes replaced by four more planes, making prisms of eight sides. These crystals are frequently aggregated or grouped together in such a manner that their form is rendered very indistinct, and being of a dirty greyish colour, *Scapolite* is not a mineral that would captivate at first sight. It is found in Sweden, Finland, and Greenland, and in the United States. Of this substance a glassy transparent sort is found at Vesuvius, which is termed *Meionite.*

CHABASIE.

The composition of this substance also agrees very closely with the preceding, but its external characters are quite distinct. It is always found crystallized in the form of the rhomboid, lining cavities in basalt or trap rocks, or within geodes of Quartz or Agate which are disseminated in those rocks; its usual colour is greyish or yellowish-white, occasionally pale brick-red, with a pearly or vitreous lustre. It does not possess sufficient hardness to scratch glass. Very large and beautiful specimens are found in Iceland, the Faroe Islands, and Greenland, frequently accompanied by *Stilbite* and *Green earth*; also at Oberstein in Saxony; with *Analcime* and *Stilbite* in the Isle of Skye; at the Giant's Causeway, Ireland; and at several localities in the United States.

PHAKOLITE.

This is a mineral found in the county of Antrim, in Ireland, resembling Chabasie in colour and lustre, as also in the primary form of its crystal, which, however, is usually so curiously modified as almost entirely to lose the rhombic form, and to assume that of a magnifying lens, covered with brilliant facets or planes. This renders apparent the necessity of a knowledge of the laws of crystallography in order to become a good mineralogist.

The few minerals which succeed, and a notice of which concludes the portion of this work devoted to the Alkalino-earthy minerals, are found to contain the rare alkali Lithia.

Tourmaline.

Of this substance there are several distinct varieties, but they all agree in containing, as their main ingredients, Silex, Alumine, Lime, and Oxide of Iron, with small proportions of Potash, Soda, Magnesia, and Boracic acid. Lithia was found by Gmelin in the blue and green Tourmalines of Utö, in Sweden, and in the variety of this substance called *Rubellite*. The primary form of Tourmaline is a rhomboid, but its usual form, a prism of six or more sides, terminated by several planes, may be observed in our figure. This mineral is found only in what geologists term the primitive rocks, such as Gneiss, Granite, and Mica schist. It occurs of various colours, and of various degrees of transparency: fine opake black crystals are found in Greenland, in Bavaria, and in Sweden, and magnificent specimens, with crystals of truly noble dimensions, have been found at Bovey, in Devonshire, where they occur in company with fine crystals of *Apatite* and crystallized *Quartz*, imbedded in a yellow ferruginous clay. We believe, however, that this locality has now become exhausted, and as good specimens are now rare, we have availed ourselves of this opportunity to present a figure of a capital crystal lent to us for the purpose. In this figure is shown a remarkable peculiarity observable in all the specimens from Bovey,—this is, that one end of the crystal is terminated by brilliant planes, while the other extremity appears to be of a fibrous structure, and to be partly incorporated with the clay in which it is imbedded: the sides of the prism are also longitudinally striated. Adhering to the crystal we have figured, are seen two very perfect crystals of *Apatite*, or Phosphate of Lime. (Plate VI. fig. 23.)

In Norway, Tourmaline occurs in small brilliant black crystals, imbedded in white Quartz; at Portsoy, in Scotland, in large curved crystalline prisms, to which variety, also found in Norway, Tyrol, and Saxony, the name of *Schorl* has been applied, a term derived from Schorlan in Saxony. The most delicate pale-green crystals occur imbedded in *Dolomite* at St. Gothard, and in Siberia and Switzerland of a nearly pure white. Most beautiful transparent crystals of several colours, such as red, green, and blue, are found at Elba, imbedded in, and in company with, crystallized white Felspar. From Alger we learn that Tourmalines of great beauty are found at many localities in the United States, and that specimens from Maine "are celebrated for their gem-like purity and transparency—the outer portion often consisting of a deep green Tourmaline enclosing a transparent Rubellite, some of the crystals being two inches in length, and an inch in diameter."

Indicolite is a variety of Tourmaline of an indigo-blue colour, found in the mine of Utö, in Sweden, and in the United States. We have referred to this variety as containing Lithia.

Rubellite.—This variety is of various shades of red and violet, and usually occurs in long indistinctly-formed crystals closely aggregated together. It is found imbedded in *Lithomarge* in Siberia, and in separate long slender prisms imbedded in *Quartz* in Moravia. This is a very rare mineral, and has been used as a gem when of good colour and transparent. In the cases of the British Museum are several fine specimens, and one particularly magnificent crystallized group, for which a very high price was given.

Lepidolite.

This beautiful mineral derived its name from the Greek, signifying a *scaly stone*, the whole mass consisting of small laminæ, or scales, often so minute as to present the appearance of a very finely granular stone. Its colour is lilac of various shades, and the small scales when separated from the mass are flexible and translucent, and are occasionally six-sided. Lepidolite was first brought only from Moravia, where it was found in granite accompanying *Rubellite,* but has since been discovered in Siberia, in Sweden, in France enclosing large *Beryls,* and of a rose-colour in the island of Elba, a locality particularly interesting from being associated in the mind with the captivity of Napoleon Bonaparte. Lepidolite is so soft as to yield to the nail, and in composition resembles Tourmaline.

Our figure (Plate VI. fig. 24) represents a specimen from Moravia.

Petalite.

The colour of this rare substance is greyish-white, or more commonly very pale rose. It is of massive structure, lamellar in one direction; is hard enough to scratch glass, and is translucent, with a rather pearly lustre. It consists of Silex, Alumine, Lithia, and water, and is found only in Sweden.

ACIDS.

Of all the acids that are known to enter into the composition of mineral substances, three only have been found in a pure and native state. Having, therefore, already given a list of all the acids that are known to mineralogists, we shall avoid occupying space unnecessarily, and content ourselves by briefly noticing the three exceptions to the rule.

Sulphuric Acid.

This has been found in a native state in the grottoes of the volcanic mountain Zaccolino, near Sienna, and, according to Phillips, assuming a cauliflower form depending from the roofs. He also mentions, that from the roof of a cavern near Aix, in Savoy, this acid, mixed with a little water and gypsum, is observed to drop. It has also been found in the caverns of Ætna; and in North America.

Boracic Acid.

This occurs in the form of a powder, and in small pearly scales aggregated together, which adhere to the fingers. Its usual colour is greyish-white, but it has occasionally a yellowish tinge, arising from an admixture of Sulphur. It is found in one of the Lipari Islands, in Tuscany, and in South America.

Arsenious Acid

Occurs, according to Alger, in minute hair-like crystals, arranged in the form of a star, implanted upon some of the ores of Arsenic, and probably arising from their decomposition.

Many of those acids which are not found naturally in a pure state, we shall take notice of as entering into the composition of the minerals of the next division.

ACIDIFEROUS EARTHY MINERALS.

ALUMINE.

THE minerals of this division consist chiefly of one earth, but occasionally two, united to an acid. We shall presently have occasion to introduce two earths which have not hitherto been noticed, because they only occur in combination with an acid,—these are Barytes and Strontian. We shall also notice Lime as a principal ingredient in a great number of these minerals, whereas, of those already noticed, Lime has only been observed as an inconsiderable ingredient. The first few, however, of this division consist principally of Alumine.

ALUMINITE.

This substance occurs in massive lumps, frequently of a botryoidal form. In colour it is of a dull yellowish-white, and in general appearance resembles chalk, but it contains no Lime, consisting simply of Alumine and water combined with Sulphuric acid. It is found imbedded in a yellowish clay resting on the chalk at Newhaven, in Sussex, and also near Halle, in Saxony.

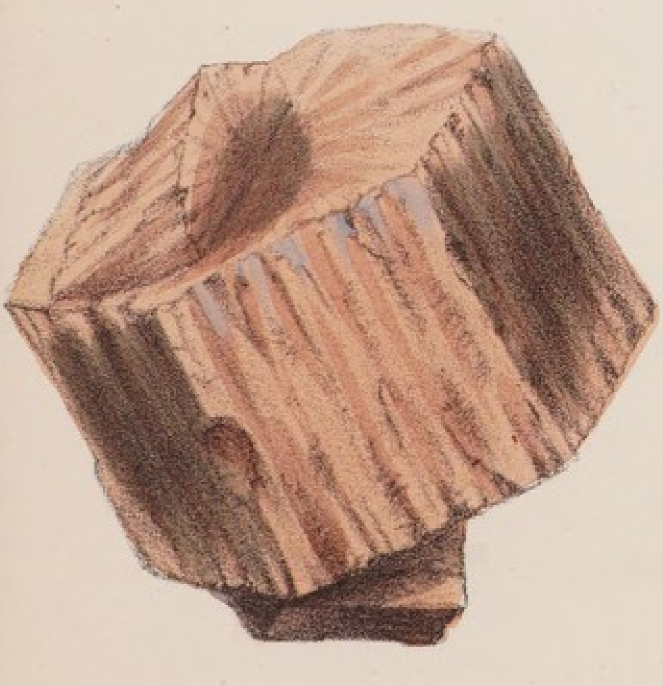
WAVELLITE.

This is termed Subphosphate of Alumine, being a combination of Alumine with Phosphoric acid and water; a little Lime, oxides of Iron and Manganese, and Fluoric acid have also been discovered in some of the varieties. The form which it always assumes is that of globular concretions, composed of minute crystals packed closely together and radiating from the centre: these concretions are of variable size, from the sixteenth of an inch to a full inch in diameter. When the upper part of one of these concretions is broken off, it is seen that the radiating crystals are possessed of a glassy lustre and are translucent. Altogether, the peculiarities of this interesting mineral serve readily to impress its appearance on the memory, and to distinguish it from all other substances.

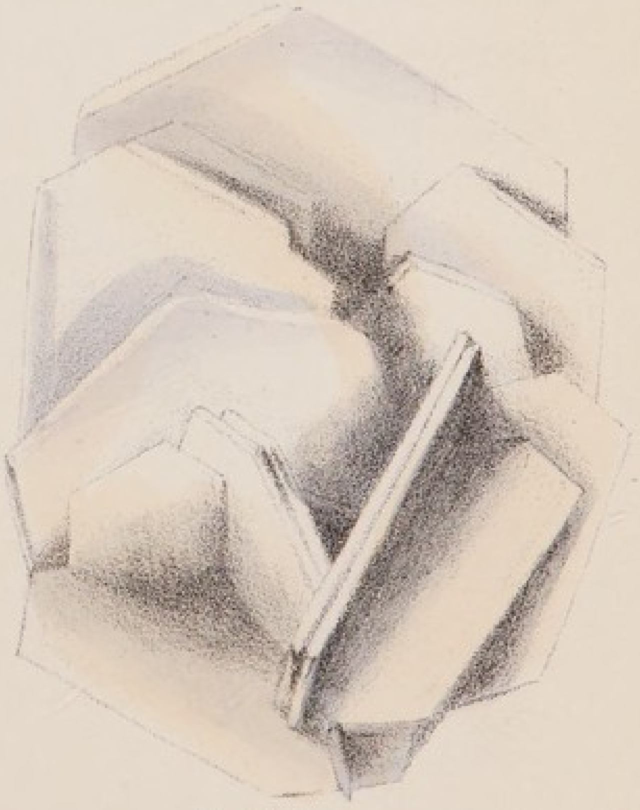
Wavellite is found of a deep green colour at Clonmel in Ireland, and occurs in Cornwall, Scotland, and at Newcastle, but was first discovered of a pale yellowish colour by Dr. Wavel (in honour of whom it received its name) near Barnstaple, in Devonshire, in a blackish slaty rock. Our illus-

25. Wavellite.

27. Flos-ferri.



28. Arragonite



26. Calc-spar.

H. Sowerby, lith. F. Reeve, imp.

tration (Plate VII. fig. 25) is taken from a specimen from this locality, and conveys a correct impression of the general appearance of the substance.

We may now fairly take our leave of the earth Alumine and of the minerals into whose composition it has been found to enter: should it again be mentioned in the course of this work, it will be merely as an accidental (that is, not an essential) ingredient in a very few substances. A short retrospective view, therefore, of so important a mineralogical constituent will not be entirely useless.

We had not proceeded very far with our observations upon the Siliceous minerals, before occasion arose to mention Alumine as the second ingredient of importance in their constitution;—in all the beautiful varieties of *Chalcedony*, *Agate*, *Jasper*, and other substances, it occupied that distinguished position. Parting with it for a time, it was again found next after Silex, in the varieties of *Garnet*, of *Stilbite*, of *Heulandite*, of *Lapis Lazuli*, and numerous others, nor did it relinquish its hold upon our attention during our examination of the *Slates* and *Clays*. We then lost sight of it in Augite and its varieties, but again found it in its old place in *Hornblende*, *Actinolite*, and in the soft silky

Asbestus. Having now, as it were, served an apprenticeship in a secondary position, it was raised to the dignity of *first ingredient* in *Corundum* and its valuable variety, the *Sapphire*; and though it retained this elevated position through but very few of our pages, in those few pages will be found descriptive notices of several important and handsome gems and other minerals. The position of *first ingredient* was then resigned, but we still found it assisting in the composition of most of the remaining earthy minerals, amongst which were *Serpentine, Beryl,* and *Emerald.*

The Alkalino-earthy minerals next claimed our consideration, and of the greater number of these we found Alumine to be an important ingredient,—*Mica, Felspar* and *Talc, Natrolite, Analcime, Obsidian, Tourmaline,* and *Lepidolite,*—all were indebted to Alumine for a large proportion of their composition. As the dying warrior (if we may be allowed the comparison) makes one grand expiring effort before leaving for ever the scenes of this world, so the last appearance of Alumine in these pages is as principal ingredient, which position it has resumed in the two acidiferous earthy minerals just described, viz., *Aluminite* and *Wavellite.*

No sooner, however, does one object in nature recede from our view, than another is presented to fill its place;

and thus it will be found that though we are compelled to leave Alumine and the minerals which it partly composes, another equally important substance is now to be submitted to the reflections of the student of Mineralogy.

> "Oh! unprofuse magnificence divine,
> Oh! wisdom truly perfect! thus to call
> From a few causes such a scheme of things,
> Effects so various, beautiful, and great,
> An universe complete!"—*Thomson.*

LIME.

> "Gnomes! you then bade dissolving shells distil
> From the loose summits of each shattered hill,
> To each fine pore and dark interstice flow,
> And fill with liquid chalk the mass below.
> Whence sparry forms in dusky caverns gleam
> With borrowed light, and twice refract the beam;
> While in white beds congealing rocks beneath,
> Court the nice chisel, and desire to breathe."—*Darwin.*

We have already observed that Lime is one of the most important of all the earths that are known. We shall now enumerate some of its properties, before entering upon the descriptions of the minerals in which it occurs. Lime has been long known, and was used by the ancients in medicine probably for the same purposes as we now employ Magnesia. It is capable of forming a cement for building, and has been used in that way from time immemorial to the present day, being the chief ingredient of common mortar, as well as of all the cements that are used by builders. As Lime is never found in an uncombined state, to obtain it in that condition it is necessary to separate it by burning from the carbonic acid and water which it contains; but so great is its affinity for these two substances that, if not kept extremely close, it will greedily imbibe both carbonic acid and moisture from the atmosphere, and again become Chalk, or Carbonate of Lime. When, by the process of burning, Lime is obtained in a pure state, it is of great utility in agriculture, and is spread over the fields before they undergo the operation of ploughing. Being thus brought into contact with the air, from which it imbibes carbonic acid, and with the earth, whence it imbibes moisture, a great degree of heat is generated, from which, if great precaution be not used, the feet both of ploughmen and horses suffer considerably.

The most common state in which Lime naturally occurs, is in combination with Carbonic acid, its union with which produces all the beautiful crystallized and other varieties of Calc-spar that ornament our collections; all the immense deposits of Limestone, of which most of our large edifices are built, and from which the capital pavements of London are derived; all the handsomely veined or pure white varieties of Marble, of which our mantel-pieces are formed, and out of which the sculptor's chisel has for ages past produced most noble specimens of art. The immense abundance in which Carbonate of Lime exists, will be well impressed on our minds, when we reflect that of that substance is composed the vast quantity of Chalk, which, being exposed to view on our sea-coasts, in the shape of bold precipitous cliffs, has rendered England so justly celebrated.

Without trenching too far upon the province of the geologist, we may present a quotation from the notes to Darwin's 'Botanic Garden,' relative to the probable origin of Limestone.

"The Limestone rocks have had their origin from shells formed beneath the sea, the softer strata gradually dissolving and filling up the interstices of the harder ones; afterwards, when these accumulations of shells were elevated above the waters, the upper strata became dissolved by the action of the air and dews, and filled up the interstices beneath, producing solid rocks of different kinds, from the coarse limestones to the finest marbles. When those limestones have been in such a situation that they could form perfect crystals they are called spars, some of which possess a double refraction, as observed by Sir Isaac Newton. When these crystals are jumbled together, or mixed with some colouring impurities, it is termed Marble, if its texture be equable and firm; if its texture be coarse and porous, yet hard, it is called Limestone; if its texture be very loose and porous, it is termed Chalk. In some rocks the shells remain almost unchanged, and only covered, or bedded, with limestone, which seems to have been dissolved and sunk down amongst them. In others the softer shells and bones are dissolved, and only sharks' teeth and harder *Echini* have preserved their form, enveloped in the chalk or limestone; in some marbles the solution has been compleat, and no vestiges of shell appear, as in the white kind called statuary by the workmen."

Whether this theory be exactly correct or not, is not for us to determine; it is, however, certain that shells are composed of Carbonate of Lime, and that in many Limestone rocks, and in Chalk, are found preserved, sometimes in perfect condition, numerous shells, Echini, salt-water fish, and other remains of marine animals.

The minerals comprehended under the title Carbonate of Lime differ greatly in external characters, but are all so soft as to be readily scratched by a knife, and effervesce if a drop of muriatic acid be placed upon them.

Calc-spar.

This mineral occurs crystallized in more than eight hundred varieties of form, which are all derived from an obtuse rhomboid. To particularize any proportion of these would occupy so much space that we shall merely mention two or three of the most peculiar. It is rarely found crystallized in the form of the primary rhomboid, but occurs of that form in very perfect, though small crystals, on *Specular Iron,* accompanying splendid crystals of *Smoky Quartz* in Cumberland, and in large crystals at Alstone Moor: it is also found in slightly modified rhomboids, imbedded in clay, and inside geodes of *Agate* and *Quartz* near Bristol. But the six-sided prism is the most common form of Calc-spar: this is sometimes terminated by three planes, forming a very obtuse pyramid, sometimes a very acute one. Occasionally the crystals will taper very gradually towards the point, but we have never observed a crystal which becomes larger towards the point, as in some varieties of *Quartz*. *Dog's-tooth spar* is a variety so termed because the crystals, tapering to the very point, and being flattened or compressed, resemble the teeth of a dog. One very interesting form is represented in our figure (Plate VII. fig. 26), these crystals being very flat, tabular, six-sided prisms, meeting and intersecting each other in every direction. In colour it is also extremely variable, though that most usual is white of different degrees of transparency. At Andreasberg, in the Hartz, it is found of an orange-red colour, which arise probably from the presence of Arsenic; in Derbyshire, of a bright yellow colour; in the Hartz it has been found of a beautifully delicate rose-colour.

The localities in which Calc-spar is found are as numerous as the crystalline forms it assumes, and we shall therefore only allude to several whence specimens of the greatest beauty have been obtained. "The rarest and most beautiful crystals are found in Derbyshire and the northern parts of England, from which were obtained a very considerable number of the vast variety described by the Count de Bournon; but it is so extremely rare in Cornwall, that it is worth noticing as having been found in veins of the slate of Tintagel, with Rock crystal, Chlorite, and Adularia." Regarding American localities, Alger states, that the finest crystals, for size and transparency, have been found at Oxbow, and at the Lead mines of Rossie, St. Lawrence county, New York, in primitive Limestone: they are here grouped with *Galena* and *Pyrites* in the most beautiful manner, and are sometimes more than a foot in length. In the Limestone at Niagara Falls, the Dog's-tooth spar variety abounds, associated with *Gypsum*, sometimes with *Fluor spar*. Masses possessing a fine green tinge are also found in Essex county, New York.

Double-refracting spar is the purest form in which Carbonate of Lime occurs. It is transparent, and possesses the interesting property of double refraction; that is, if a word be written on a piece of paper, and placed beneath a fragment of the mineral, it appears as if the word had been written twice, for in addition to the written word, a perfect transcript or reflection of it is distinctly visible, and by turning the specimen round, this reflection also revolves. This property may be made productive of much amusement, by sketching the figure of a man in the act of running, and this being placed beneath the Double-refracting spar, the figure is doubled, and by revolving the specimen we get the appearance of two men running a race, each alternately getting ahead of his opponent, or losing ground. This variety, being found in Iceland, is sometimes termed *Iceland spar*. It is never found crystallized, but may be readily broken into the most perfect rhomboids. Alger mentions a pale rose-coloured variety as being found in Upper Canada, where it was discovered by Dr. Holmes.

Schieffer spar.—This occurs in thin laminæ aggregated together, presenting a mass of slaty structure, of a yellowish-white colour, and of pearly lustre, the leaves being sometimes curved or waved. It is found in Saxony, Dauphiny, and Norway; also in Cornwall, in Scotland, and in Ireland.

Satin spar is a fibrous variety of Carbonate of Lime, which when polished, or even when broken, presents a most beautiful satiny appearance. It bears a great resemblance to fibrous *Gypsum*, but may be distinguished by its being much harder than that mineral. Being susceptible of a high polish, it is employed in inlaying, and in the manufacture of necklaces in imitation of pearl. In Cumberland it occurs in veins from one to four inches thick, and is also found in Scotland and in North America.

Stalactitic Calc-spar.—The term *stalactite* is derived from the Greek, and signifies a drop, or an icicle; hence this name is applied to that variety of Calc-spar whose mode of occurrence resembles an icicle. In some cases it is found mammillated or botryoidal, like Chalcedony,—sometimes in long pendulous tubes or masses, occasionally branched in the manner of coral, and sometimes the stalactite is terminated by a head resembling a fungus. The interior of some caverns is lined with Stalactitic Calc-spar, which sometimes is of prodigious dimensions, and these caverns, when visited and examined by the aid of torch-light, are truly gorgeous to behold. Descriptions of these have been so often published that it will not be necessary to describe them here; in fact, any attempt must fall far short of the reality; but it will be well to mention one or two of the principal caverns, assuring the learner that should it lie in his power to visit any of them, he will be amply rewarded. The Grotto of Antiparos, in the Archipelago, the Woodman's Cave, in the Hartz, and that of Auxelle, in France, are striking instances of caverns being filled with Stalactitic Calc-spar. The most remarkable in Britain are the cavern of Castleton and other caverns in Derbyshire, and Macallister Cave in the Isle of Skye.

The process of the formation of stalactites is continually going on. "They are deposited from water loaded with particles of carbonated Lime, in the hollow places and caverns of mountains: the water finding its way into these caverns through crevices in the roof, becomes exposed to the air; evaporation ensues, causing the particles of Lime to precipitate." Some caverns have been entirely filled with calcareous Stalactite, so that it is occasionally obtained in large masses: in this state it is called *Alabaster*, and is used in statuary and in the formation of vases, its soft nature rendering it a very available material for those purposes, while the purity of its white leaves nothing wanting in beauty, and is so well known that "as white as alabaster" has become almost a proverb. The name Alabaster is derived from Alabastron, an Egyptian village between the Nile and the Red Sea, which was the principal locality whence the ancients obtained their supply of this substance: a colossal figure of an Egyptian idol formed of this Alabaster was in the Napoleon Museum, at Paris,—whether it is still there, we do not know.

Marble.—This is only a granular variety of Limestone, and itself assumes several varieties. The most celebrated Marble is that which the French termed *Chaux carbonatée* *saccharoïde,* from its likeness to loaf-sugar when in small masses; by us it is known as Parian Marble, but was known to the ancients by the name of Lichnites; of this marble the celebrated statue of the Venus de Medicis and other models of art are fashioned.

> " Hence wearied Hercules in marble rears
> His languid limbs, and rests a thousand years;
> Still, as he leans, shall young Antinous please
> With careless grace and unaffected ease;
> Onward with loftier step Apollo spring,
> And launch the unerring arrow from the string;
> In Beauty's bashful form, the veil unfurled,
> Ideal Venus win the gazing world."
>
> *Darwin.*

The quarries of this marble are, however, said to be exhausted, and that termed Carrara Marble is now usually employed by statuaries. This marble has a fine grain and a close texture; its quarries are on the eastern coast of the Gulf of Genoa, and are worked on the face of a mountain to the height of eight hundred feet. The *Lumachelli,* or *Fire marble,* owes the latter name to the display of iridescent colours which it exhibits in flashes here and there on its surface, which colours are usually of a fiery red and yellow, intermixed with brilliant green, and are supposed to be owing to the fragments of a species of Nautilus contained in it. At Kilkenny, in Ireland, is found a fine black variety of marble, which encloses numerous fossilized shells, and these, when the marble is cut and polished, exhibit fine curved lines and portions of circles. The Museum of the East India House contains many fine collections, and the objects placed in what is termed the *new* Museum are particularly interesting, and calculated to arrest the attention of the visitor, but we have observed that the mantelpiece, which is manufactured of this marble, and is a magnificent structure, always excites the lion's share of admiration.

We must now pass over the other varieties of Marble, having noticed such as are most remarkable—a liberty that we shall also take with the Limestones; and proceed to notice briefly one or two other minerals which consist of Lime and Carbonic acid.

Pisolite, or *Pea-stone*, occurs in small round masses about the size of a pea, aggregated together: each pea generally contains in its centre a grain of sand, round which the many thin layers of calcareous matter have been gradually deposited. Its colour is a pale buff of different tints, and it is generally brought from Carlsbad, in Bohemia.

Chalk.—In addition to what has already been said of this substance, we may observe that it is found principally in Poland, France, and England. There are two beds of Chalk, the upper containing horizontal layers of Flint, and the lower being quite destitute of that substance. The uses of Chalk are numerous: it furnishes lime for cement and manure, it is used in polishing glass and metals, by mechanics as a marking material, by chemists and starch-makers, and, when washed and purified, forms the substance called *whiting*.

Tufa is an impure and porous variety of Carbonate of Lime. Phillips observes that "the various articles which, being placed in certain springs or waters in Derbyshire, become covered by an earthy substance, and which thereby acquire the external appearance of petrifactions, are in fact only incrusted by a kind of Tufa." Tufa is also sometimes of volcanic origin.

ARRAGONITE.

This elegant mineral contains a portion of the earth Strontian in addition to its Lime and Carbonic Acid. It occurs distinctly crystallized in six-sided prisms, and in other forms, the primary being a rhomboid: our figure

(Plate VII. fig. 28) represents a fine crystal from Arragon, in Spain, where the substance was first found, and from which it takes its name. The crystals are sometimes very transparent, and of different shades of yellow, pink, grey, or bluish-white. This mineral may be readily distinguished from Calc-spar by exposing them both together to heat, when the Arragonite will at once fly into powder; but the Calc-spar will remain unchanged. Fig. 27, Plate VII., represents a most beautiful variety of Arragonite, which is termed *Flos ferri*, its appearance resembling white coral, the branches being twisted in every fantastic direction. The finest specimens of this variety are brought from Styria, but very charming ones are found in our own country, at Ilfracombe, in Devon. A pale blue botryoidal variety occurs at Pfitch, in the Tyrol.

Bitter-spar.

In this and the two following minerals, *Pearl-spar* and *Dolomite*, the earth Magnesia is associated with Lime and Carbonic acid. Bitter-spar usually occurs in the form of an obtuse rhomboid, imbedded in *Chlorite* or *Serpentine*, in the Tyrol, Sweden, Dauphiny, and in North America.

Dolomite is a whitish granular variety of the last mineral, and might be mistaken for granular Limestone, which it much resembles, but may be distinguished by touching it with acid, when it will effervesce very feebly in comparison with the latter substance. When struck in the dark, it emits a pale phosphorescent light.

Pearl-spar, so named in allusion to its beautiful pearly lustre, is also a common variety of Bitter-spar. Its form is the same rhomboid, but the crystals are aggregated together, and, being always curved, present a very curious appearance. Pearl-spar is sometimes of a pale flesh-colour, sometimes yellowish or white. It is a common mineral, but a very interesting one, and when, as is often the case, it is found associated with Fluor spar, the contrast in form and colour of the two substances is somewhat striking. It is found in the Lead-mines in the north of England, in the Tin-mines of Cornwall, and in Derbyshire and Devonshire.

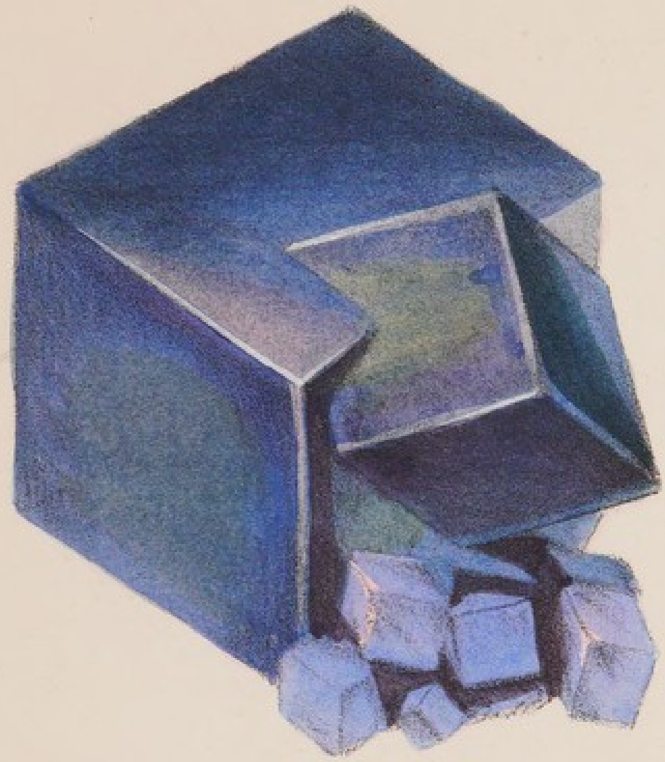
APATITE.

In this substance we find Lime in combination with Phosphoric acid, forming a Phosphate of Lime. Its name of Apatite is derived from the Greek, and signifies *to deceive,* in allusion to the resemblance it bears to some other minerals. Its crystal is a six-sided prism, often terminated by a single flat plane, but still more frequently having the edges replaced, as shown in the figure both of Tourmaline, to which crystals of Apatite are adhering, and in Plate VIII. fig. 29, where a single crystal of Apatite is shown in company with crystallized Quartz: both of these specimens are from Bovey, Devonshire. The colour varies considerably: the crystals from St. Gothard are beautifully white and transparent; those from Arendahl, in Norway, are of a green colour, and are termed *Moroxite*; at Zillerthal, in the Tyrol, is found a straw-coloured variety, imbedded in green Talc—this is termed *Asparagus-stone*; other crystals are of a pale rose or violet tint. Apatite is also found massive in Norway, Saxony, and other places. It is found finely crystallized in the Tin veins of St. Michael's Mount, Cornwall, in company with crystals of *Topaz*, which much resemble it in colour, but are readily distinguished by the form.

Phosphorite is a massive, pale buff-coloured variety of Apatite, so named from its exhibiting phosphorescence when heated. It is found in Spain and Bohemia.

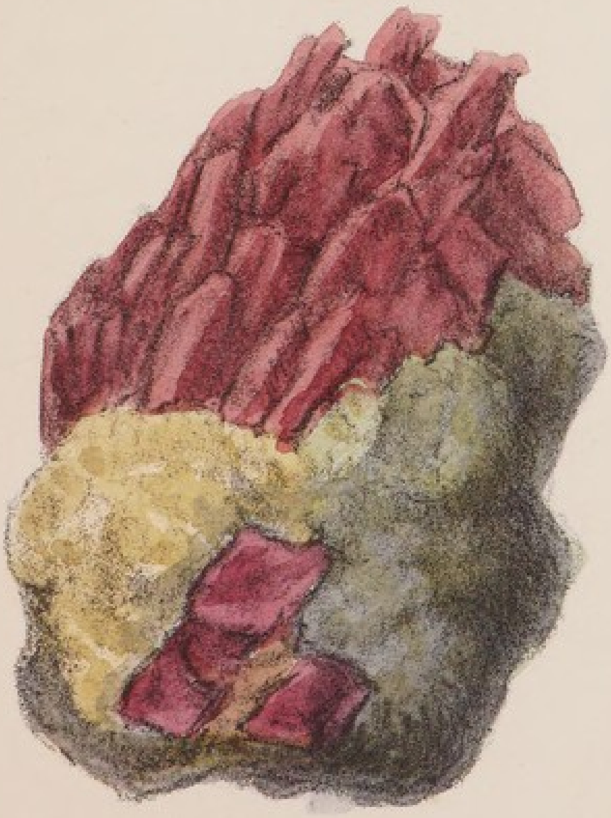
Fluor Spar.

During the progress of our descriptions, we have had

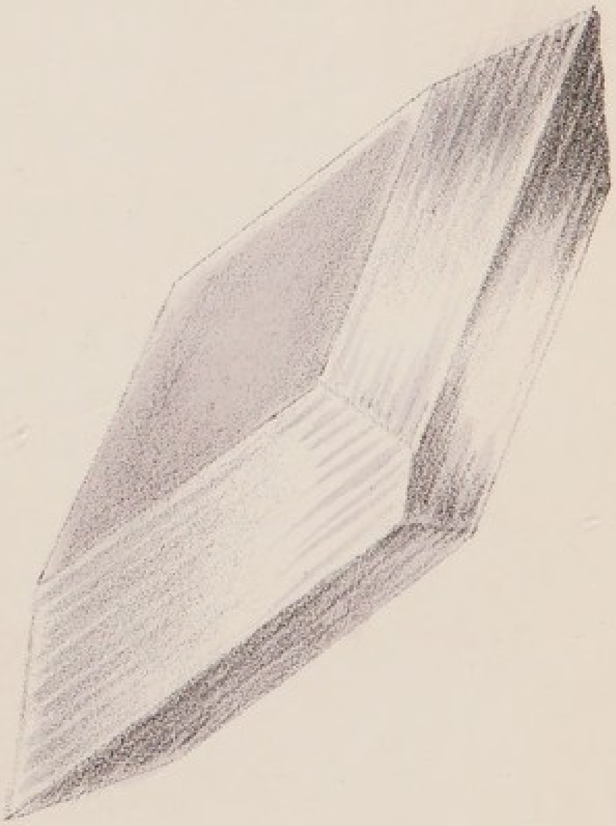


30. Fluor.

29. Apatite.



31. Chlorophane.



32. Selenite.

H. Sowerby, lith.

F. Reeve, imp.

before us each drawer of our cabinet, in order that we might, as far as possible, place before the student every point of interest or beauty observable in the different substances described. The drawer to which we have now arrived is that containing the numerous varieties of Fluor-spar, and if we have hitherto been successful in picturing the peculiarities of substances to the mind of the student, we must confess that language will now fail us in doing justice to the *beauty* of the specimens now before us. Fluor spar, of all other minerals, is calculated to excite admiration from the most indifferent observer, and we have always found, when exhibiting our collection to friends who did not pretend to a knowledge of minerals, that this particular drawer occupied more time in scrutinizing than any of the others.

Fluor spar is a combination of Lime with Fluoric acid, and is consequently *Fluate of Lime*, but is much more generally known by its former title. The primary form is the octohedron, in which form it is sometimes very distinctly crystallized, but more frequently in the form of a cube. Its crystals occasionally present modifications of one or other of these forms, a not uncommon one being the cubo-octohedron, that is, the octohedron passing into the cube by having its solid angles replaced; but, generally speaking, the crystals are in clearly-defined cubes. One most interesting and peculiar mode of crystallization is seen in specimens of pale-green Fluor found in Cornwall: the crystals, which are octohedral, being composed of an immense number of minute cubes, these diminishing in number until on each solid angle of the octohedron there is a single distinct cube, which is generally larger than those forming the body of the crystal. Fluor is found perfectly white and transparent, and also nearly black and opake. Octohedrons of a pale rose-colour are found with Rock crystal at St. Gothard; of a pale green hue at Beer Alstone in Cumberland, and in the United States; in cubes of a deep purple or bright yellow colour in Cornwall, Saxony, and America, and of a very beautiful purple in the Tyrol; but, as is justly observed by Alger, no part of the world has hitherto produced finer specimens of this species than Cumberland, Derbyshire, and Cornwall. Those varieties from the Lead-mines of Alston Moor and Derbyshire usually assume the form of the cube, and present the finest shades of blue and green. We have figured a specimen from Cumberland (Plate VIII. fig. 30): this, when viewed in one direction, appears to be of a pale dull green, but in another presents the richest blue tint.

Chlorophane.—This is a remarkable variety of Fluor spar, its name signifying *bright green.* Few would suspect, when viewing this substance in its usual state of a dull reddish or brownish purple colour, that when exposed to heat it exhibits a most brilliant green phosphorescent light. The best method of observing this is to heat the poker to a red heat, and allow it to cool on the outside; carry it then to a dark corner, and place a fragment of Chlorophane upon it, when the beautiful property of that substance will be exhibited. The dark-coloured variety (Plate VIII. fig. 31) is brought from Kleopinsky in Siberia; but there is a pale-green variety found also in Siberia, which exhibits phosphorescence in the dark, merely by the heat of the hand.

Etchings on glass are obtained by coating the plate of glass with wax, and etching thereon the figures. Exposing it then to the action of Fluoric acid in a state of gas, those parts covered with wax will remain entire, while those parts from which it has been removed will be eaten away to the desired depth.

ANHYDRITE.

In this mineral we find Lime combined with Sulphuric acid. It most usually occurs of a fibrous structure, and of a greyish, bluish, or reddish colour: it is found in the Tyrol and a few other localities. Its name is from the Greek, and signifies *without water*, by which it is distinguished from the following substance.

GYPSUM.

This consists of Lime and Sulphuric acid, and in addition a considerable proportion of water. It occurs in fibrous masses of great beauty and satin lustre, at Matlock in Derbyshire, and at Bex in Switzerland. Gypsum is also found crystallized, when it is termed *Selenite*: a gigantic specimen of Selenite stands in a case by itself in the British Museum, and was presented by Prince Albert. Selenite is also found in very distinct crystals in the London Clay, these crystals being of the form represented in Plate VIII. fig. 32. Gypsum is also found in foliated masses of large dimensions in Ireland, and some other localities. It is very soft, and usually white and transparent. In America it is abundant, and both there and in England, what is commonly known as *plaster of Paris* is manufactured from it.

In *Nitrate of Lime* we find that earth associated with Nitric acid and water; in *Datholite,* and its variety *Botryolite,* with Boracic acid and water; and in *Pharmacolite* with Arsenic acid and water. This brings us to the next series of acidiferous earthy minerals, which contain no Lime at all, but consist of the earth Magnesia in combination first with Carbonic acid, next with Sulphuric, and lastly with Boracic acid.

MAGNESIA.

Carbonate of Magnesia.

This is rarely found crystallized, but generally in masses without any determinate form: these are of a dull opake white, sometimes imbedded in *Serpentine,* as in Upper Styria, in Spain, and in the United States. An earthy variety is termed *Meerschaum,* which is so soft as to yield easily to the nail, adheres to the tongue, and is sometimes so light as to float on water. This substance is well known to smokers as that of which the Meerschaum pipes are supposed to be fashioned, but of which few of them are really made. Meerschaum signifies in English *sea-foam*, whence a vulgar notion exists that Meerschaum pipes are manufactured from the froth of the sea. On the contrary, this variety of Carbonate of Magnesia is found in beds or layers, and when first dug up is soft like clay, but becomes hardened by exposure to the atmosphere. When in the soft state it is made into pipes. Meerschaum is employed in the Turkish dominions as *Fullers' earth* is with us, and is used by the women as soap for washing their hair. It is found in Carinthia, Moravia, and in Spain.

Sulphate of Magnesia.

This is of a white colour, and is generally found to occur in crystalline fibres, but rarely in the state of a powder: it is very brittle, and in taste exceedingly bitter and nauseous, being composed of Magnesia, Sulphuric acid, and water. This salt forms the principal ingredient of several mineral waters, and is found in crystalline flowerets springing from the surfaces of Coal, Gypsum, Sandstone, Lava, and often from the mortar used in building, as in Madrid, and in several instances in our own country. When we observe that the principal waters impregnated with this Sulphate of Magnesia are at Epsom, in Surrey, the learner will have little difficulty in recognizing in this mineral the horror of his childhood, viz., *Epsom Salts.*

Boracite.

This is a combination of Magnesia with Boracic acid, as its name implies. It occurs crystallized in the forms of the cube and dodecahedron variously modified, imbedded in Gypsum near Luneburg, and at a few other localities. Plate IX. fig. 33 represents two dodecahedral crystals imbedded in the matrix, from Luneburg.

BARYTES.

We have now to introduce the combinations of the earth Barytes, first with Carbonic acid, and then with Sulphuric. The first is termed

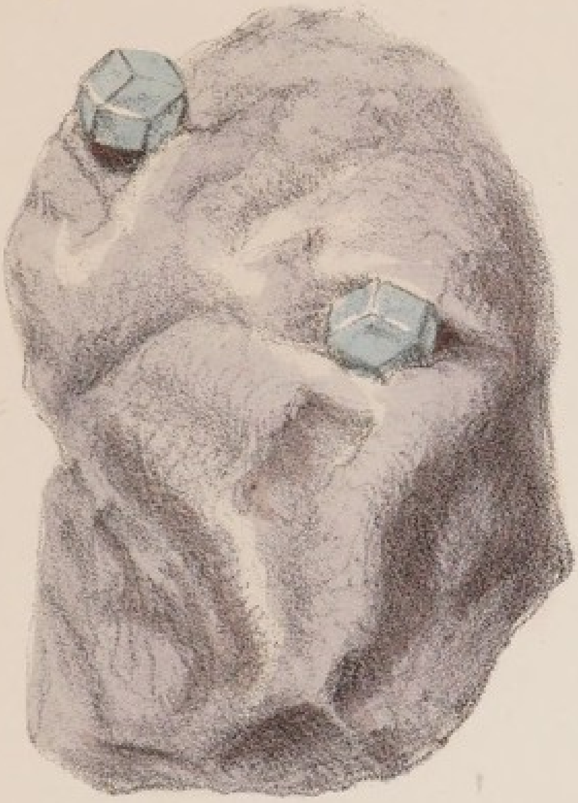
Witherite.

This occurs massive and fibrous, but generally crystallized in the form of a six-sided prism, terminated by six triangular planes, as in Quartz, from which its softness distinguishes it readily. The crystals are usually of an opake white, and sometimes the planes of the two pyramids meet, to the exclusion of the prism; occasionally, too, the crystals present a form resembling an hexagonal magnifying glass, which two varieties are represented in one specimen, in Plate IX. fig. 34. It occurs nowhere so abundantly as in the Lead veins in the north of England.

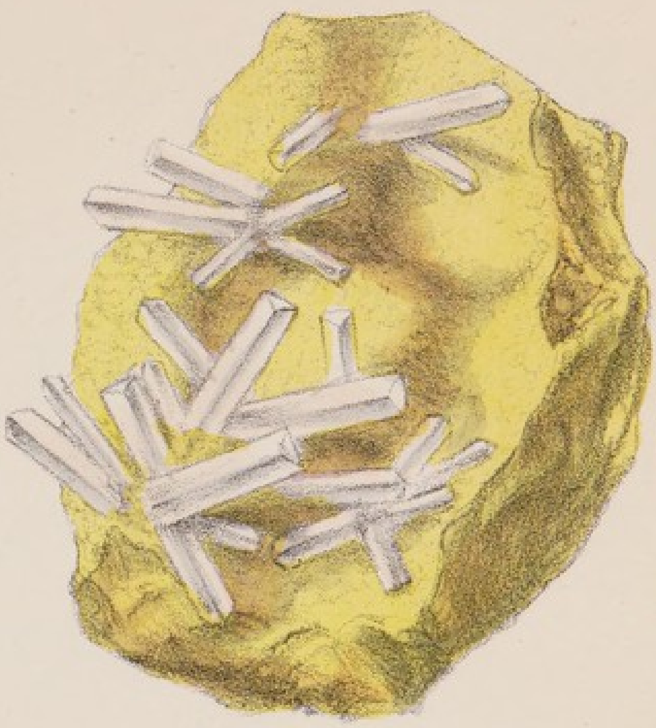
Heavy-spar.

When Barytes is found in combination with Sulphuric acid, it is termed *Heavy-spar,* and of this substance there are several varieties. It is a widely-diffused species, and presents a great variety of crystalline forms, but the primary, a rhomboid, is shown in Plate IX. fig. 35, representing a specimen from Schemnitz. Crystals of Heavy-spar of immense size, and weighing upwards of half a hundredweight, are sometimes found at Dufton, in Cumberland, its most noted locality. In Bohemia, Hungary, Auvergne, and the United States it is a common mineral, its most usual colour being a pale yellowish-brown or white, but in Surrey it is found of a beautiful wine-yellow colour.

Bolognian stone is a variety of Heavy-spar, which occurs in rounded masses of a radiated structure, and of a dirty-grey colour. It is chiefly remarkable for exhibiting phos-

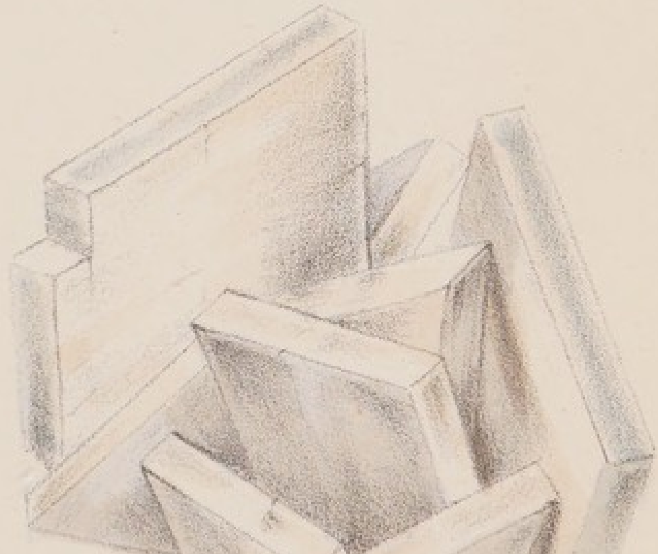


33. Boracite.



36. Celestine.

34. Carbonate of Barytes



35. Heavy-spar.

H. Sowerby, lith.

F. Reeve, imp

phorescence when heated, for which property it has been poetically celebrated by Darwin.—

> "So, warmed and kindled by meridian skies,
> And viewed in darkness with dilated eyes,
> Bologna's chalks with faint ignition blaze,
> Beccari's shells emit prismatic rays."

STRONTIAN.

In this, the last series of this division of minerals, we find the earth Strontian in combination with different acids.

Strontianite.

This rare mineral consists of Strontian, combined with Carbonic acid and water. It is commonly of fibrous structure, and of a pale green colour, but very splendid crystals have been found in Salzburg. The properties of this substance were first described by Dr. Hope, and it was first discovered at Strontian, in Argyleshire.

Baryto-strontianite.

So named because it contains some Barytes and Lime, besides Strontian and Carbonic acid. It is found in fibrous diverging concretions, of a pale blue colour, in a kind of Clay-slate at Stromness, in Orkney, which is the only locality known.

Celestine.

This is a Sulphate of Strontian, consisting of about equal parts of Strontian and Sulphuric acid. It occurs in several varieties of colour, some specimens being white and transparent, others of a pale flesh-colour, and one variety of a pale blue. This last is fibrous, and is found at Aust Ferry, near Bristol; but the most magnificent crystallized groups are found in the Sulphur-mines of Sicily, whence the specimen we have figured was brought. (Plate IX. fig. 36.) The crystals are, however, often much larger than those represented. In the pale red crystallizations that are found near Bristol, the modifications of form are very intricate, so much so, that the primary form, a rhombic prism, can scarcely be recognized. Alger mentions many localities for Celestine in the United States.

ACIDIFEROUS ALKALINE MINERALS.

This division of minerals contains those which consist of an alkali and an acid united together: they are seldom found pure in a natural state. *Potash* is found combined only with Nitric acid, forming *Nitrate of Potash*, or

Nitre.

> " Hence orient Nitre owes its sparkling birth,
> And with prismatic crystals gems the earth,
> O'er tottering domes in filmy foliage crawls,
> Or frosts with branching plumes the mouldering walls."
>
> *Darwin.*

This substance, which is found in a natural state crystallized and in hair-like fibres and leafy forms, is produced in all situations where animal and vegetable matters are completely decomposed, and are exposed to the action of the air, as on the walls of stables and slaughter-houses. "It occurs on or near the surface of the earth, on old walls, &c. In Hungary, Persia, Arabia, Egypt, and on many of the plains of Spain, it is found in considerable quantities. It is also common in India, especially on a large plain near Agra, in Bengal. The mountainous regions of Kentucky, which are calcareous and full of caverns, afford it to the inhabitants of North America. In South America, the plains bordering the sea, near Lima, are covered with it. It is not, however, produced naturally to an extent sufficient for its multiplied uses, and is therefore principally procured artificially from the decomposition of animal and vegetable substances." Nitre is used in medicine, in the arts, and in metallurgy; but its chief use is in the manufacture of gunpowder, for which purpose that imported from Egypt is most valued. Thus this mineral substance, unimportant in appearance, and unknown to all but the few initiated, produces, when mixed with nine per cent. of sulphur and fifteen per cent. of charcoal, a material of most terrific power, the discovery of which has placed at the disposal of man the means not only of intimidating and destroying his enemies, or of defending himself and those he loves from their attacks, but of rending mountains asunder in order to obtain the riches contained within them; and should immense cliffs stand in the way of any of his projected lines of railway, they are but trifling obstacles, for by the aid of gunpowder he speedily consigns them to the depths of the sea;—witness the late grand operations at Dover. Does a sunken vessel obstruct the course of navigation, a few casks of gunpowder remove the impediment. Besides these great uses, man is hereby furnished with a healthful and exhilarating sport, and in some countries with the means of obtaining food for himself and those dependent on him for support.

The allusion to gunpowder in Darwin's 'Botanic Garden' is so fine, that little apology is needed for introducing it in this place, and thus concluding our notice of Nitre.

> "You taught mysterious Bacon to explore
> Metallic veins, and part the dross from ore;
> With sylvan coal in whirling mills combine
> The crystal'd nitre, and the sulphurous mine;
> Through wiry nets the black diffusion strain,
> And close an airy ocean in a grain.—
> Pent in dark chambers of cylindric brass,
> Slumbers in grim repose the sooty mass;
> Lit by the brilliant spark, from grain to grain,
> Runs the quick fire along the kindling train;
> On the pained ear-drum bursts the sudden crash,
> Starts the red flame, and Death pursues the flash.—
> Fear's feeble hand directs the fiery darts,
> And strength and courage yield to chymic arts;
> Guilt with pale brow the mimic thunder owns,
> And tyrants tremble on their blood-stained thrones."

Natron.

This is a combination of Soda with Carbonic acid, deriving its name from the desert of Natron, where it was formerly collected. In the plain of Debretzin, in Hungary, it appears during the heat of summer in saline efflorescences like heaps of snow: it is found in the water of certain hot springs in Carlsbad and Iceland, also in Egypt and Hungary, whence it is brought over in pulverulent dirty grey masses. It is used in making soap, and for other purposes, but specimens are not often seen in a natural state in the cabinets of collectors. The same may be said of *Sulphate of Soda* (Glauber Salt), of *Nitrate of Soda*, and of *Borax*, a combination of Soda and Boracic acid; but the next combination of Soda with an acid deserves a more lengthened notice.

Common Salt.

> "Hence with diffusive Salt old Ocean steeps
> His emerald shadows and his sapphire deeps.
> Oft in wide lakes, around their warmer brim,
> In hollow pyramids the crystals swim;
> Or, fused by earth-born fires, in cubic blocks
> Shoot their white forms, and harden into rocks."—*Darwin.*

Phillips states this to be a compound of Soda and

Muriatic acid; but Alger says that it consists of Sodium and Chlorine, and is consequently a Chloride of Sodium. Whichever is right, Common Salt is a most abundant substance, occurring not only in large beds and masses, but forming about one-thirtieth part of the waters of the ocean. It occurs crystallized in the form of the cube, but more commonly in immense masses which are transparent, and, when pure, nearly white, but when accompanied by any foreign admixture, brick-red, green, or blue. In Africa it occurs in thick beds on the surface of the earth; in Savoy, at an elevation equal to that of perpetual snow. In Peru it is found in rounded masses, five or six feet in diameter, and is used by the inhabitants in building their houses. It has been found in America beautifully crystallized, and many tons of Salt are annually obtained from the springs at Droitwich, in Worcestershire, and in many parts of Europe, but its chief repository is in Poland, where one of the mines is so immense as actually to contain a town, with a market-place, a river, and a church!

> "Thus caverned round in Cracow's mighty mines,
> With crystal walls a gorgeous city shines;
> Scooped in the briny rock long streets extend
> Their hoary course, and glittering domes ascend;

Down the bright steeps, emerging into day,
Impetuous fountains burst their headlong way,
O'er milk-white vales in ivory channels spread,
And wondering seek their subterraneous bed."—*Darwin.*

By some, the saltness of the sea is considered as the principal cause in preserving its waters from putrefaction, and this idea is expressed by Sir Richard Blackmore in the following lines :—

"What does the sea from putrefaction keep?
Should it lie stagnant in its ample seat,
The sun would through it spread destructive heat.
The wise Contriver, on his end intent,
Careful this fatal error to prevent
And keep the waters from corruption free,
Mixed them with salt, and seasoned all the sea."

It is much more probable, however, that its freedom from corruption is in a great degree owing to its being continually in motion.

The salt used at our table has undergone a purifying process, and is generally of fine granular texture, but is seen at some tables in the state of crystals of considerable size: this is much more expensive here than in its ordinary condition, but in some parts of France the prices are reversed, and salt in its common form is sold at a higher rate than the crystallized. Eating salt with another person is by the Arabs considered an inviolable pledge of friendship.

It only remains for us to caution the young mineralogist against keeping his specimens in a damp place, for if he does, he will find that the substances we are now treating of, and particularly the common salt, are so affected by moisture that many of them will entirely melt away.

AMMONIA.

The last series of substances belonging to this division, consist of *Ammonia* united to an acid; they are but two in number.

Sulphate of Ammonia.

A combination of Ammonia with Sulphuric acid and water. It has a bitter taste, and occurs in a stalactitic form or in that of a mealy powder, and occasionally in efflorescences. It is found amongst the lavas of Vesuvius and Etna, and near Sienna in Tuscany.

Muriate of Ammonia.

This occurs massive and fibrous, in small octohedral crystals, and in a feathery form. It is easily soluble in water, but does not, like the Muriate of Soda, attract moisture from the atmosphere. It is found in several localities, principally at Etna and Vesuvius. Under the name of *Sal ammoniac* it is well known as a smelling salt, and, in combination with Carbonic acid, assumes a beautiful white colour and concrete form, and is then the salt called *Sal volatile,* so often contained in ladies' smelling bottles. Its uses are also very great in medicine, and in various arts, particularly that of dyeing.

ACIDIFEROUS ALKALINO-EARTHY MINERALS.

The minerals of this division present few attractions to the eye, and may be considered comparatively rare substances; as, however, they constitute a distinct division, it is necessary to take some notice of them. The first only is of any commercial importance, but they are all remarkable for their composition, containing an acid, an earth, and an alkali in combination together.

Alum.

This substance consists of about ten per cent. of the earth Alumine, combined with Sulphuric acid, water, and Potash. When prepared artificially, it assumes the octohedral form, but occurs in a state of nature in efflorescences on different kinds of slates and on lavas. The Alum-slate of Whitby, in Yorkshire, produces Alum in the greatest abundance, and from that source nearly all the Alum used in dyeing, in medicine, and in several manufactures, is obtained. It is also found in Norway, Bohemia, and the United States.

Alum-stone.

A greyish or reddish white substance, usually massive, and minutely crystallized in the cavities. It contains a larger proportion of Alumine than the preceding, and differs also in containing a proportion of Silex. It occurs in a rock at Tolfa, near Civita Vecchia, in small masses and veins; that which is found in Hungary is so hard and compact as to be used for millstones.

Cryolite.

A massive white substance of lamellar structure, found only in Greenland, accompanying Galena, Quartz, Felspar, and sometimes Carbonate of Iron and Iron pyrites. Its earth is Alumine, its acid the Fluoric, and its alkali Soda. *Amblygonite* also contains Alumine and Fluoric acid, but in addition a proportion of Phosphoric acid, and its alkali is *Lithia.*

Glauberite.

This mineral contains Lime, Sulphuric acid, and Soda. It is found crystallized in a very flat rhomboidal form, and is of a dull yellowish-grey colour. It occurs imbedded in

Rock salt in Spain; also in Upper Austria and South America.

Polyhallite.

This name is derived from the Greek, and signifies *a stone of many salts.* It contains two earths, Lime and Magnesia, —two alkalies, Potash and Soda,—two acids, the Sulphuric and Muriatic, and nearly six per cent. of water. In colour it is a dark brick-red, and it is found in compact, fibrous masses in beds of *Rock salt* at Hall, in the Tyrol, and in Upper Austria.

METALLIFEROUS MINERALS.

"And now the regions deep explore,
Where metals ripen in vast cakes of ore.
Here, sullen to the sight, at large is spread
The dull unwieldy mass of lumpish lead;
There, glimmering in their dawning beds, are seen
The light aspiring seeds of sprightly Tin;
The Copper sparkles next in ruddy streaks.
* * * *
The Silver then, with bright and burnished grace,
Youth and a blooming lustre in his face."—*Garth.*

"Where lingering drops from mineral roofs distil,
And pointed crystals break the sparkling rill;
Unpolished gems no ray on pride bestow,
And latent metals innocently glow,—
Approach, great Nature studiously behold,
And eye the mine without a wish for gold."—*Pope.*

At length, after "dragging our slow length along" amongst those minerals which are "of the earth, earthy," we have to present to the student's attention a new division of substances, whose main characters are essentially different from the foregoing. These are the metals and their combinations, with other ingredients; the metals themselves numbering twenty-eight, of which comparatively few are found in a native state, that is, free from all admixture. Man has, however, made himself acquainted with the operations necessary to obtain them all in a pure condition, and with those peculiarities which render most of them useful to him in some degree or other; this degree of course varying with the properties which they may possess, with the generality of their occurrence, and with the expensiveness of the processes requisite to render them available. Whilst inspecting the divisions already noticed, we have perhaps dwelt more at length upon their beauties than upon their usefulness; but in the minerals about to be described, we shall find both beauty and utility existing to so great an extent, that, for want of more space, we shall devote our pages more particularly to descriptions of the uses to which they are put, and the methods of preparing them for such uses, so far as we think those particulars would interest and be comprehended by the youthful student of mineralogy. It is not for us to expatiate at great length upon the influence that a knowledge of metallurgy exercises upon the comforts and happiness of human beings, but we remember to have read some observations (where, we cannot remember) to the effect that just in proportion to the increase of a knowledge of metals (particularly Iron) was to be observed a corresponding advance in civilization, in the arts and sciences, and, above all, in happiness and prosperity. *Iron*, the first metal of which we shall treat, is undoubtedly the most abundant and the most truly useful, for without it we should be deprived of the means of cultivating the vegetable productions of the earth which are necessary to our existence. It is true, we might have wooden spades, wooden rakes, harrows, or even ploughs, and these might answer the purpose after a fashion, but still we should require some harder and sharper material for carving these implements into shape, and if Iron were not to be had, we should be reduced to the primitive condition of the Indians, who, in constructing a canoe, used fire to hollow out the inside, and sharp flint and stone hatchets for completing the external portion. On this subject our favourite old author John Maplet observes—"If you go to use and wade no further, this kinde of mettall is principall amongst the rest, which thing necessitie teacheth, and is the best proufe: which we also doe approue then, when as we are cōstrayned and driven to Weapon and Armourie; for without thys coulde wee neyther be quiet at home amongst ourselues, neyther could we keepe off, from our Countrie borders and limits, other our outward enimies. Further (to stay our selves in things at home and not to seeke other) there could be no mans Arte practised, no commoditie had by occupation and science; further, not so much could the earth be either sowne or reaped to any increase without this. Therefore in this behalf it mought be called all graine and fruites Nurse."

IRON.

"Hence dusky Iron sleeps in dark abodes,
And ferny foliage nestles in the nodes;
Till with wide lungs the panting bellows blow,
And waked by fire the glittering torrents flow;—
Quick whirls the wheel, the ponderous hammer falls,
Loud anvils ring amidst the trembling walls,
Strokes follow strokes, the sparkling ingot shines,
Flows the red slag, the lengthening bar refines;
Cold waves, immersed, the glowing mass congeal,
And turned to adamant the hissing steel."—*Darwin.*

It was long doubted whether this metal had ever been found in a native state and of terrestrial origin, but authentic information has removed all doubts, and several instances are known of its occurring in that state: by far the greater portion, however, of native Iron known to exist, is also known, or rather presumed, to derive its origin from the sky, and is termed *Meteoric Iron.* Iron exists in immense abundance in combination with different acids, with sulphur, oxygen, and other ingredients; but the greater part of the iron of this country is obtained from *Clay Iron-stone,* which consists of Iron, oxygen, and carbonic acid: this will be described in its place. Without further preface we shall commence with Iron in its purest state, and then proceed to notice its combinations.

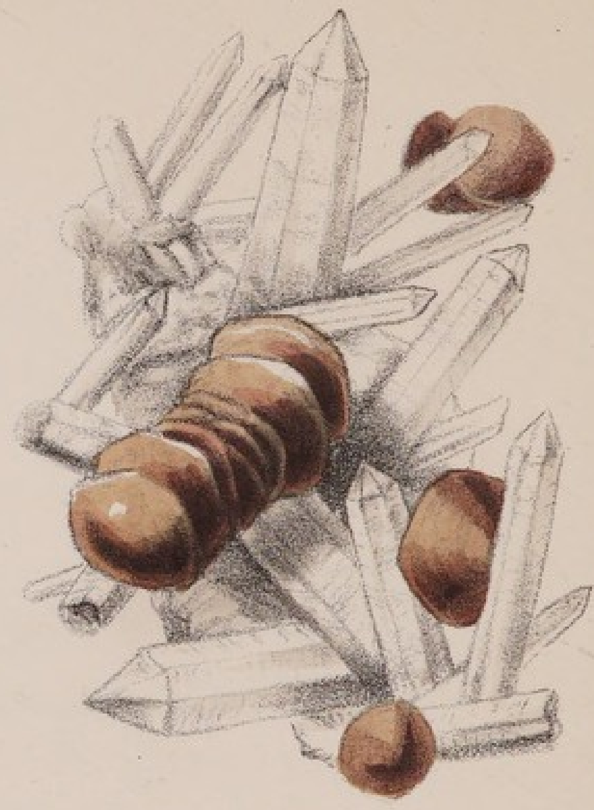
NATIVE IRON.

Native Iron has been found in a mass weighing four pounds in the mines of Hackenburg; in the form of a branchy stalactite *in a vein* traversing the mountain Oulle, near Grenoble, in France; and at three different places and situations in Saxony. Alger states that there are two or three well-authenticated instances of the occurrence of Native Iron of terrestial origin in the United States;—at Canaan, Connecticut, where it formed a vein about two inches thick, attached to a mass of Mica-slate, and in Guilford County, where a mass of twenty-eight pounds weight was obtained, from which an *octohedral* crystal, weighing seven ounces, was detached. This is the primary form of Native Iron; its colour is pale steel-grey; it is soluble in all the acids, and acts powerfully on the magnet. Native Iron has also been found to be a volcanic production, since it was discovered "in a ravine formed by torrents across the lava and scoriæ of the mountain of Grenavière, in Auvergne."

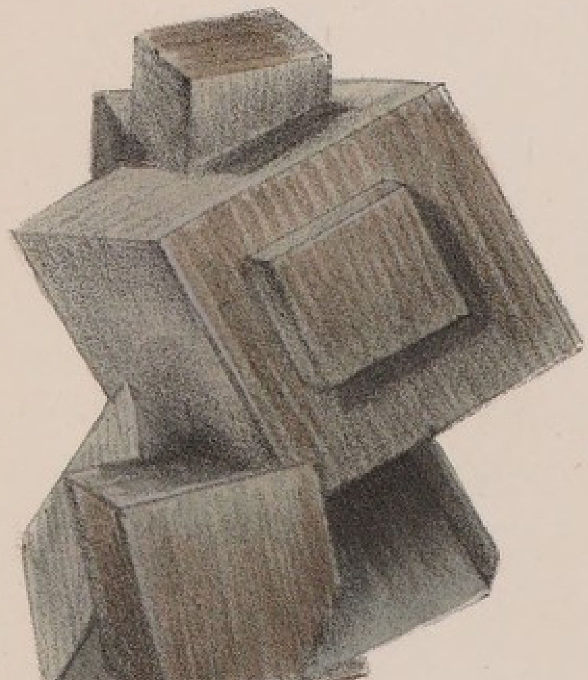
Meteoric Iron.

This term is applied to those masses of Iron, many of them huge in dimensions, that have either been seen to fall, or are by a clear train of reasoning supposed to have fallen, from the sky. In addition to these masses of nearly pure Iron, stony masses of different sizes, containing Iron and many other substances, are also known to be of the same origin. These will be described as *Meteoric stones*, or *Aerolites*. To a mind that has not been exercised upon the study of the extraordinary phenomena of Nature, the announcement of large lumps of Iron falling from the sky would naturally be received with incredulity; but to those who are duly impressed with a sense of the great Creator's power, and with the curious manner in which the laws of nature are occasionally exemplified, the chief difficulty will be to account in a satisfactory manner for the causes of phenomena which are so well authenticated as these. We are only aware of one *mass of Iron* having been seen to fall from the atmosphere, near Agram, in Croatia; but instances are numerous of masses being found in such situations that they could hardly have had any other origin. One remarkable circumstance is observable of all or most of these masses, viz., that they contain the metal *Nickel*, which is of rare occurrence, in comparison with the other metals found in the earth. Meteoric Iron is commonly massive, but, when polished, exhibits a highly crystalline structure, particularly the mass from Lenarto, in Hungary, a slice of which is in the British Museum, and that from Texas. It has a metallic lustre, is flexible, malleable, and tough. Of that from Lenarto, Mr. James Sowerby (the author's grandfather) caused a splendid sword to be made, which he presented to the Emperor of Russia, who sent him in return a most valuable ring, now in the possession of Mr. James de Carle Sowerby. We shall mention only some of the most remarkable masses of Meteoric Iron known to exist. A mass weighing 1,680 Russian pounds was found by Professor Pallas on the top of a mountain in Siberia: it possessed malleability and flexibility, and was reported by the inhabitants to have fallen from the sky.

37. Meteoric Iron.



40. Carbonate of Iron.



38. Iron pyrites.

39. Hæmatite.

H. Sowerby, lith. F. Reeve, imp.

In the desert of Sahara, in Africa, a mass was found which contained four per cent. of Nickel. In the province of Atacami, in Peru, was found a mass of considerable size, enclosing rounded crystalline masses of *Olivine*, as shown in our figure of a small polished slice from that locality. (Plate X. fig. 37.) Near the Red River, in Louisiana, North America, was found a mass exceeding sixteen hundred pounds in weight; this was covered with a blackish crust, and in its cavities were found octohedral crystals more than half an inch in length. In 1833 a mass of Meteoric Iron was discovered at Claiborne, Alabama; and in Coke County, Tenessee, was found a mass about two thousand pounds in weight. Many more instances might be given; but we must now proceed to notice, as of the same origin, those masses which, though not consisting entirely of Iron, yet contain that metal in considerable proportion.

Aerolites.

These are masses of stony appearance which have fallen from the sky at different periods and in different countries. They are generally of a rounded form, and are coated over with a shining black crust; internally they are of granular texture and greyish colour. The natural history of these and the preceding has lately been elevated into a distinct study, by Professor Shepard, under the proposed name of *Astrolithology*, from three Greek words signifying *a meteor*, *a stone*, and *a treatise*. Nevertheless, as that mineralogist has found in those masses many mineral substances identical with those belonging to the earth, such as Iron, Nickel, Cobalt, Magnesia, Soda, Silex, Apatite, Pyroxene, Garnet, Sulphur, Plumbago, and others, and as the subject is one of so great an interest, we shall quote from Sowerby's 'British Mineralogy' a short notice by Mr. King of stones said to have fallen from the clouds in former times.—

"Tradition has handed down to us the fall of stones in ancient times. The learned Grævius leads us to conclude that the image of Diana was a stone which fell from the clouds. He tells us, on unquestionable authorities, that many other images of heathen deities were merely such.

"Herodianus says that the Phœnicians had no statue of the sun but a great stone, which they reported to have fallen from heaven.

"Plutarch mentions a stone which formerly fell from the clouds; and the old writer from whom he took his account, says, 'It hovered about for a long time; seemed to throw out splinters, which flew around like wandering stars before they fell, and at last it came down to the earth a stone of extraordinary size.' Pliny tells us of its being preserved in his days, and that it was of a dark burnt colour. He mentions one, also, which fell at Abydos, and was worshipped at that place."

Thus much of traditionary Aerolites: we now come to those of later date, and which, either whole or in part, are preserved in public museums and private collections. Of such as are contained in Professor Shepard's collection, he has given a list, in number thirty-five, arranged according to the dates of their falling, and amongst the earliest of these we find that of L'Aigle, in France, in which place a shower of these stones fell in the year 1803; these were generally about the size of a common hen's egg, and were all coated by a shining blackish covering, which is the case with almost all meteoric stones. In the year 1810 we find recorded a stone of considerable size, which fell in Tipperary, Ireland. Three years later, fell a stone in the county of Limerick, and in 1844 the county of Tyrone was also the scene of a similar occurrence. Other parts of the world, particularly France, Spain, Russia, and the East Indies, have been equally favoured; a large entire stone, from the latter locality, is preserved in the Museum of the East India Company. In America instances are numerous of stones falling from the atmosphere, and we subjoin an account of a remarkable one which fell in Bishopsville, South Carolina, in March 1843 (from Professor Shepard's Report on American Meteorites).—

"For my first knowledge of this, the most remarkable of all the hitherto described Meteorites of the United States, I am indebted to Dr. J. C. Haynsworth, of South Carolina, who in his letter to me says, 'I have in possession a meteoric stone, which fell in March 1843, near Bishopsville. The passage of the meteor and its explosion were witnessed by many spectators, over a range of country thirty or forty miles in diameter. The descent of the stone itself, also, was observed by a number of negroes. Their terror was so great on seeing the excavation it produced, the scattering of the soil, and, more than all, by the insupportable sulphurous odours with which the air was filled, that they fled in a panic from the field. On the following morning, however, headed by a white man, they returned to the spot; and, after digging three feet or more, in a sandy soil, they came upon the stone which I now possess. It has more the appearance of limestone than any other rock with which I am acquainted, though it is much heavier than the same bulk of lime-rock. It has, moreover, numerous particles resembling oxide of iron diffused through it. It is coated with a dark shining surface, resembling glass that has been stained with some metallic oxide. When first dug up, the sulphurous odour was said to have been overpowering. This has now subsided, though it can be reproduced by friction or slight warmth." The weight of this stone was thirteen pounds.

The most remarkable stone that has fallen in England is known as the Yorkshire Meteorite. This was, shortly after its fall, exhibited in the Museum of the late Mr. James Sowerby, but is now in the British Museum, having been purchased for the sum of two hundred and fifty pounds. In the first instance, however, the stone was in the possession of Major Topham, in whose grounds it fell. But the gallant Major soon found, to use his own words, that "the man who happens to possess any extraordinary curiosity, has a very troublesome companion. He is liable to have his time occupied in answering letters from any stranger that may choose to ask questions, his house searched, his grounds ransacked; and if the circumstance be very singular, he has the additional pleasure of having every word he says disbelieved on the subject." The major had bravely faced the enemy, but it required more courage than he possessed to face the host of inquiring philosophers who invaded his domains on the first news of a stone having fallen in them, and therefore wisely concluded to transfer his troublesome treasure to Mr. Sowerby's museum, where, as he observes, it would be subject to be examined, disputed, and commented upon by every philosopher in the United Kingdom. He forwarded, along with the stone, an account of its falling, which is published in Sowerby's 'British Mineralogy,' an extract from which will be found highly interesting.—

"It was on Sunday, about three o'clock, the thirteenth of December, 1795, that the stone in question fell within two fields of my house. The weather was misty, and at times inclining to rain; and though there was some thunder and lightning at a distance, it was not till the falling of the stone that the explosion took place, which alarmed the surrounding country, and which created so distinctly the sensation that something very singular had happened.

"When the stone fell, a shepherd of mine, who was returning from his sheep, was about one hundred and fifty yards from the spot; George Sawden, a carpenter, was passing within sixty yards; and John Shipley, one of my farming servants, was so near the spot where it fell, that he was struck very forcibly by some of the mud and earth raised by the stone dashing into the earth, which it penetrated to the depth of twelve inches, and seven afterwards into the chalk rock,—making in all a depth of nineteen inches from the surface.

"All the three witnesses who saw it fall agree perfectly in their account of the manner of its fall, and that they saw a dark body passing through the air, and ultimately strike into the ground; and though, from their situation and character in life, they could have no possible object in detailing a false account of this transaction, I feel so desirous of giving this matter every degree of authenticity, that, as a magistrate, I took their accounts upon oath."

No more need be said of Aerolites; but we may add, that although they undoubtedly have *fallen from the sky*, it is by no means certain that the ingredients of which they are composed did not previously belong to the earth, whence they may have been projected by volcanic force into the atmosphere. This subject is now engaging the attention of several eminent American *savans*, and, mysterious as it now appears to be, will probably be rendered much more intelligible by the results of their investigations.

Iron Pyrites.

This is one of the commonest combinations of Iron, being composed of that metal and sulphur in nearly equal proportions. It is found in almost every situation and in almost every kind of rock. Distinctly-formed crystals are very common, both cubic and octohedral; and these often present such a vast variety of modifications that it is difficult to recognize the regular form. In colour it is brass-yellow, sometimes approaching to steel-grey, and usually possesses a high metallic lustre, but is occasionally found of a dull brown colour, owing to the progress of decomposition, and is then termed *Hepatic pyrites.* In the Cornish mines are produced very large and perfect cubes, which are often aggregated together, as shown in our figure (Plate X. fig. 38), the same locality yielding the octohedral form, which is frequently found coating or covering crystallized Quartz, Fluor spar, Carbonate of Iron, and other minerals. From Sweden, Elba, Saxony, Brazil, and Piedmont, are obtained brilliant specimens of this substance; which also occurs in great abundance and in surpassingly beautiful groups at many places in the United States of America. But Iron pyrites does not always occur in a crystallized state, being sometimes mammillated, stalactitic, globular, cellular, and even capillary in form. In many Chalk cliffs it is found imbedded in masses of a rounded or elongated form, which, when broken, exhibit a fibrous diverging structure. These masses are often found strewed upon the sea-beach, but they are then externally of a dark brown colour, owing to decomposition, and have quite lost the brilliant lustre which they possess when first dug out from the chalk. This brown coating, however, is not very deep; and when they are broken, the very beginner in Mineralogy will at once detect in their fresh surfaces the peculiar aspect of Iron pyrites.

"Pirrites is a kinde of stone, yealow, like to the fire his flame, and in qualitie almost all one with the fire: for the which I suppose it tooke his name, it is soone kindled and set on fire. It also sparkleth, and being hardly holden and pressed in any mans hande burneth him sore or he perceiueth it. Whereupon the Lapidare hath these two verses.

"The Pirrite must with easie hand
And marvellous soft enholden be:
For being prest and helde to hard
Doth burne thy flesh or ere thou se."

When reading John Maplet's account, as given above, of *Pirrites,* we confess that we at first had some doubts as to the identity of his *kinde of stone* with our *Iron pyrites,* and we even had the courage to try the experiment of holding a piece of Iron pyrites in our hand, squeezing it as hard as we could, in order fairly to test its power of burning our flesh before we were aware of it. This effect it certainly did not produce, but the worthy old author was not altogether in the wrong, for under the influence of the atmosphere or of water this ore of Iron is extremely liable to decomposition, and during the progress of this decomposition a considerable degree of heat is generated. Although Iron pyrites is not one of those ores from which Iron is extracted, it is very useful in another way, for Sulphuric acid is obtained from it by producing decomposition artificially. In Carnarvonshire it is also decomposed for the purpose of procuring Sulphur from it, the iron that remains being *red ochre,* a common paint.

There are several varieties of this ore of Iron, but the most remarkable is that termed *Magnetic Iron pyrites,* so named from its power of affecting the magnetic needle. It differs from common Iron pyrites in the proportions of Sulphur and Iron which it contains; for whereas that substance is composed of about 48 per cent. of Iron and 52 per cent. of Sulphur, the present variety contains nearly 64 of Iron to only 36 of Sulphur, which, according to some authors, accounts for its magnetic properties. Exhibiting an equal lustre, it is generally of a darker colour than the ordinary variety, and occurs of a broad lamellar structure. It is found in Norway, in Siberia, in Scotland, and in Cornwall.

MISPICKEL.

In this substance Iron is found combining with Arsenic, and it is consequently known as *Arsenical Iron*; Sulphur also enters into its composition. Externally it differs from Iron pyrites in its colour, which approaches more to that of tin-white than to brass-yellow: its form, too, is different, the primary being a rhombic prism instead of the cube. Accompanying the ores of Silver, Lead, and Tin, it is found abundantly in the mining districts of Saxony, and fine crystallized specimens are brought from Cornwall. At Andreasberg is found a variety which contains in addition some Silver and Antimony; and in several parts of Saxony this variety is worked for the sake of the Silver it contains, amounting to about thirteen per cent.

Although Iron in combination with Sulphur (*Iron pyrites*) is a mineral of extremely common occurrence, the same metal combined with oxygen, forming *Oxide of Iron*, or with oxygen and water, forming *Hydrous Oxide of Iron*, is still more abundantly diffused over the earth, and produces a considerable number of minerals which vary much in outward form and appearance, and are known under many different names. The most interesting of these is undoubtedly that popularly known as *Natural Magnet*, or *Loadstone*, and to mineralogists as

Magnetic Oxide of Iron.

This is found crystallized in an octohedral form, the crystals being usually very distinct, and sometimes of considerable dimensions: they are of a black colour, and possess a shining metallic lustre when broken. The finest and most perfect crystals are found imbedded in *Chlorite* at Fahlun, in Sweden, at Traversella, in Piedmont, and very perfect crystals imbedded in the same substance were brought from the Philippine Islands by Mr. Cuming. The crystallized variety is also found abundantly in the United States. But the character by which this species is particularly distinguished is best observable in the massive variety, to which the term Loadstone more especially refers.

This kind occurs in large irregular beds and masses in many parts of the world, and the finest description of steel is manufactured from the extensive and celebrated mines of Sweden and Norway, almost all the Iron contained in them being magnetic. The Sterling mine, in Orange county, New York, is so extensive as to cover a space of thirty acres: the mine that has been worked to the greatest depth in the United States is that at Sucasunny, New Jersey; and Alger observes, as a remarkable circumstance, that this deposit rarely affords any examples of the crystallization of this species, while the other localities supply them abundantly and in great perfection.

Specimens of *Natural Magnet* are not uncommon, but the degree in which they exhibit the property of magnetism varies greatly: some specimens will only attract a needle, and even that with difficulty; others will take up a small pair of scissors or two or three large nails with facility. A specimen in our cabinet possesses the attractive power in a very great degree, and presents a most ludicrous appearance when brought in proximity to a few hundred small nails, which then spring towards it from the distance of a quarter of an inch: those which reach the magnet first hang on in very respectable order, but those last in the race, impelled by the same irresistible power, cling on to the first in all sorts of positions,—by their heads—by their points—sideways, or lengthways. Some specimens exhibit polarity,—that is, at one point they attract iron, and at the opposite point repel it: one that we have seen in the East India House Museum shows this very distinctly.

That the property of magnetism was known to the ancients is beyond all question, but it was reserved for modern philosophers to discover the truly important service to which that property might be applied in the art of navigating the ocean, and thus spreading the advantages of commerce to distant countries. Darwin has poetically alluded to an improvement invented by Michell, in the mariner's compass.—

> "Last Michell's hand, with touch of potent charm,
> The polished rods with powers magnetic arm;
> With points directed to the polar stars
> In one long line extend the tempered bars;
> Then thrice and thrice with steady eye he guides,
> And o'er the adhesive train the Magnet slides;
> The obedient steel with living instinct moves,
> And veers for ever to the pole it loves."

Nor has this substance escaped the observation of "John Maplet, M. of Artes," who says,—

"The Lodestone commeth from Indie, and is almost Iron colour like. It is founde most rife amongest the Trogloditas people, in the furthest part of Affrick, beyond Æthiopia, who are saide to dwell in Caues, and to eate Serpents flesh. It draweth Iron to it, euen as one Lover coueteth and desireth an other. The common people therefore hauing sometime seene this so done by secret and unknowne working, have iudged and reputed y^e Iron liuely. There is another kind of Lodestone in Thessalie, that is of contrarie set and disposition, which will have none of Iron, nor will meddle with it. But for the other that is reckned principall and best, which in colour is blew. Saint Augustine saith, that if any man put under any vessel eyther golden or of brasse, or holde under these any piece of Iron, and lay aboue the vessels or upō them this Lodestone, that euen through the verie motion or mouing of the stone underneath, the Iron shall moue up and meete with it as nigh as the vessel wil suffer at the verie top."

Hippocrates, Plato, and Aristotle were all acquainted with the attractive and repulsive powers of the magnet, and so well are they known at the present day, that even children's toys are made which exhibit its interesting properties.

Magnetical Iron ore, containing generally about seventy per cent. of iron to thirty per cent. of oxygen, is of course a very valuable ore for smelting purposes, and we have already observed that the Swedish Iron is found to produce the best steel. About thirty miles from Upsal, in that country, a mine still exists that has been worked for upwards of three hundred years; and the mountain called Taberg, whose upper bed is 370 feet thick, has been worked for a similar period of time.

The first process undergone by this ore of Iron, and, indeed, by all others, is that termed *roasting*; that is, the stone is broken up into pieces, and then spread on the ground in the open air, a layer of pit-coal is then placed upon it, then another layer of Iron ore, and another of pit-coal, and so on alternately, until a very large heap is made, when the coal is set on fire, and the heat serves to dissipate any Arsenic or Sulphur that may have been united with the ore. It is next mixed with a certain proportion of *Charcoal*, which is composed of carbon, and with Limestone; and these being melted in the furnace, the produce is *Cast Iron*. The cast iron obtained by this process is as white as silver, of crystalline structure, extremely hard and brittle, and, being run into moulds, of a semi-cylindrical form, is termed *pig-iron*. It will thus be seen that the cast iron which is moulded into such a vast variety of shapes, all useful and important in their way, has only required first to be separated from impurities and then to be mixed with carbon; the proportion in which that substance is added, affecting the qualities of the Iron. But to render this cast-iron in a fit state for forging, it is necessary again to deprive it of its carbon. This is done by again subjecting it to heat, but of greater intensity than that at first used, and when the metal has run out and cooled, it is subjected to high pressure between rollers. Afterwards, to give the metal the necessary degree of solidity and closeness, it is again heated, and then beaten out with hammers into ingots or bars of about three feet in length, which are partially divided in several places to facilitate their being broken. This is now *malleable iron*, is by far the most tenacious of all the metals, and is capable of being drawn out into the finest wire.

There is one kind of manufactured Iron, called *Steel*, which must not be overlooked, for no other metal is known that could supply its place in the arts, manufactures, and agriculture of the world, nor its utility as a weapon of war; —cannon are made of cast iron or brass, but swords are made of steel. Whatever objection may be entertained against warfare, all will agree that if men will fight, good sword-blades are preferable to bad ones. Now, in order to make steel, that called pig-iron is used, and this, as we have observed, has been artificially impregnated with carbon, which it is necessary to remove for the production of malleable iron. When the Iron has thus been brought to a malleable state, it is again mixed with carbon, but in smaller proportion than is contained in pig-iron, and the metal is now *Steel.*

> "Hail, adamantine Steel! Magnetic Lord!
> King of the prow, the ploughshare, and the sword!
> True to the pole, by thee the pilot guides
> His steady helm amid the struggling tides,
> Braves with broad sail the immeasurable sea,
> Cleaves the dark air, and asks no star but thee.—
> By thee the ploughshare rends the matted plain,
> Inhumes in level rows the living grain;
> Intrusive forests quit the cultured ground,
> And Ceres laughs, with golden fillets crown'd.—
> O'er restless realms when scowling Discord flings
> Her snakes, and loud the din of battle rings,
> Expiring Strength and vanquish'd Courage feel
> Thy arm resistless, adamantine Steel!"—*Darwin.*

A most extraordinary fact has lately been discovered with reference to iron in a state of fusion: this is, that if heated beyond a certain degree, the finger, hand, or arm may be dipped into the fluid metal, and even stirred about in it, without any sensation of pain, and when withdrawn will be found to have sustained not the slightest injury! Some courage would be requisite to try this experiment, but that it has recently been tried by several persons, and in all cases with success, is an undoubted truth.

We shall now notice the other varieties of Oxidulous Iron. The first of these also possesses the property of magnetism, but in a less degree than that already noticed.

Oligiste Iron.

This term includes several varieties of Oxidulous Iron, differing considerably from each other in some of their external characters, particularly in crystalline form and mode of occurrence, their primary form being an acute rhomboid. The most beautiful of these is that variety called *Elba Iron*, from the locality in which it is found, where the mines are most extensive, and are said to have been worked upwards of 3000 years. From these mines are brought the most splendid crystallized specimens, the crystals sometimes displaying the most gorgeous iridescent hues. Very capital specimens are also found at St. Gothard, accompanying *Rock crystal* and *Adularia*; the crystals consist of hexagonal plates, and are grouped together in the form of rosettes; shooting out from these are seen transparent wine-red crystals of *Titanium* of the most perfect form. Oligiste Iron is also found in small crystals scattered over or completely covering *Quartz* in Cornwall; and in Cumberland it occurs in the most brilliantly crystallized groups with *Smoky Quartz*.

Micaceous Iron is a variety occurring in extremely thin and brilliant plates, sometimes, as at Lorraine in France, interspersed in *Rock crystal*, sometimes in *Lithomarge*; and in Cornwall it is found in masses consisting only of minute scales, which adhere to the fingers. In Brazil it occurs in large thin plates, which, if held up to the light, appear to be of a deep red colour.

Hydrous Oxide of Iron.

Most usually this substance is found in a crystallized form, but is sometimes massive. The crystals are small and black, but very brilliant, and occur in stalactitic groups, or imbedded in *Quartz*, at Lostwithiel, in Cornwall. Acicular crystals, grouped together very prettily, are found in *Quartz* geodes near Bristol, and at Oberstein; it occurs in *Amethyst* at Petrosbotzky in Russia.

HÆMATITE.

This very abundant mineral occurs of various shades of red, brown, and black. It never assumes a crystalline form, but is always of a fibrous structure, and occasionally botryoidal and stalactitic; sometimes coating crystals of *Quartz*, as in Cornwall. Externally the mass is often black and shining, and even iridescent. Hæmatite is plentiful in a vast number of localities in England, Scotland, France, Germany, Poland, Russia, and in the United States. It affords a very tough, compact cast iron, and is also converted into malleable iron of superior quality; in America the best iron, both malleable and cast, is obtained from the brown-coloured variety. The figure represents a specimen from Lancashire (Plate X. fig. 39).

Red ochre is a variety of Hæmatite, which is soft and greasy to the touch, and stains the fingers with a light red colour. It occurs with, and coating, the other varieties.

Lepidokrokite.—This resembles Hæmatite in external characters and in main composition, but it contains, in addition, some Phosphoric acid. It is found only in Thuringia, and is a rare mineral.

Bog Iron-ore.

In colour this is generally of a dark yellowish-brown, and in structure is earthy and either friable or compact. One variety occurs in small round masses adhering together, and is termed *Pea Iron ore.* Another variety occurs in separate masses of a rounded form and considerable size: these are hollow, and generally contain some loose grains, which rattle about when the stone is shaken. Bog Iron ore is supposed by Werner to arise from the decomposition of rocks over which water passes, and to be deposited by the water when in a state of rest in bogs and marshy places.

These, then, are the principal substances in which Iron exists in the state of an Oxide, that is, in combination with oxygen. The learner's attention may next be directed to the varieties of Carbonate of Iron, which, as is implied by that term, consists of Iron in combination with Carbonic acid.

Carbonate of Iron.

The primary form of this ore of Iron is an obtuse rhomboid, but it is seldom seen crystallized in that form. More commonly it occurs in lenticular crystals composed of hexagonal layers grouped together. In colour it is usually brown of different shades, and sometimes approaches to black. Most interesting specimens, one of which is figured (Plate X. fig. 40), have been found in Cornwall: in these the brown crystals of carbonate of Iron are deposited here and there on crystallized opake white Quartz, sometimes supported by two Quartz crystals, sometimes placed on the very point of a single one, or adhering to its sides. A curious instance of *pseudomorphism* is seen occasionally in this substance, when it forms long flat hollow crystals, which taper gradually to a point: we are, however, not aware what substances formerly occupied those forms. Carbonate of Iron is also found fibrous, the fibres being parallel and of a dark brown colour. In the Hartz most magnificent crystallized specimens are found, as also in the Silver veins at Freyberg: it is obtained from several localities in the United States.

Clay Iron-stone.—From this variety of carbonate of Iron a large proportion of all the Iron manufactured in England is obtained. It occurs in large rounded masses of a dirty grey colour, very hard and compact, and of such ordinary appearance that the beginner would but grudgingly afford a specimen of it room in his cabinet. We trust, however, that it will be regarded with some favour on account of its great value as an ore of Iron. Clay Iron-stone is most abundant in the coal-measures, but frequently occurs in detached nodules imbedded in strata of clay, varying in size from that of a potato to five feet in diameter: they often lie at regular distances, forming an almost continuous bed, but are sometimes scattered promiscuously through the clay: on breaking some of them, fossil fishes, crabs, or plants are seen. The furnace used for smelting this ore is usually a square pyramidal tower of solid brickwork, from forty to fifty feet high; in these there is a door near the top, for the purpose of attending to the progress of the smelting. To one who beholds these furnaces for the first time on a dark night, the sight is most interesting, although strongly suggestive of Pandemonium, especially when the workmen open the door in the side. Through this opening is seen the most intensely glaring fire, before which the men with instruments resembling large pitchforks, flit, like so many evil sprites, backwards and forwards. From the top of the furnace issue huge volumes of dense black smoke, and the whole atmosphere around is impregnated with a strong sulphurous odour. Usually there are several of these furnaces in close proximity, and when dark mountains rise up on either side, the effect of the scene is not a little heightened.

Phosphate of Iron.

This consists of Iron, Phosphoric acid, and water. It occurs crystallized and earthy. The crystals, which are of various shades of dark blue or green, are composed of thin laminæ, and occur imbedded in *Iron pyrites* in Cornwall. A nearly black crystallized variety is found imbedded in *Bog Iron ore* and *Sandstone* at Allentown in New Jersey. The earthy kind is of a lighter blue colour, but when first exposed to the air is grey, yellow, or greenish-white. It is found in Styria, Carinthia, Greenland, and several places in England. Phosphate of Iron is also known by the name of *Vivianite.*

Sulphate of Iron.

This occurs in most mines where Iron pyrites is found, from the decomposition of which it arises. Its colour is green of various shades, but it becomes, by exposure, yellow or yellowish-brown. Being obtained by artificial means from *Iron pyrites,* it is caused to crystallize over various ornamental articles, such as wire baskets, &c., and in many chemists' shops are exhibited large artificially crystallized specimens, but in a native state it is very rarely found crystallized.

Chromate of Iron

Consists of Iron in combination with Chromic acid, and generally some Alumine and Silex. Its crystalline form is the octohedron, the crystals being commonly minute, and of a black colour. It also occurs massive and sometimes lamellar in structure. Near Baltimore, in North America, very perfect and brilliant octohedrons are found imbedded in *Serpentine*, which is also its matrix in two of the Shetland Isles. The large proportion of chrome contained in this ore of iron renders it a very valuable one, yielding, in combination with the oxides of other metals, green, yellow, and red colours, which are employed in oil-painting and in colouring porcelain.

Arseniate of Iron.

This combination of Iron with Arsenic acid and some other ingredients, is the last ore of that metal which we have to notice; but it must not be forgotten that we have necessarily omitted many distinct minerals, which are also ores of Iron, but whose rarity of occurrence will justify us in sacrificing them to our confined limits.

Arseniate of Iron occurs crystallized in small cubes of various shades of brown and green: they are generally translucent, and are variously modified. It has been found in France, but most of the specimens seen in cabinets are from Cornwall.

MANGANESE.

Although in usefulness this metal will not bear comparison with Iron, it is yet of considerable importance in some of the arts and manufactures. It has never been found in a pure state, but in all its ores is in combination with Oxygen, and when in this state is turned to great account for the purpose of obtaining oxygen gas from it for the manufacture of bleaching powder. Oxide of Manganese has already been alluded to as being used in the manufacture of glass, in order to render it colourless. This metal has not long been known.

Grey Manganese.

The primary form of this substance is a rhombic prism, from which the crystals in which it usually occurs are derived. The crystals are often of considerable size, and are of a greyish-black colour and very brilliant. It is also found in long slender prisms aggregated together, having in the mass a fibrous appearance. From Thuringia are brought the finest crystallized specimens, but of the latter

41. Black Manganese

42. Rose Manganese.

43. Sulphuret of Molybdena

44. Oxyde of Tin.

H. Sowerby lith.

F. Reeve, imp.

variety very good ones are found in Cornwall. The specimen figured (Plate XI. fig. 41) is termed *Black Manganese* merely in allusion to its colour, and exhibits another variety of the oxide of this metal, whose form is botryoidal. An earthy variety is found in several localities, and is known by the euphonious name of *Wad*. *Braunite*, *Hausmannite*, and *Pyrolusite* are other varieties in which Oxide of Manganese occurs; indeed, the last of those three is the one principally in use in the purification of glass.

Rose Manganese.

There are several ores of Manganese to which this name might be applied with equal justice as to the specimen figured (Plate XI. fig. 42) of *Carbonate of Manganese*. This, which is from Nagyag, in Transylvania, is of the most delicate rose-colour. The crystals are rhomboids, generally curved more or less, and occur lining cavities in *Sulphuret* of Manganese, which is of a black colour. The other rose-coloured ores of this metal are the *Silicate* and the *Bisilicate*: this latter is found massive in Devonshire, associated with the grey and black oxides; also in other localities.

Helvine.

This is very different in general character from any other ore of Manganese, occurring in tetrahedral crystals of a light brownish-green colour. It contains, in addition to the Oxides of Manganese and Iron, the earths Silex, Alumine, and Glucine. The best-known localities for it are Schwartzenberg, in Saxony, and Hortekulle, in Norway.

MOLYBDENA.

This metal does not appear to have been put to any particular use, although in America it occurs in considerable abundance. Its ores are only two in number.

Sulphuret of Molybdena.

It is composed of the metal and Sulphur, and always occurs in laminæ, or plates, which are either of a hexagonal shape, and so arranged as to form a crystal, or else irregularly aggregated in a mass together. The colour is a bluish-grey, and the lustre metallic: the laminæ are opake and very flexible. Sulphuret of Molybdena is found in Greenland, Norway, Sweden, Saxony, France, and Peru. Plate XI. fig. 43 represents two hexagonal plates of this substance imbedded in a flesh-coloured Felspar. Cornwall produces it in some abundance, and the granite of the United States contains it in great quantity. It bears some resemblance to Graphite, but is much lighter, both in colour and weight.

Oxide of Molybdena

is of a yellow colour, and is only found in very minute quantities encrusting the Sulphuret.

TIN.

"Hence glows, refulgent Tin! thy crystal grains,
And tawny Copper shoots her azure veins;
Zinc lines his fretted vault with sable ore,
And dull Galena tessellates the floor."—*Darwin.*

WITH this metal the ancients appear to have been well acquainted, it being frequently mentioned in the writings of Moses. In the time of Edward the First the *Stannaries* were established by Royal Charter, being courts for the administration of justice amongst the tin-workers of Cornwall and Devonshire. A greatly increased demand arose for it in the eighth century, when bells for churches came into more general use, for tin not only is a necessary ingredient in bell-metal, but also in brass and pewter. Tin is one of the lightest metals known; is tolerably malleable, as the thin leaves called *tin-foil* will prove; and is flexible. It is never found pure in a native state, and only occurs naturally in two conditions, viz., combined with Oxygen, and as a Sulphuret.

OXIDE OF TIN.

This commonly occurs crystallized in four-sided prisms terminated by pyramids of four planes, but its primary form is an obtuse octohedron. The crystals are sometimes very distinct, especially in Cornish specimens, but they are often modified, and occasionally macled, that is, two crystals are joined together, neither of them showing their full form. The peculiarity of a macle of Oxide of Tin is shown in Plate XI. fig. 44. When in regular four-sided crystals, it often varies considerably in general form, the prisms being sometimes very short and thick, sometimes very long and slender, and the pyramids being in some crystals very obtuse, in others sharp and pointed. The colour, and transparency too, varies much, as it occurs almost transparent, either colourless or of a yellowish tint; hair-brown or reddish-brown, and translucent; commonly deep brown passing into black, and opake. In Saxony very brilliant crystallized specimens of Oxide of Tin are found, sometimes in macled crystals weighing several pounds. Spain, France, Greenland, and South America, produce Oxide of Tin in some abundance. Sumatra and Borneo are rich in it. The United States have produced but very little, the chief repository of this ore being in Cornwall, which county has annually produced it to the average value of about £300,000. A large proportion of this is yielded by the variety called *Stream Tin,* which consists of rolled fragments of different sizes, and is found in many of the low and marshy places in Cornwall. This is only the debris of the Tin veins, and is found mixed with gravel and sand, and even grains of Native Gold. These mines are called stream-works, because streams of water are employed to wash the gravel and sand, and separate therefrom the tin ore: they were evidently worked by the Romans at a very early date, for not unfrequently Roman coins have been met with in them. From this variety is produced the best Tin.

Tin ore, obtained from the mine, is first broken into pieces not larger than two or three inches square, and is then taken to the stamping mill, which has the effect of crushing it till it is reduced to a coarse powder; this is washed and sifted many times, in order to separate the particles of granite, sand, and other impurities. After undergoing the process of roasting, and another washing, it is in a state to yield from fifty to seventy-five per cent. of metal, and is then smelted in furnaces, from which the liquid Tin runs off into a large receptacle, leaving the impurities behind, in the shape of *slag*. The metal being afterwards refined, it is run into moulds, and comes to the market under the name of *Block Tin*. From the stream ore is obtained Tin of a finer quality, which is termed *Grain Tin*.

We might now, in fairness, ask the learner to descend with us to an apartment in the lower regions of the house, known as the kitchen, in order to make an examination of the many and various articles of domestic use that are manufactured of this metal; and we have no doubt an instructive, if not a pleasant hour, might be passed in inspecting and handling the kettles, saucepans, and candle-sticks that we should not fail to observe in that place. The knowledge, however, that such things exist, will be sufficient for the present, although it is necessary to correct a general impression that they are manufactured wholly of *Tin*; the fact being, that they are made from thin sheets of *Iron*, which have been dipped into melted Tin, and have thus received a coating only of that metal. The practice of coating with Tin, vessels of Copper or Iron which are used in cooking, is a very useful one, as it prevents their being acted upon by the air, water, or acids. Tin is used in dyeing, and is essential in producing the finest scarlet and crimson colours in cloth. It amalgamates with Mercury, and thus furnishes the metallic coating to our looking-glasses: a knowledge of this fact alone will, we are sure, give the ladies a favourable opinion of the study of metals; but another fact, almost equally interesting, deserves mentioning, viz., that an artificial combination of Tin and Sulphur produces beautiful golden-coloured scales, much used by japanners upon tea-trays, as a paint. This is *Mosaic Gold,* and when polished it much resembles Gold in appearance.

Thus have been enumerated the principal properties of Tin, but we find others ascribed to it by Maplet, who shall again speak in his own words:—

"Aristotle sayth, in his fourth booke of Meteores, y[t] it is compound of Quicksilver indifferent good, but of very base brimstone, and therefore this kind of Mettall is nothing proporcionably mixt, but al out of square compound, for the which it looketh so raw, and hath Silver his verie colour, but not his goodnesse. Cardane saith, that Tin descrieth and reueleth if any poyson be hid, for both it hisseth and cracketh if it be so, and also showeth thin stripes in maner like to a bow. I have seene it my selfe when as this kinde of mettall being molten in the pit, and but a spoonefull of water being cast into, it hath floushed and leapt up to the top of the house: but a whole Potfull of Beere or Ale being cast in, it hath not once moued, but laughed by and by. The cause I may giue that Cardane doth, applying it to all mettalls, onely Golde excepted: for sayth he all other (onely Golde excepted) are fertile and fat. And being thus, laffe at their like, and refuse the residue. And thus much of Tin."

Sulphuret of Tin.

This ore of Tin, which, besides Tin and Sulphur, also contains some Copper and Iron, is only found in Cornwall. In colour it is a dull bronze, and in structure granular.

TUNGSTEN.

This metal occurs only in a state of oxide. It is of a yellow colour, and is found associated with Wolfram (Tungstate of Iron) in *Quartz*, at Lane's mine, Monroe county, United States; also in Cornwall. Tungstic acid in combination with Lime forms the Tungstate of that earth. This metal has not been put to any use.

TITANIUM.

Some of the minerals which contain this metal are exceedingly interesting; in all of these it exists as an oxide, never being found pure.

Anatase.

This is an oxide of Titanium, and occurs in very beautiful small crystals of an acute octohedral form. Their colour is steel-grey, or various shades of brown, and they are occasionally translucent. Before the blowpipe it forms with borax a dull yellow globule, which becomes white on cooling. At Oisans, in Dauphiny, it occurs in granite, accompanying *Felspar*, *Axinite*, *Rock crystal*, and *Chlorite*. In Brazil minute crystals are found partly imbedded in *Rock crystal*. It has also been found in Cornwall.

Titanite.

Although none of the forms of Oxide of Titanium can

47. Uranite.

45. Brookite.

46. Titanite.

48. Orpiment.

H. Sowerby, lith. F. Reeve, imp.

be said to be common, this is by far the most abundant of any of them. It occurs in four-sided crystals of considerable size in Spain, and in long acicular prisms imbedded in *Rock crystal* in Brazil. In Scotland the prisms are found intersecting Quartz, as shown in our figure (Plate XII. fig. 46). Its usual colour is reddish-brown, but at Tintagel, in Cornwall, it is found in fine hair-like fibres of a yellowish colour. Titanite is found in many parts of the United States.

Brookite,

So named in honour of the celebrated living mineralogist of that name, has not yet been analyzed, but may be considered a variety of Oxide of Titanium. Its best-known locality is Snowdon, in Wales, but it has also been brought from Dauphiny. At Snowdon it occurs in large tabular crystals of great beauty, usually translucent, and of a deep wine-red colour (Plate XII. fig. 45), but occasionally opake and iron-brown.

Crichtonite

Occurs in small shining black crystals of an acute rhomboidal form, having the summits replaced, and being otherwise modified. It has only been found on *Rock crystal*, near Oisans, in Dauphiny, and is an extremely rare mineral : it is named after Sir Alexander Crichton.

Sphene.

This is the last ore of Titanium we shall notice, although there are several others known. It occurs in crystals differing greatly in form, but all derived from an oblique rhombic prism. In colour, also, it is very variable, being sometimes grey, yellow, red, or brown, but that most usual is a shade of yellowish-green. It consists of Oxide of Titanium, Silex, and Lime.

Cerium is the metal that we find next in order, with the minerals in which it occurs, but these are not likely to interest the beginner in mineralogy, nor is he likely to possess them, owing to their rarity. Passing over these and the Columbiferous minerals, we introduce a metal which, though it has not been applied to any great uses, will always claim admiration on account of the extreme beauty of its Phosphate.

URANIUM.

THE Oxide and the Phosphate are the only ores of this metal that are known as minerals. With oxygen and a few other ingredients it forms a substance called *Pitch-blende*, or *Uran-ochre*, which is massive, black, and shining, and is found at Johanngeorgenstadt, in Saxony, and in Tin Croft mine, Cornwall, accompanying the following species.

URANITE.

This consists chiefly of Oxide of Uranium, Phosphate of Copper, and Phosphoric acid, and is therefore a Phosphate of Uranium. It occurs crystallized in the form of a square prism, which may be readily divided into thin laminæ.

At Autun, in Burgundy, Phosphate of Uranium occurs of a rich lemon-colour, and occasionally of a delicately pale yellowish-green, but specimens showing these tints are rare; the most beautiful, and at the same time the most common, varieties being found in Cornwall, and possessing a splendid green colour. In these specimens the Uranite sometimes occurs coating dark brown-coloured Quartz, with brilliant drusy crystallizations, sometimes in distinct crystals amongst yellowish-brown Iron-ore. At Gunnislake, in Cornwall, was formerly found a very interesting variety, peculiar to that locality, which, however, no longer produces it. Plate XII. fig. 47 exhibits the manner in which the broad square plates or laminæ composing the crystals are irregularly aggregated together.

CHROME

Is of more frequent occurrence combined with other metals, than as a distinct substance. Oxide of Chrome is, however, found in granular masses of a dull green colour, near Lyons, and forming veins of a bright green colour, in *Chromate of Iron*, at Unst, one of the Shetland Isles.

BISMUTH.

This metal is most commonly found in a native state.

Native Bismuth.

The primary form is an octohedron, but it very seldom has been found in that form, most usually occurring in masses of granular structure, the grains being sometimes very minute indeed; but sometimes, as in handsome specimens recently found in Cornwall, Native Bismuth occurs in broad laminæ, in which crystallized Quartz is imbedded. Saxony, Bohemia, France, and Sweden, also produce the native metal. It is of a silver-white colour, tinged with red, but, if exposed to the air, soon becomes tarnished. It readily alloys with other metals, whose fusibility is in some cases remarkably increased by the mixture. This metal is not very useful, but enters into the composition of some kinds of pewter, and printing-type. Some kinds of white paint are also derived from it, and it is occasionally used in medicine.

Sulphuret of Bismuth occurs generally in lead-grey needle-shaped crystals, and is found in Cornwall. The Oxide and Carbonate are rare.

ARSENIC

Is found in a native state, as an Oxide, and as a Sulphuret.

Native Arsenic.

This occurs in a botryoidal form, and when newly broken has a very brilliant lustre, but, by exposure to the air, assumes a dull black colour. Before the blowpipe it melts readily, burning with a blue flame and a dense white arsenical vapour, and leaving nothing behind but a minute portion of Iron. It occurs in Norway, in Bohemia, in the Hartz, and in America.

Its *Oxide*, an artificial preparation of which is sold in the shops, and so often proves fatal to human life, is rarely found in a natural state. It is of a bluish-white colour, and gives off the smell of garlic before the blowpipe.

The *Sulphuret* occurs of two colours, and has two different names. *Realgar* is the name of the bright-red variety, which occurs crystallized in a prismatic form, whose primary is a rhomboid. It is also found massive, associated with the following variety. *Orpiment*, a figure of which is given in Plate XII. fig. 48, is of a bright lemon-yellow colour, and occurs in masses of a broad foliated structure: it may be separated easily into exceedingly thin laminæ. The specimen figured came from Nagyag in Transylvania, but Orpiment is also found in China, Mexico, Hungary, and Piedmont. Its name is derived from the Greek, and signifies *gold-yellow*.

Although, combined with oxygen, this metal is a most deadly poison, yet when discreetly administered in small doses, it is a medicine of great value. The paint known as *King's-yellow* is a preparation from Arsenic, which is also used for colouring glass, and is alloyed with the Lead of which shot is manufactured. Pure metallic Arsenic has no deleterious effects upon human life. *Arsenic Acid* is a combination of the metal with a larger proportion of Oxygen than is contained in the ore termed *Oxide of Arsenic*; and the young mineralogist will not fail to observe that those minerals into whose composition this acid enters are generally remarkable for their beauty.

COBALT.

Several ores of this metal occur in a natural state, but it has never been found pure. Its most common occurrence is in combination with Arsenic.

Arsenical Cobalt.

Of this mineral there are several varieties. The first is termed *Bright White Cobalt,* whose crystalline forms exactly resemble those of Iron pyrites, but it differs in colour and in its behaviour before the blowpipe. It is found imbedded in *Copper pyrites* in Norway and Sweden. Its colour is yellowish-white, with a tinge of red, and its crystals are very brilliant. In both of these characters, and in the proportion of its composition, it differs from *Grey Cobalt,* which is of a greyish-black colour, and is never crystallized. *Tin-white Cobalt* is found accompanying the other ores of the metal: the principal of these are—

Arseniate of Cobalt,

which consists of Cobalt combined with Arsenic acid and water. It sometimes occurs in acicular diverging prisms of a crimson-red colour and translucent, and sometimes in an earthy or powdery form, and is termed *Cobalt Bloom*; this variety we have figured in Plate XIII. fig. 49: its colour is a pale rose-red, and it occurs on a brownish-coloured matrix, at Schneeberg, in Saxony.

Sulphate of Cobalt.

This consists of Oxide of Cobalt, Sulphuric Acid, and water. It occurs in crystalline translucent masses of a delicately pale rose-red colour.

All the ores of Cobalt, when before the blowpipe, tinge Borax with a blue colour. Its principal value to mankind consists in yielding a substance called zaffre, which is greatly used for colouring earthenware, staining glass, and other purposes. A paint known as *Cobalt blue,* and a very curious and beautiful sympathetic ink, are derived from it. "Characters written with this ink are perfectly invisible when cold, but, on gently warming the paper, appear of a fine blue or green, according to the purity of the metal employed. These, when cold, disappear again, and the experiment may be repeated as often as desirable, provided the paper be not too much heated. Landscapes, representing a winter scene, have been drawn on a fire-screen, and the leaves and grass, being drawn with this ink, were of course invisible, until the screen has been brought near the fire, when the barren trees have been immediately covered with verdure, as if by magic; the ground has become green, and the whole has assumed the appearance of spring." This ink is obtained by digesting *zaffre* for three or four hours in nitro-muriatic acid, by the application of a moderate degree of heat.

NICKEL.

This may be considered a rare metal in comparison with many others, a circumstance the less to be regretted as it possesses neither any great beauty to attract our admiration, nor any peculiar properties that might render it of great service to mankind. In a native state it occurs but sparingly.

Native Nickel

Is found in the form of flexible hair-like filaments, of a yellow colour, in Saxony, Bohemia, and the Hartz. In Cornwall it is found occupying the cavities in the following species.

Arsenical Nickel.

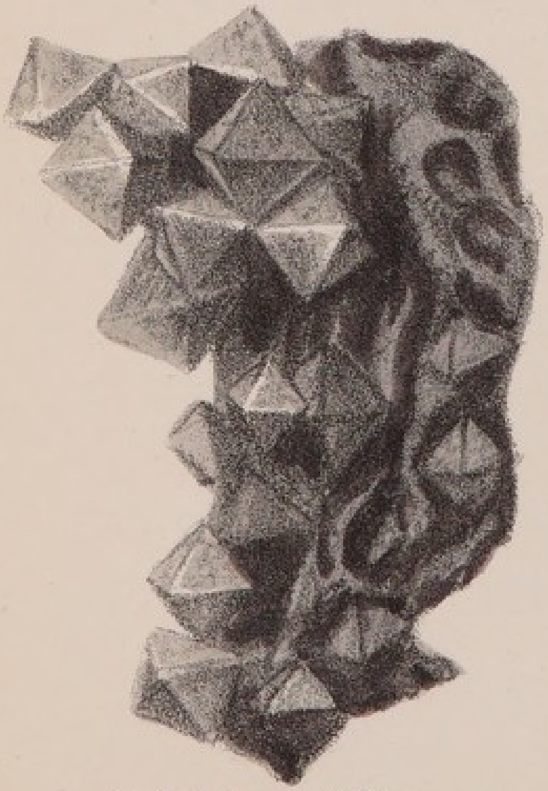
This consists principally of Arsenic and Nickel, as is implied by its name, but contains also Cobalt, Iron, Lead, and Sulphur, in small proportions. It sometimes occurs dentritic and botryoidal, but is generally massive, and in colour approaches copper- or yellowish-red. It is found in several European countries, and in America, but is most abundant in Cornwall. *Nickel-ochre* is of a pale green colour, and is found coating Arsenical Nickel, to the decomposition of which it owes its existence.

Pimelite is of an apple-green colour, and consists of Oxide of Nickel, Silex, and water, with the earths Alumine, Lime, and Magnesia in small proportions. It is found associated with *Chrysoprase,* whose green colour, we have before observed, is probably owing to the presence of Nickel.

Gold, Copper, Tin, and Arsenic are rendered brittle by being alloyed with Nickel, but its alloys with Silver and Iron are ductile. The most interesting circumstance connected with this metal is, that it almost invariably abounds in Meteoric Iron and Meteorites, of which we have already treated. It possesses the quality of retaining magnetism to a high degree, and has been employed to make magnetic needles, being less liable to rust than steel.

49. Cobalt bloom.

50. Native Silver.



52. Sulphuret of Silver.

51. Native Silver.

H. Sowerby, lith.

F. Reeve, imp.

SILVER.

"On Vermil beds in Idria's mighty caves
The living Silver rolls in ponderous waves.
With gay refractions bright Platina shines,
And studs with squandered stars his dusky mines;
Long threads of netted Gold, and silvery darts,
Inlay the Lazuli, and pierce the Quartz;—
Whence, roofed with Silver, beamed Peru of old,
And hapless Mexico was paved with Gold."—*Darwin.*

THERE is every reason to suppose that this metal was known at as early a period as Gold, for we find them both mentioned together in Scripture, as constituting part of Abraham's wealth. By the poets it is frequently alluded to as an object of comparison, particularly with the moon, whose soft and modest splendour has been aptly compared to the chaste lustre of the metal we are about to notice. For a reward of a few shekels of silver, Judas betrayed his Master, and we fear that this is not the only instance of villany being stimulated by the expectation of reward in the shape of one or other of the precious metals. We must not, however, condemn the metal because it may often have been applied to base purposes; on the contrary, its immense usefulness as a circulating medium, and for other purposes, entitles it to our admiration and respect,—sentiments that will certainly not vanish on our inspecting the beautiful and valuable series of specimens in the cases at the British Museum, or even such as we may have succeeded in adding to our own private collections.

Silver yields only to Gold in malleability, and possesses that property in so great a degree, that it may be beaten out into leaves 100,000th of an inch in thickness; and from a single grain a vessel may be made, capable of containing an ounce of water. In tenacity it far surpasses Gold: thus, a Silver wire, the tenth of an inch in diameter, will support, without breaking, a weight of 250 pounds; but a Gold wire of equal thickness will only bear a weight of 191 pounds. Silver is too soft in a pure state to be sufficiently durable for coinage, and is therefore always alloyed with some other metal; for which purpose Copper is used in the coinage of England, as also in articles of domestic use and ornament; in which the relative proportions of Silver and Copper used are about the same as in coin. Many articles are only plated with Silver, an account of which process we extract from a little work published by the Society for Promoting Christian Knowledge.—

"Copper, alloyed with brass, is cast into ingots, which are filed perfectly smooth on the face, or faces, to be silvered over. A silver plate, the thickness of which is regulated by that of the copper, is cut rather smaller than the face of the copper to which it is to be applied, and scraped perfectly smooth and clean. The two metals are then placed together, and firmly bound with wire, a saturated solution of borax being inserted round the edges, between the two faces. This substance, by fusing at a red heat, *runs*, and thus prevents the air from getting at, and oxidizing, the surface of the copper; an effect which would prevent the union of the two metals. The ingot, thus prepared, is put into a proper furnace, and heated till the partial fusion of the copper and silver causes them to unite by their two surfaces. When this takes place, the ingot is immediately withdrawn, and is ready for *rolling*." This process consists of pressure between two rollers, until it becomes a perfectly even, flat plate, the silver being spread over the whole of the surface of the Copper; and it is then ready to be manufactured into the various articles requiied.

A combination of Silver and Nitric acid forms Nitrate of Silver, better known as *Lunar caustic*, which is used by surgeons for burning away diseased portions of flesh, and, dissolved in gum-water, makes an indelible ink for marking linen. Two dangerous fulminating powders are also prepared from Silver.

Silver is most commonly found in a native state, but frequently occurs as a Sulphuret, and often combined with Antimony, Iron, Lead, and other metals; rarely with Carbonic or Muriatic Acid.

Native Silver

Occurs crystallized in the forms of the cube and octohedron, but more generally in filaments resembling wire, which are sometimes exceedingly thin and fine. These *wires* are either packed together closely, as in the Cornish specimens, or in small irregular bundles; or are separate, as shown in Plate XIII. fig. 50, which is taken from a specimen from Norway, lent to us by Mr. Wright. Another beautiful form is shown in Plate XIII. fig. 51, a portion of a large mass from Fürstenberg, in Saxony, which consists of branches having the general appearance shown in the figure; these branches and their branchlets being entirely composed of minute crystals piled one on the top of another. In this, as well as in the preceding variety, the Silver occurs imbedded in Calcareous spar, a very common matrix for Native Silver. Sometimes it is imbedded in *Jasper*, *Hornstone*, *Quartz*, and many other minerals, and occasionally it is found in very large masses weighing many hundreds of pounds.

The most magnificent crystallized specimens have been brought from Kongsberg, in Norway, and from Saxony, where mines of great extent are worked. Schemnitz in Hungary, Joachimsthal in Bohemia, Austria, Russia, Spain, Andreasberg in the Hartz, and many other localities, may be mentioned, as productive of large quantities of this metal;—China may be alluded to as being exceedingly rich in it, in proof of which we may call to mind the immense sum paid by the Chinese to England in silver on a late occasion. As our space will not permit us to mention all its other localities, we shall confine ourselves to America, which is, without question, that quarter of the world producing the greatest quantity of silver. In Peru, near the source of the River Plata, stands a mountain, which is six leagues in circumference at its base, in height 4,200 feet, and in form resembling a sugar-loaf. This mountain is filled all through with the richest veins of Silver ore, and the passages or galleries which perforate it in every direction are the celebrated mines of Potosi. The whole mountain, indeed, may be said to consist of Silver, for if a tuft of grass be pulled from its surface, filaments of Silver are found amongst its roots: had it not been so prolific, its wealth might never have been discovered. "The mountain is now completely excavated. It is perforated by above three hundred pits, few of which, however, exceed seventy yards in depth. At the base are numerous galleries, called *socabons*, six feet high and eight broad. In these places the air is cold and unwholesome, yet the Indian miners who work in them, alternately night and day, are entirely naked, to prevent the possibility of embezzlement." But the ore now produced by these mines has, since its discovery, materially decreased in richness, and the Mexican mines are now most profitable. These are about 3,000 in number, the largest being one in the Andes, which consists of a vein of silver some 300 miles in length. By far the greater portion of Silver obtained in England is procured from *Galena*, or Sulphuret of Lead, which sometimes contains as much as seventy ounces of Silver in a ton of Lead ore. This can be profitably worked if it contain only six or seven ounces, but less than that proportion would not repay the expenses of working. In conclusion, we may state that whilst the annual supply from all the European Silver mines amounts to about £564,600, the American mines furnish Silver annually to the amount of £7,241,000.

ANTIMONIAL SILVER.

This ore generally contains more than three parts of Silver to one of Antimony. It is usually granular, and in colour between silver- and tin-white. Before the blowpipe the Antimony is driven off in the form of a white vapour, and a bead of pure Silver remains. It is found in the Hartz, in Spain, in Salzburg, and in France, but is a rare substance.

Still more rare is *Telluric Silver,* which occurs in coarse grained masses of a lead-grey colour, and is found only in the Silver mines of Savodinski in the Altai mountains, Siberia. The young mineralogist is not likely to meet with a specimen of this substance, and if he does, he may be sure a long price will be demanded for it; we should not, therefore, have mentioned it, but that it is the only instance of a combination of Silver with the scarce metal *Tellurium.*

SULPHURET OF SILVER.

This ore of Silver is of a dark lead-grey colour, often nearly black, and is so soft that it may be readily cut with a knife. It occurs crystallized in cubes (its primary form), octohedrons, and rhombic dodecahedrons; it is also found massive, arborescent, and capillary. The specimen figured (Plate XIII. fig. 52) shows the octohedral form of crystallization very distinctly, and much more so than is generally observed. The planes of the crystals are rough, with a slight metallic lustre. Sulphuret of Silver is found in *Gneiss* at Freyberg in Saxony; in *Mica-slate* at Joachimsthal in Bohemia; and in *Greywacke* in the Hartz: but the Mexican mines produce it in the greatest abundance. A variety, said to contain some Iron, and found only in Hungary and Saxony, is termed *Flexible Sulphuret of Silver*, from its possessing that quality when in thin laminæ. Another variety, containing Antimony, Iron, and Copper, is known as *Brittle Sulphuret of Silver.*

RED SILVER.

Of this, the most beautiful of all the ores of Silver, there are two distinct varieties. One is of a dark red colour, and consists of Silver, Antimony, and Sulphur; the other is of a light crimson-red colour. They both vary in their degree of translucency, some specimens, when held up to the light, exhibiting the richest wine-red colour; others being nearly opake. Both varieties assume a great number of crystalline forms, all of which are derived from an obtuse rhomboid. In the case of this mineral the character alluded to in a former portion of this work as the *streak*, will be found a useful one to distinguish it from some varieties of *Realgar*, to which it bears a resemblance; the streak of the former being different shades of cochineal-red, while that of the latter is yellow.

The light red variety occurs chiefly in the Saxon and Bohemian mines, whilst the dark red is produced by Hungary, Spain, Norway, France, and particularly Andreasberg in the Hartz, where it occurs with *Calcareous spar*, *Native Arsenic*, and *Galena*.

The remaining ores of Silver, such as *Bismuthic Silver*, the *Seleniuret*, the *Muriate*, and the *Carbonate*, are comparatively rare, and to those we shall not further allude, with one exception, viz.,

Muriate of Silver.

This occurs massive, and rarely crystallized in cubes and acicular prisms. It is generally of a brown colour and waxy lustre, and is so soft as to yield easily to the nail. It occurs with some of the other ores of Silver in Saxony, Hungary, and Siberia, and has also been found in Cornwall, but is most abundant in the mines of Potosi.

COPPER.

With the exception of Iron, no metal occupies so prominent a position with reference to its extensive usefulness to mankind, as Copper, although it is not, like Gold and Silver, honoured with the appellation of a *precious* metal: it is also one of the most abundant of metals. When pure it is of a reddish-brown colour, a hue which belongs to no other metal except Titanium. It is very malleable and ductile, and possesses greater tenacity than any metal excepting Iron. But for most of the purposes for which Copper is available, it is used in the state of alloy with other metals, its combination with which sometimes effects the most remarkable changes;—for instance, alloyed with Tin it forms *Bell-metal.* Now, though both Copper and Tin are ductile metals, yet when mixed together the compound is extremely brittle, and possesses no ductility whatever. A brief allusion to some of the uses of Copper will not be without interest to the young mineralogist, who, like all other mortals, must constantly be either using or deriving benefit from it or some of its compounds. Copper-sheathing to the bottoms of vessels secures the wood from the destructive attacks of the sea-worms (*Teredo navalis*). Large boilers for brewing, for sugar-works, &c., domestic articles, such as kettles and coal-scuttles, are all constructed of Copper comparatively in a pure state; as also plates for engraving on. *Brass* (a mixture of Copper and Zinc) is one of its most important alloys: this is more easily fusible than copper, more ductile, and equally malleable; and from it are manufactured astronomical and philosophical instruments, machinery, cannon, wire, and pins: and we may here observe that the greater part of the metal used in decorating theatres and other public places is *not* gold-leaf, but merely a kind of brass beaten out into thin leaves, which have a great resemblance to gold, and are known as *Dutch gold.* Pewter pots are made of a compound of Copper and Lead. But the most interesting of all the alloys of Copper is that from which church bells are manufactured. This is composed of three parts of Copper to one of Tin, with the addition of proportions of Zinc, Antimony, and Silver, which improve the sonorousness of the compound. Who has not felt, when the sound of the bell tolling afar off has caught his ear, that it possesses a kind of attraction, difficult to resist, towards the building erected for public worship? Who has not felt himself reproached, by its truly solemn sound, for his carelessness of those interests which are eternal, in comparison with those of an earthly nature? But our space is too short for moralizing. The process of casting a bell is highly instructive, and is described in so many works, that it is needless here to repeat it, but we must beg our readers, if they have not already done so, to read Schiller's noble poem on the subject, as a treat of no ordinary kind. From a translation of that poem we shall offer an extract, previous to noticing the modes of occurrence of Copper and the combinations which it forms in a natural state.

"Fast immured, with clay well fashioned,
Stands the mould in earthy cell;
Comrades, soon our toil is ended,
For to-day we cast the bell.
Soon our foreheads o'er
Must the heat-dews pour:
Praise be to the workmen given,
But the blessing comes from Heaven.
* * * *
Take the pine-tree's driest branches,
See the flame be fierce and good,—
Ere the furnace can be heated
It must feel the burning wood.

Throw the Copper in,—stir it with the Tin:
Let them be in measured masses,
For each into the other passes.
The work which with metallic power
  Deep in the silent earth we frame,
Shall, from the belfry's loftiest tower,
  In accents loud our art proclaim;
To distant lands, to men unborn,
  Shall raise its deep majestic voice,—
Shall with the troubled spirit mourn,
  And with the joyful heart rejoice."

Native Copper

Occurs crystallized in the forms of the cube and octohedron, but these are generally so modified, or irregularly shaped, that neither of them can easily be distinguished. The crystals are generally aggregated together in branches formed by their union, much after the manner of Native Silver. Sometimes it occurs in flattened dentritic layers, sometimes in a wiry form, and occasionally massive. The most splendid crystallized specimens of Native Copper are found in Siberia, where it also occurs massive, imbedded in *Chrysocolle.* It is also common in the South American mines, where masses many hundred pounds in weight have been found. In North America it has not been worked with much success, although there is no doubt that it exists there in abundance, many detached masses of considerable size having been met with. One of these, weighing between three and four thousand pounds, and measuring four and a half feet in length and about two feet thick, was brought from the Ontonagon river, near Lake Superior, and is now deposited in the museum of the National Institute at Washington. But no country can vie with our own in the production of Native Copper. In 1768 a mine was discovered in the northern part of Anglesea from which such vast quantities of the metal were raised as to have had a great effect in lowering the market price. In Ireland small quantities are found, as also in Lancashire, Westmoreland, Cumberland, and other parts of England; but the great Copper deposits are in Cornwall and Devonshire. Many of these mines are remarkable for their romantic situations, particularly the Botallack mine, "the entrance to which is in the rock, immediately overhanging the sea, and the works are carried many hundred feet under the bed of the ocean! The roar of the waves during storms can be heard in the galleries beneath, producing a most appalling effect." The most extensive mines in Cornwall are the Consolidated Mines, near Redruth. From one of these the specimen figured in Plate XIV. fig. 53 was disentombed.

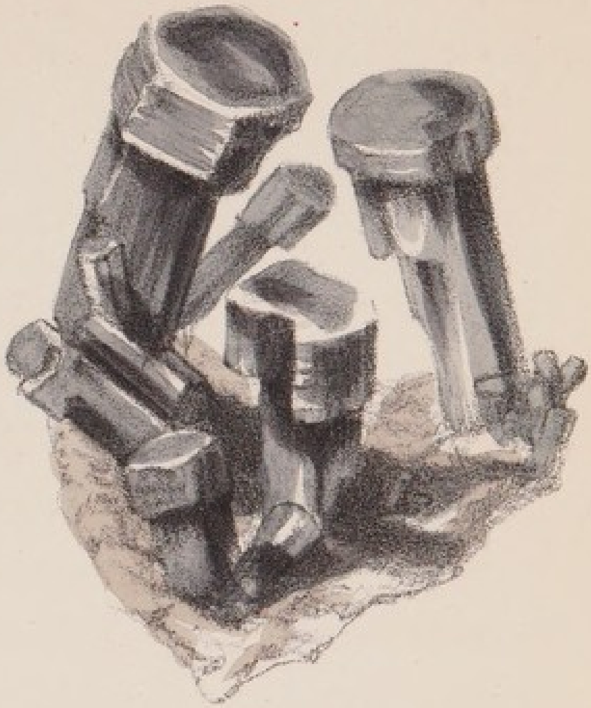
Vitreous Copper.

This is a Sulphuret of Copper, containing also small proportions of Iron and Silex. In colour it is of various shades of lead or iron-grey, and in lustre presents a good illustration of that termed *vitreous*. The primary form is a six-sided prism, which is the general form it assumes: the crystals are often extremely perfect in their figure, but are also frequently irregular, as is shown in our figure, Plate XIV. fig. 54 (erroneously called *Grey Copper* on the plate). In this interesting specimen, which is from North America, the long prisms are surmounted by flat prisms of larger diameter. The finest specimens are found in Cornwall and in North America, but it occurs massive in almost all Copper mines. This ore is highly prized by the miner.

Buntkupfererz.

The ingredients of this substance are the same as of the preceding, but in different proportions. It is found both massive and crystallized, in the general form of the cube. It is of variegated colours, purple and green being the most

53. Native Copper.



54. Grey Copper.

56. Ruby Copper.

55. Copper pyrites.

H. Sowerby, lith.

F. Reeve, imp.

prevailing. The best specimens of this, as of most Copper ores, are found in Cornwall, but handsome specimens are found in Siberia, where it occurs imbedded in a pale silvery-green *Mica*.

Grey Copper.

This mineral, better known, perhaps, as *Fahlerz,* consists principally of the Sulphurets of Copper and Antimony. It occurs in brilliantly modified tetrahedral crystals of a grey colour at Freyberg in Saxony, at Andreasberg in the Hartz, and other foreign localities, but the largest crystals are found in some of the Cornish mines near St. Austle; these usually have a dull and rough exterior.

Copper Pyrites

Is the most abundant of all the ores of Copper. It consists of the Sulphurets of Copper and Iron in nearly equal proportions. In colour it is brass-yellow, but it frequently presents the most gorgeous play of iridescent hues. From Iron pyrites, which it resembles, it may be distinguished by its inferior hardness, yielding readily to the knife. Its primary form is an acute octohedron, but more frequently it crystallizes in the form of a tetrahedron, as exhibited in

Plate XIV. fig. 55, where two crystals are seen nestling, as it were, amongst crystallized *Carbonate of Iron*. Our specimen is from Cornwall, where this ore is so plentiful that a large proportion of all the Copper is obtained from it.

Ruby Copper.

This beautiful ore consists of Copper and Oxygen, containing about eight parts of the metal to one part of oxygen. Its colour is red of various shades, and its most usual form is the octohedron, but occasionally the cube. Sometimes it occurs in fine capillary filaments of a bright crimson colour, imbedded in massive Quartz : Plate XIV. fig. 56 is a specimen of this variety from Cornwall, which locality yields the largest quantity of Oxide of Copper: it is often found there in extremely brilliant and minute crystallizations associated with Native Copper. At Chessy, near Lyons, fine isolated crystals of dodecahedral and octohedral forms are found imbedded in *Lithomarge*, and these are generally coated by green *Carbonate of Copper*. The Bannat, Siberia, and Cuba produce very fine specimens; and some have been found in the United States.

57. Malachite.

58. Carbonate of Copper.

59. Arseniate of Copper.

60. Native Gold.

H. Sowerby, lith.

F. Reeve, imp.

Carbonate of Copper.

There are two distinct varieties of this species, both containing the same ingredients, viz., Oxide of Copper, Carbonic acid, and water, but in slightly different proportions; these are the green carbonate and the blue carbonate, which differ principally in colour.

Blue Carbonate of Copper occurs crystallized in a great variety of forms, the primary being an oblique rhombic prism: less frequently it occurs mammillated, stalactitic, botryoidal, or massive. The crystallized specimens are of the richest blue tint, and are translucent. At Chessy, near Lyons, have been found the most splendid groups of crystals, sometimes imbedded in *Carbonate of Magnesia*, and presenting a truly handsome effect. The botryoidal variety is usually of a deep indigo-blue internally, but externally of a light blue colour and velvety appearance (Plate XV. fig. 58). In Siberia and in the Bannat are found large and very distinctly formed crystals of the primary form; Cuba also produces good specimens, but in Cornwall, or, indeed, in any part of England, it is rare; and it has been found but sparingly in the United States.

Green Carbonate of Copper, or *Malachite*, is also a very handsome mineral. It occasionally occurs crystallized in minute slender prisms, but generally is massive and fibrous. It is so well known in ornamental work, as to need but little description, particularly as our representation of a polished slab from South Australia (Plate XV. fig. 57) gives a fair notion of its general appearance and colour. Siberia and the Bannat have long been known as the localities whence the noble specimens, some of which have even served as the tops of tables, are derived, but those discovered in South Australia, and which the 'Burra Burra' mines mainly contain, bid fair to rival them in size, if not in beauty.

Chrysocolle is a variety of Carbonate of Copper, containing some Silex. It occurs massive and botryoidal, and is of different shades of green.

Dioptase

Occurs in crystals of the most beautiful emerald-green colour, accompanied by *Calc-spar*, only in the Kirghese Steppes of Siberia. Its primary form is an obtuse rhomboid, but it always assumes a well-defined dodecahedral form.

Copper is also found combined with *Sulphuric acid*, forming *Blue vitriol*, which is principally derived from the natural or artificial decomposition of Copper pyrites (in the same way as *Green vitriol* is derived from Iron pyrites), and is used in printing cotton, and in dyeing;—with *Muriatic acid,* forming *Muriate of Copper,* which generally occurs in an arenaceous form, of a dark green colour, and a portion of which, being placed in the flame of a candle, tinges it with a bright green or blue colour;—with *Phosphoric acid,* forming *Phosphate of Copper,* a dark green crystallized or massive substance of rare occurrence;—and with *Arsenic acid,* producing the many beautiful varieties of

Arseniate of Copper.

The varieties of this mineral differ slightly in their composition, but very considerably in colour, in form, and in general appearance. One of the most beautiful is that termed *Copper Mica*: this is of a bright green colour, and occurs in six-sided crystals composed of thin, transparent laminæ. Another is of a bright blue colour, and occurs in obtuse octohedral crystals, which are generally elongated in one direction. *Olivinerz* is of a dark olive-green colour, and occurs in very distinct prisms about a quarter of an inch in length, or in acicular prisms grouped together in a botryoidal form. The variety we have figured (Plate XV. fig. 59) occurs in veins of a fibrous structure, and is of a brownish-green colour. One variety is of a pale greenish-white colour, and amorphous. But the most beautiful of all occurs in long slender prisms, of a light olive-green colour, grouped together in the most interesting manner. Concerning all these, the general observation must be made, that they consist mainly of Copper and Arsenic acid, and that they are found only in the mines of Cornwall: the variety called *Olivinerz* has, however, been seen in Cumberland.

Many other distinct substances are known as ores of Copper, but the learner must consult other works for descriptions of them, so soon as he is acquainted with all that we have noticed. To conclude with a caution:—if any of our young friends should visit Cornwall, let them be on their guard against *artificially made-up* specimens of minerals, for such are not uncommon.

GOLD.

> "What is here?
> Gold! yellow, glittering, precious Gold! No, gods,
> I am no idle votarist. Roots, you clear heavens!
> Thus much of this will make black, white; foul, fair;
> Wrong, right; base, noble; old, young; coward, valiant."
>
> *Timon of Athens.*

SHAKESPEARE certainly has not over-rated the powers of this king of metals; its extreme ductility and durability, combined with its solid beauty, having, from time immemorial, given to it the superiority over all others: and, considering the great influence exercised by it upon the destinies of man, whether regarded as the 'sinews of war,' as the capital of the merchant, or as the circulating medium between all civilized countries, its claims to the sovereignty will scarcely be denied. The extensive use of this metal wherever gorgeous ornament is required, as well as in the simplest designs of art,—from the glittering crown of an emperor to the neat little wedding-ring of the village-maid,—imparts to Gold an interest in our eyes that other metals have failed to acquire. Further, despite our laudable detestation of 'filthy lucre,' it must be confessed that there is something decidedly pleasing to the senses in the jingling sound of a purse well stored with Gold, the attainment of which is a very general desire amongst mankind. This fact is well illustrated by the immense number of individuals of all nations who were attracted to California immediately it became known that Gold was found there in great abundance. They heeded not the dangers to be encountered, the privations to be endured, nor gave a single thought to the possibility of being robbed of their Gold when they had accumulated it, but, forsaking parents, wives, families, and homes, rushed madly to 'El Dorado,' in the expectation of the golden age having at length arrived. Poor simple folks! they forgot that Gold will not satisfy the cravings of hunger, when no provisions are to be had,—they did not calculate how many ounces of Gold would be demanded for a loaf of bread, or for a night's lodging under a miserable tent:—in effect, that all the Gold that resulted from their severe toil would no more than suffice to buy their necessary provisions. We allude particularly to the first settlers, for we believe that many have since been more fortunate, and realized considerable wealth in the Californian regions.

"But scarce observed, the knowing and the bold
Fall in the general massacre for Gold.
Wide-wasting pest! that rages unconfined,
And crowds with crimes the records of mankind.
For Gold his sword the hireling ruffian draws;
For Gold the hireling judge distorts the laws.
Wealth heaped on wealth, nor truth nor safety buys,
The dangers thicken as the treasures rise."

In order to give some idea of the amazing degree in which Gold possesses the properties of malleability and ductility, we will glance at the processes by which it is made into gold-leaf and wire. In the first case, a quantity of Gold is melted in a crucible with some borax, and poured into an iron mould, previously heated and greased. The bar of Gold thus obtained is then made red-hot, and forged on an anvil into a long plate, which is further extended by being passed between steel rollers, until it becomes a ribbon as thin as paper. This is divided into pieces which are again forged until they are an inch square, and about the 766th part of an inch in thickness. These pieces are laid between slips of parchment, and, being bound down tightly together, are subjected to beating with a heavy hammer. They are then again divided and beaten between *gold-beater's skin* (ox-gut), and this process is repeated several times, until the thickness of the leaf is the 282,000th part of an inch! Twenty-five pieces of this leaf are then placed in a book about four inches square, which is sold for the sum of eighteenpence. The gold used for this purpose is alloyed with Copper in order to harden it. To make gold wire, an ingot of silver superficially gilt, about an inch thick and two feet long, is drawn by a machine, successively through holes that gradually diminish in size, till it becomes no larger than the hair of the head. The Gold with which the ingot of Silver was covered must now have been stretched to a wonderful degree of fineness, yet it still holds firmly together, and never shows the least signs of the Silver underneath. A single grain of Gold thus extended will be 345 feet long, presenting a surface equal to 98 square inches.

Gold combines with most other metals, but has the strongest affinity for Mercury: the gilders of metals avail themselves of this property by forming an amalgam with those two metals, which they spread on the pieces to be gilt; they then expose them to a certain degree of heat, which evaporates the Mercury, and leaves the Gold behind: in this manner the brass plates and wheels which compose the inside of a watch, are gilt. But though a violet-coloured powder, which is Oxide of Gold, has been obtained by subjecting it to great heat under a burning lens, Gold has very little affinity for oxygen: hence it does not rust when exposed to the air, and it may be melted over and over again without losing any of its weight.

Let us now observe Gold in its native state, ere yet the art of man has stamped upon its face the image of his rulers,—ere yet its vast influence for good or evil has been exercised upon our commerce or our happiness,—ere yet its virgin purity has been sullied by the rough handling of man, and by the scenes of wealth, splendour, misery, and crime in which its future destiny is to bear so conspicuous a part.

Native Gold

Occurs crystallized in cubes and octohedrons, which are generally modified: but more commonly it is found foliated, capillary, or, more commonly still, in rolled masses and grains of different sizes. Its colour is yellow, of various shades, sometimes verging even on grey; this difference arises from the nature and quantity of the metal with which it may be combined,—that of a *gold-yellow* being the purest, the brass-yellow being mixed with Silver, and the greyish with Platina. It is not affected by the acids generally, but a mixture of the nitric and muriatic acids readily dissolves it. The specimen of the foliated variety figured (Plate XV. fig. 60) is from Transylvania.

Its principal European localities are Hungary, the Bannat, and Transylvania. In the first of these, it occurs in veins of great extent, being in some parts a hundred and twenty feet thick; and both there and in Transylvania the rivers are rich in Gold sand. Germany, France, and Spain produce some Gold, but are not rich in that metal. Gold has been found in Cornwall, in grains mixed with the *Stream-Tin*; in Devonshire, in a matrix of brown Iron ore; also in small quantities at the Lead hills in Scotland. At Wicklow, in Ireland, a great quantity was found by the country-people in a stream which runs over rocks of clay-slate. It has been calculated that at least £10,000 of Gold was collected in this way before the works were taken possession of by the Government; but when they were, the total quantity collected did not repay the cost of the workings and the various trials made in search of the original deposit. Russia produces Gold in vast abundance, and it sometimes occurs there in very large masses; the largest on record was found on the eastern side of the Ural mountains, and weighed about eighty English pounds. Gold also occurs in several parts of India. The commerce in Gold-dust extends almost all over Africa, and in its northern parts it is said that the Russians have lately discovered mountains of Gold-dust, far exceeding the asserted production of California. Some are of opinion that the country of *Ophir*, whence Solomon obtained Gold, was situated on the southern coast of Africa. But America must certainly be considered the gold-producing quarter of the world. In Peru, Bolivia, and Chili, it is found both in veins of *Quartz* (its most usual matrix everywhere), and in alluvial soil. Miers gives the following information concerning the Chilian mines and miners. "The Chileno miners are very expert in following the course of a vein, though entirely ignorant of any rule that they can explain; it, however, frequently happens that they are mistaken in their ideas, and in consequence many miners are ruined by their speculations. For the greater convenience and saving of labour, the galleries are generally opened in the sides of the hills. These passages are seldom more than four feet in height and the same in width, so that it requires the labourer to carry his load with his back and knees nearly doubled; in some places they are so contracted that he can scarcely crawl among them.

The Chilenos, however, who from their infancy are accustomed to sit upon their hams, acquire by this means a remarkable suppleness in their hip and knee joints, which qualifies them for crawling through these passages."

We shall now allude to California; which is not, however, the only locality in North America whence the precious metal has been obtained, for in North and South Carolina, Virginia, Tennessee, Georgia, and Alabama, it was found in some abundance long before the discovery of the riches of California. In the first place, there is no reason to doubt that Gold is found there in immense abundance,—a fact sufficiently demonstrated by the large importations of it that are continually arriving in the United States and in England, and sufficiently authenticated by official reports. It is mostly found in grains and masses in alluvial soil, and some of these masses are said to be of very large size; we have seen one in the possession of a friend, the intrinsic value of which was thirty-five guineas. The larger of these masses are generally associated with Quartz, showing that to be the substance in which they were originally imbedded; indeed, these original deposits have been discovered in several places, and Gold in rich lumps has been obtained from them. But by far the larger quantity of Gold is extracted from the beds of water-courses, by washing, in the following manner. With a tin bowl or basin in his hand, the gold-seeker walks out some little distance into the stream, and then takes up into his bowl a quantity of the sand and loose stones from the bottom. Holding the bowl an inch or two under water with one hand, the other is employed in stirring up its contents, and occasionally throwing off the loose stones, whilst the running water carries away the lighter earth. A quantity of black sand, intermingled with particles of Gold, remains; this is spread on a handkerchief to dry, and the sand being then blown off, the pure grains of Gold remain. But some of the adventurers are not satisfied with this primitive way of collecting, and use a machine fashioned like a cradle. This consists of a kind of trough about six or eight feet long, open at the foot, and placed on rockers. It requires four men to work this machine: whilst one digs the ground in the bank close by the stream, another carries the produce, and empties it into the cradle, a third gives a rocking motion to it, while the fourth man dashes water upon it. There is a sieve placed inside, so as to prevent the coarse stones from entering; the water washes off the earthy matter, and the gravel is carried out at the foot of the machine, leaving the black sand and Gold at the bottom. Thus Gold, like infant beauty, is rocked out of its primitive state into the world, the one to pamper pride, the other eventually to feed the worm. To all who contemplate emigrating to these auriferous regions, we would say, *Go,*—not to *dig for gold* in the rocks or the streams, but to *earn* it by the exercise of your trade or your calling. Labour of all kinds is sure to produce a competency in that country. The carpenter, the smith, the shoemaker, and the tailor, are sure to thrive in California.

> "So shall you gain the Gold without alloy,—
> Without oppression or the treacherous snares:
> So shall you know its use,—its powers employ,
> And yet avoid its dangers and its cares."

Gold sometimes occurs combined with *Tellurium* and with *Iron pyrites,* which thence are termed auriferous. The *Micaceous Iron* from Brazil is said by Alger to contain minute compressed laminæ of Native Gold. *Electrum* is a pale-coloured variety of Gold, containing a great proportion of Silver.

PLATINA.

This rare metal is in colour steel-grey, and is only found in irregular masses and grains. It always contains some admixture of other metals, such as Iron, Rhodium, Palladium, and others: when alloyed with Iron, it possesses magnetic properties. It is one of the most infusible of all metals, and is therefore valuable in certain chemical operations; and wire made of it is used to hold specimens whilst under the influence of the blowpipe. It was first discovered in Jamaica, in 1741, but is chiefly found in the Ural Mountains, in Siberia, where it accompanies grains of Gold and the still rarer metals which follow.

PALLADIUM

Bears a great resemblance to the preceding, and occurs in grains intermixed with it. Its grains are of a fibrous structure. Before the blowpipe it is infusible, but, with the addition of Sulphur, melts with ease.

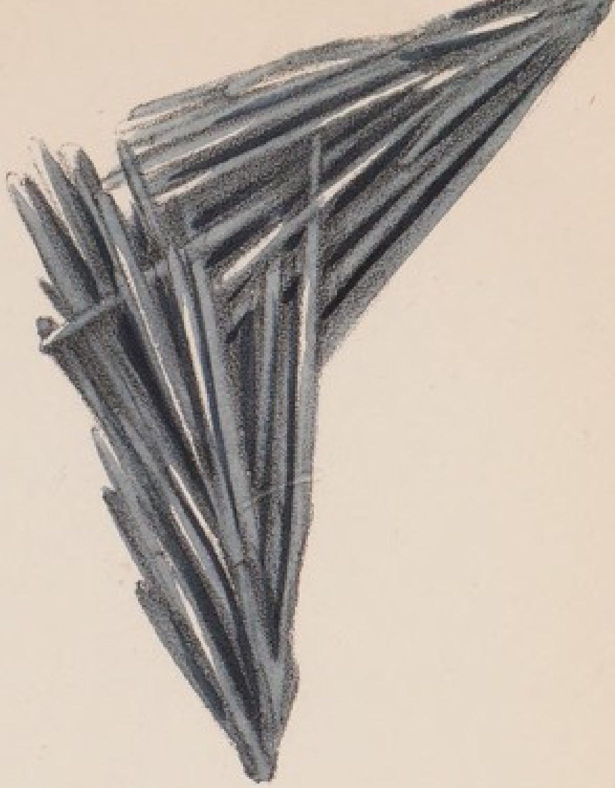
IRIDIUM AND OSMIUM.

These metals are generally alloyed together in grains, mixed with those of Platina. Iridium is chiefly remarkable for being heavier than Platina, and therefore the heaviest of all known bodies.

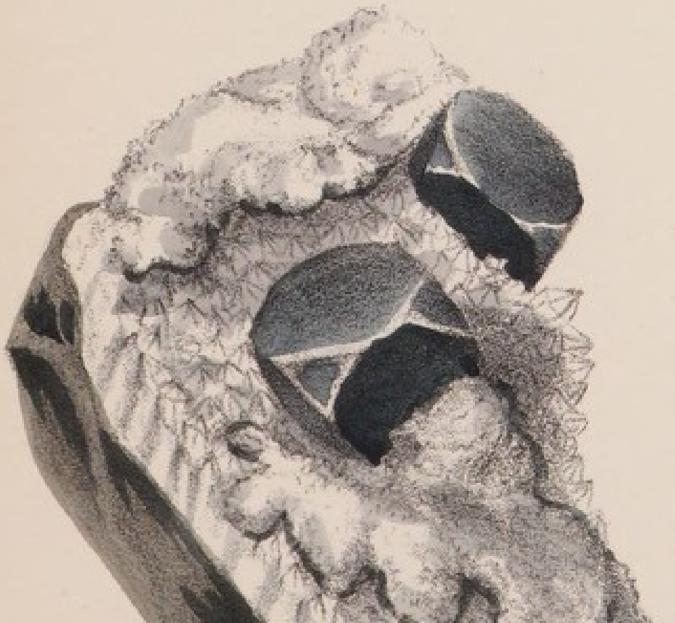
TELLURIUM.

This metal occurs native, but is generally alloyed by Gold, Silver, Lead, and other metals. Its alloys have several different names. *Graphic Tellurium* is of a grey colour, sometimes with a gold-coloured tarnish, and occurs in thin acicular prisms, arranged, sometimes singly, sometimes in rows, or crossing each other, bearing some resemblance to graphic delineations (Plate XVI. fig. 61). *Yellow Tellurium* is of a brass-yellow colour, and occurs in small but well-defined crystals at Nagyag, in Transylvania, with

61. Graphic Tellurium.



62. Sulphuret of Antimony.



63. Galena.

64. Minium.

H. Sowerby, lith. F. Reeve, imp.

the other ores of the metal in veins of porphyry. *Black Tellurium* is a combination of Tellurium with Gold, Lead, and Sulphur. It is found in small tabular crystals, and in foliated masses, often accompanying *Rose Manganese*, in Transylvania. Its colour is dark lead-grey. In thin laminæ it is highly flexible, but not elastic.

ANTIMONY.

The uses of Antimony, though not very numerous, are yet considerable, particularly in medicine, and in the manufacture of fire-works. Its alloys with other metals are also of service, that with Lead forming the plates on which music is engraved,—that with Tin, a kind of pewter,—and that with Lead and Copper, the type used in printing. By the Eastern women, preparations of Antimony are used for staining the eyelids, which is a custom of very ancient date. Antimony is found in a native state, and combined with Sulphur and with oxygen.

Native Antimony.

When newly broken, this is of a tin-white colour of extreme brilliancy, but by exposure becomes tarnished. It is never found crystallized, but occurs granular, in veins traversing *Gneiss*, at Dauphiné, and at Andreasberg, in the Hartz. It is also found at Allemont, in France, where it is generally accompanied by *Antimony-ochre*.

Sulphuret of Antimony.

This, the most common ore of the metal under consideration, is simply a combination of it with Sulphur. It is of a light lead-grey colour, and generally occurs in long slender prisms grouped divergingly together. These groups sometimes meet each other at the extremities, as shown in our figure (Plate XVI. fig. 62). The crystals, particularly in specimens from Hungary, which sometimes contain Native Gold, are often of very considerable size, and when split open, the fresh surfaces present very tolerable *natural looking-glasses*. Hungary is its principal locality, but it is exported in immense quantities from Borneo, and is also found at St. Gothard. A massive variety, of fibrous structure, is found in Cornwall, and is known as *Jamesonite*. The *Federerz*, or *Feather-ore*, of the Germans, is a variety which occurs in fine capillary crystals, which are flexible, and are packed together so as greatly to resemble a cobweb. It is usually found occupying the cavities of *Quartz*, at Freyberg, and in the Hartz.

Red Antimony.

This consists of Antimony, Sulphur, and oxygen. It generally occurs in acicular groups of crystals of a dark crimson colour, accompanying the other ores of the metal. A variety termed *Tinder-ore* consists of fine fibres so closely interlaced as to resemble tinder.

Oxide of Antimony

Is of a snow-white colour, sometimes with a tinge of pink or yellow. It occurs in acicular diverging groups on the other ores, in Bohemia, Saxony, and Dauphiné, but is a very rare substance. *Antimony-ochre* is a combination of Antimony, oxygen, and water, and occurs in earthy masses of a brownish or yellow colour; principally with *Jamesonite* in Cornwall.

LEAD.

Lead is certainly one of the most abundant of metals, and at the same time one of the most useful. It is one of the seven metals known to the ancients. It is lighter than Gold and Mercury, but heavier than Iron and Copper, which may easily be seen by dropping pieces of those metals into melted lead, when the gold will sink to the bottom, but the copper and iron will float like corks upon the surface. It is malleable, and may be beaten into thin plates, which are used for roofing, but its ductility and tenacity are very small, and a leaden wire would support but a moderate weight without breaking. By exposing thin leaves of lead to the fumes of vinegar, an oxide of lead is formed, which is known amongst house-painters and others as *white lead,* and is largely used by them. By other processes are formed the yellow oxide called *Massicot,* and the red oxide called *Minium*: this last is also found in a natural state. A solution of Lead in acids (*Sugar of Lead*) is used to give a sweet taste to wines and to cyder,—a most pernicious practice, all the preparations of lead being highly poisonous, as painters and the workmen in white lead mills know by sad experience. Lead is said to have been found in a native state, but it is certainly of very rare occurrence. It occurs combined with many of the acids.

Galena.

This combination of Lead with Sulphur (*Sulphuret of Lead*) is the ore from which the greater proportion of the lead of commerce is derived; and often contains Silver in sufficient quantities to render it worth while to work it for that metal. Galena very commonly occurs crystallized in cubes and octohedrons, but more generally in a combination of those two forms, viz., cubo-octohedrons; this form is shown in our figure (Plate XVI. fig. 63), in which two crystals are represented upon crystallized Quartz. Its colour is lead-grey, and it generally shows a brilliant lustre, particularly when broken. Crystals of the largest dimensions have been found at Alston Moor, in Cumberland, where, and in Derbyshire, Galena occurs in the richest repositories. Several parts of Scotland, particularly the Lead Hills, produce it in abundance, and in these as well as in most of the English localities it occurs in veins, accompanied by *Calc-spar, Fluor spar, Blende, Pearl spar,* and other minerals.

Alger observes that probably the richest Lead mines in the world are those in the western section of the United States: these produce large quantities of Galena, which in some instances is found encrusting the roof, sides, and floor of large caves. When Galena is acted upon by the blowpipe, the Sulphur is driven off, though with some difficulty, and a bead of pure Lead remains.

Native Minium.

This is supposed to be an Oxide of Lead, and to arise from the decomposition of *Galena,* in veins of which it occurs. It is of a bright scarlet colour, and is always amorphous or pulverulent. It is found in Yorkshire, in Siberia, and in the United States, but is a rare substance. (Plate XVI. fig. 64.)

Plombgomme.

Probably this is the rarest of all the ores of Lead, consequently the beginner in collecting is not very likely to obtain a specimen. It is of a yellowish-brown colour, and occurs in masses which are composed of concentric botryoidal layers, and often resemble *Chalcedony*, *Calamine*, and other substances that assume a botryoidal form. Before the blowpipe it is infusible alone; with Borax it fuses but does not separate the Lead; Soda being added, the bead of metal is obtained. It is found at Huelgoet, in Brittany, with Galena, Blende, and Iron pyrites.

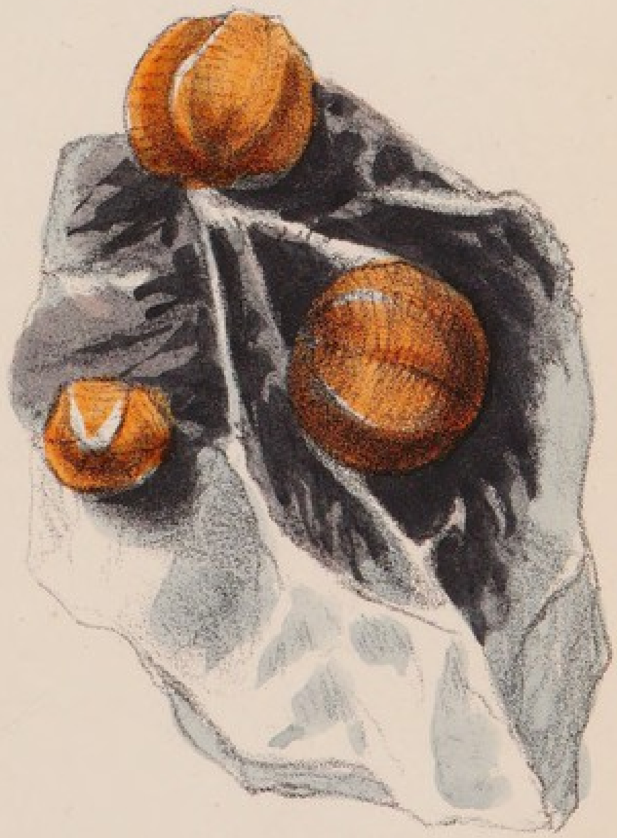
Carbonate of Lead

Occurs in the most elegant crystallized groups of a pure white colour, the prisms being sometimes six-sided and terminated, more often consisting of silky fibres packed together, and arranged irregularly, as in the specimen figured (Plate XVII. fig. 65). Occasionally, as in some Cornish specimens, the larger crystals have numerous minute acicular crystals arranged about them, either adhering by their sides, or by one end. The crystals are usually macled, but the primary is a rhombic prism. The most beautiful English specimens are found in Cornwall, and at the Lead Hills in Scotland; Saxony, Siberia, the Hartz, and Bohemia, yield also very fine ones. Alger says that within the last five years a locality was discovered in the United States, that produced specimens which, from

65. Carbonate of Lead.

66. Phosphate of Lead.

68. Chromate of Lead.



67. Campylite.

H. Sowerby, lith.

F. Reeve imp.

their pure white, silky lustre, and their beautifully delicate crystallizations, are rarely surpassed by the finest from Saxony.

Phosphate of Lead

Is generally of a yellow colour, or yellowish-green, sometimes a bright green. It occurs crystallized in its primary form, the six-sided prism, these prisms being either acicular or tabular, and commonly very distinct in form. An interesting variety is shown in our figure (Plate XVII. fig. 66), in which some of the crystals are swelled out in the centre, resembling miniature tubs or water-butts in general form, and are scattered promiscuously upon a pale blue variety of *Quartz*. The Saxon and Bohemian Lead mines furnish fine crystallized specimens, but the greatest number of interesting varieties are found in Cumberland, in the Lead Hills, Scotland, which yield a bright orange-coloured variety, and in Cornwall. In the first of these localities is found a mineral termed *Campylite*, which is supposed to be a variety of Phosphate of Lead, and whose peculiar method of crystallizing is expressed in Plate XVII. fig. 67. This variety occurs of different shades of orange, brown, and yellow, and is always found in *Quartz* veins, which are in parts coloured by Manganese.

Arseniate of Lead.

A combination of Oxide of Lead with the Arsenic and Muriatic acids. It is of various shades of yellowish-red and reddish-brown, and crystallizes in six-sided prisms, which are sometimes acicular and sharp-pointed. On charcoal it fuses, emits Arsenical vapours, and is reduced to globules of Lead. Cumberland, Cornwall, Auvergne, and St. Prix, in France, produce its different varieties.

Chromate of Lead.

A most beautiful mineral, remarkable for its rich scarlet colour, and for its peculiarly wedge-shaped crystals, whose primary form is a rhombic prism. It consists of about 70 per cent. of Oxide of Lead, and 30 per cent. of Chromic acid. The beautiful specimen figured (Plate XVII. fig. 68) is from Siberia, its principal locality; it is also found in Brazil, but it is a scarce substance.

The other ores of Lead which have not yet been noticed are its combinations with the Sulphuric, Muriatic, Molybdic, and Tungstic acids, and other ingredients. The minerals thus produced are for the most part extremely rare, and highly interesting; and amongst them we must particularly notice the *Cupreous Sulphate of Lead*, an exceedingly rare but very beautiful mineral, resembling, in its rich blue colour, the blue variety of Carbonate of Copper, but differing in form, and of course in composition. Its colour is owing to the presence of Copper.

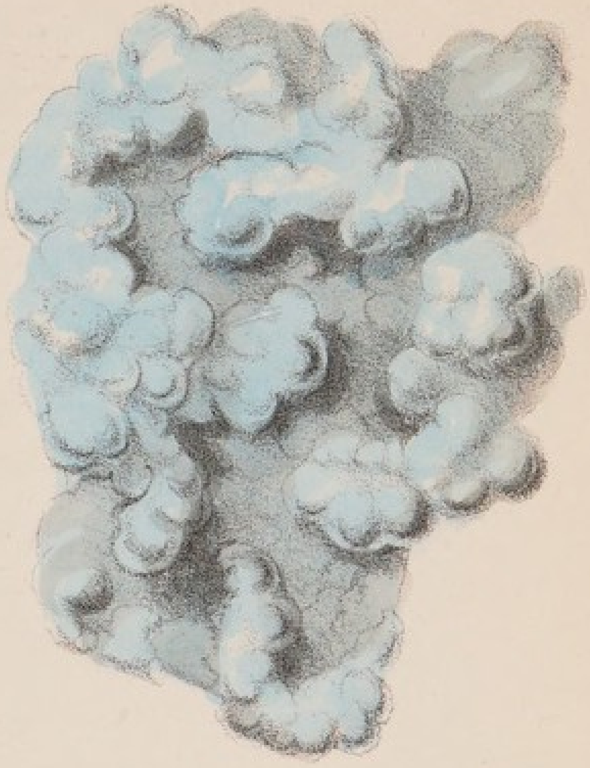
ZINC.

The chief uses for which this metal has been found available are in the manufacture of water-pipes, gutters, chimney-pots, baths, electrical apparatus, and plates for engraving. It does not occur in a native state, but most commonly is combined with Sulphur. It is more ductile than Tin or Lead, but does not possess that property to any great extent. We have already alluded to it as entering into various alloys, the most important of which is Brass.

Blende.

This is a Sulphuret of Zinc. Its primary form is the rhombic dodecahedron, but most usually it is found crystallized in tetrahedrons or modifications of that form. Its colours vary from reddish-brown to black, its most common tint, but it is occasionally found of a greenish-yellow colour. When broken it exhibits a brilliant lustre. The dark-coloured varieties are usually from Cumberland, Cornwall, and Derbyshire, and in the first of these localities is found

69. Blende.



70. Calamine.

Quicksilver.

72. Cinnabar.

H. Sowerby, lith.

F. Reeve, imp.

the variety figured (Plate XVIII. fig. 69), which is of a reddish-brown colour. Transylvania, the Hartz, Saxony, and Hungary, produce the most beautiful specimens. A fibrous variety of Blende is known, which contains Cadmium.

Zinc is also found as an oxide, of a red colour, interspersed in *Oxide of Iron* in America; as a carbonate (*Calamine*) occurring in a botryoidal form, and of various colours, such as green, grey, yellow, brown, and delicately pale blue (this last variety is figured in Plate XVIII. fig. 70): and in the form of *White Vitriol*, which is a combination of Oxide of Zinc with Sulphuric acid.

MERCURY.

This metal is perhaps more remarkable than any of its predecessors, from its being the only one which exists in a fluid state at an ordinary temperature: if, however, it be subjected to an excessive degree of cold, it becomes solid, and may then be cut with a knife, and is malleable. According to the degree of cold or heat to which Mercury may be exposed, it contracts or expands, and is consequently an extremely valuable fluid for the construction of thermometers. Combined with Chlorine, it forms the *Calomel* so celebrated in medicine, and the same combination, in different proportions, produces *Corrosive Sublimate*. The principal demand for it is in separating Gold from its matrix by amalgamation, but a considerable quantity is used for looking-glasses.

Native Mercury or Quicksilver

Occurs in globules of a Silver-colour and high metallic lustre, intermixed with the other ores of Mercury. The chief mines of it are in Austria and Spain, and in South America. Peru formerly produced it in great abundance, and thousands of persons were employed underground in raising it, who were never suffered to enjoy the light of the sun.

> "Thus in the dark Peruvian mine confined,
> Lost to the cheerful commerce of mankind,
> The groaning captive wastes his life away,
> For ever exiled from the realms of day,
> While all forlorn and sad, he pines in vain
> For scenes he never shall behold again."

The workmen who are employed in gilding, suffer severely from paralytic affections, caused by their inhaling the mercury which escapes from the amalgam used. Plate XVIII. fig. 71 represents a specimen of Native Mercury, which is disposed in globules on the following substance.

CINNABAR.

From this, which is *Sulphuret of Mercury*, is obtained the greatest proportion of the metal. Its colour is crimson-red, occasionally scarlet, and, in some varieties, dark reddish-brown. It is rarely crystallized, but generally massive, and of a granular structure. Almaden, in Spain, produces capital specimens, as also Idria, in Carniola, whence the specimen figured (Plate XVIII. fig. 72) was brought. The paint called *Vermilion* is a preparation of Cinnabar.

Native Amalgam consists of Mercury and Silver, and is found massive and crystallized, chiefly in Hungary. This and several other ores of Mercury are rarely met with, and good specimens are of considerable value.

The last series of substances that we have to notice, contains those minerals which are of a combustible nature; and the student will find that their general characters sufficiently distinguish them from those minerals arranged under the foregoing divisions.

73. Native Sulphur.
(crystallised.)

74. Native Sulphur.

75. Plumbago.

76. Anthracite.

H. Sowerby lith.

F. Reeve, imp

COMBUSTIBLES.

"Hence sable Coal his massy couch extends,
And stars of Gold the sparkling Pyrite blends;
Hence dull-eyed Naphtha pours his pitchy streams,
And Jet uncoloured drinks the solar beams;
Bright Amber shines on his electric throne,
And adds ethereal lustres to his own."—*Darwin.*

THE main constituents of this division of minerals are Sulphur and Carbon. The first is found only in a pure or nearly pure state; the second is found pure in the *Diamond*, nearly pure in *Charcoal*, and, in combination with hydrogen, forms all the varieties of Bitumen, Amber, Jet, and Coal.

NATIVE SULPHUR.

This substance occurs crystallized in a great variety of forms, which are all derived from an acute octohedron; occasionally it is found crystallized in the primary form, as shown in Plate XIX. fig. 73. When pure, its colour is pale citron-yellow, but sometimes, as in the massive variety figured (Plate XIX. fig. 74), it is of a brown colour.

Sulphur occurs either in rocks of *Gypsum* or *Salt*, as in several localities in Spain, Sicily, and Poland, or else is of volcanic origin, being found abundantly in or about the craters of volcanoes: it is then either crystallized in the cavities of the rock, or forms stalactites and efflorescences upon it. The most beautiful specimens, some of them having crystals two or three inches in diameter, are met with in Sicily, whence the greatest quantity of Sulphur is obtained. In the Lipari and Sandwich Islands, and in Peru, it is obtained in considerable abundance; but the United States furnish very little. It is used in medicine, in bleaching, and in various other ways.

Diamond.

This is the hardest substance known to exist, and consists of pure carbon. It is always found in detached crystals, whose primary form is the octohedron, but which present a great variety of modifications, leading from the primary octohedron to a rhombic dodecahedron: in some crystals the planes are all curved. Diamonds are either colourless or of a yellowish, bluish, or rose-red tint, and are transparent or translucent; a black variety has lately been discovered, which is perfectly opake. The matrix in which Diamonds are found imbedded usually consists of broken and rolled fragments of Quartz, and they are all obtained by the process of *washing*. "These valuable gems are scarcely ever found without great labour and the most diligent search, even in those districts where they are known to be most abundant." The principal localities in which Diamonds are found are in India, Brazil, and Borneo: they are also found in Siberia and Africa. The finest are of course reserved for ornamental purposes, but great quantities of the coarser kind are reduced to powder for the purpose of cutting and polishing other precious stones. Some are used in watch-making, and by glaziers for cutting glass. In order to give some impression of the value of these gems, we shall notice a few of the most celebrated, premising that as much care is often taken to record their histories as to trace the genealogy of the noblest houses. That known as the 'Maximilian' Diamond is of a yellow colour, and is valued at £155,000; the 'George IV.,' whose weight is twenty-nine carats and a half, is of a splendid blue colour, and was purchased for £22,000; a rich sky-blue Diamond, which belongs to the crown jewels of France, weighs sixty-seven carats, and is valued at three million livres. This is, however, far surpassed, both in weight and nominal value, by the 'Pitt Diamond,' which was found in the celebrated mines of Golconda, weighs a hundred and thirty-six carats, and is valued at twelve millions of livres. This Diamond was worn by the kings of France in their hats, and Bonaparte had it fixed to the pommel of his sword. The Emperor of Russia possesses one from the same district, which weighs a hundred and ninety carats: this once formed the eye of an Indian idol. One has been found in Borneo which weighed upwards of three hundred and sixty carats. The 'Koh-i-noor,' or 'Mountain of light,' lately brought over to England, a description of which appeared in all the papers of the day, is the last Diamond that created much sensation. The whole number of Diamonds above *thirty-six* carats in weight, that are as yet known to exist, does not exceed twenty.

It is a strange fact, that this substance and the following, which differ so widely in colour, lustre, transparency, and hardness, are both composed of carbon, pure in the one, and in the other only mixed with some little impurity.

Charcoal

Is found in a native state. If a piece of Coal be examined, this substance is generally seen in patches here and there: these are of silky fibrous appearance, and very soft; they consist of vegetable matter that has not been completely changed into Coal.

Plumbago.

This is the substance of which *Lead* pencils are made, and consists of Carbon and Iron, but no Lead whatever. In colour it is dark grey, and occurs in irregularly-shaped granular masses, sometimes of great size. The best description of Plumbago is found at Borrowdale; in Cumberland, and in Spain. It is sometimes found crystallized, and in scales like *Mica*, from which it may be distinguished by its colour and by its leaving marks upon paper. Pl. XIX. fig. 75.

Anthracite

Is a combination of Carbon with some Silex, Oxide of Iron, earthy matter, and water. It is of great value as fuel, burning without flame or odour, and is found in immense deposits in America. Some specimens exhibit the most beautiful iridescence, which we have endeavoured to show in Plate XIX. fig. 76.

Mineral Oil.

Of this there are two kinds, viz., *Naphtha* and *Petroleum.* The first is transparent and nearly colourless, and burns with a white flame and a great deal of smoke; it is essential in the manufacture of varnish, and is occasionally used in oil-painting. It is found in Persia, where it is used instead of oil for lamps. *Petroleum* is of a reddish-brown colour, rather thicker than common tar, and has a strong bituminous odour. It is found in France, England, Scotland, Switzerland, and at Parma, in Italy, where, says Alger, it gives out so powerful an odour that the workmen cannot long endure it without danger of fainting.

Bitumen.

Three varieties are known of this substance, viz., *Earthy*, *Elastic*, and *Compact*. *Earthy Bitumen* is soft, solid, and of a blackish-brown colour. The elastic variety is of various shades of brown, and is also flexible; it is found in *Limestone* near Castleton, in Derbyshire, whence the specimen figured (Plate XX. fig. 77), was brought. *Compact Bitumen*, or *Asphalt*, is massive, has a conchoidal fracture, shining lustre, and a dark brown or black colour.

Plate XX

77. Bitumen.

78. Dysodile.

80. Retinasphalt

79. Amber.

H. Sowerby, lith. F. Reeve, imp

It is the most common of the varieties of Bitumen, and is so light as to float on the waters of the Dead Sea; it is also found in France and Switzerland; and in the Island of Barbadoes it forms with sand a lake three miles in circumference.

Bitumen was used by the Egyptians in the process of embalming; and is employed by us in preparing certain varnishes, and in forming Asphaltum pavements.

Common Coal.

It will not be necessary for us to attempt a description of this well-known substance, which, although possessing small claims to admiration on account of its beauty, is yet perhaps the most important of all the minerals we have noticed, considering that without Coal most of the metalliferous ores to which allusion has been made would never have been of the least use to mankind, for want of the means of extracting the metal. It is true that some of the metals occur in a native state, and these so far would have been available; but an immense proportion of all the metals now known are obtained from their ores only by the use of Coal as a fuel.

"Most useful is the might of fire,
When man directs and guides its course;
And whatsoe'er his thoughts desire
He fashions by its helping force."—*Schiller.*

All are aware that Carbon is the principal constituent of vegetable matter, and it is consequently not surprising that Coal, being of vegetable origin, should contain about seventy per cent. of carbon; its other chief ingredient being *Bitumen*. This contains a large proportion of hydrogen gas, which, in combination with the carbon, produces the gas which lights up all our towns. This gas may be manufactured on a small scale, by filling the bowl of a tobacco-pipe with powdered Coal, and closing it up with clay: the bowl being then inserted in the fire, a stream of gas issues from the tube, and this may be set light to and will burn for some time. England and Wales possess many great coal-fields, the principal of which are those of Northumberland and Durham, Yorkshire, Nottinghamshire, and Derbyshire, Lancashire, Staffordshire, and South Wales. Several other European countries possess Coal; and many of the United States produce it in great abundance. The best Coal is that which contains the largest proportion of Bitumen.

Having said thus much of Common Coal, we shall merely mention the other varieties known, referring for their description to Alger's edition of Phillips's 'Mineralogy:' their names are *Cannel Coal, Moor Coal, Wood Coal, Surturbrand,* and *Bovey Coal.*

Jet is also considered to be a variety of Coal. Its fine black colour, and its uses in ornamental articles, have long been familiar to every one.

Dysodile,

Otherwise termed *Paper Coal,* from its occurring in thin leaves like paper, which are of a greenish-brown colour. The leaves of which it is composed are extremely brittle, but, when soaked in water, acquire some flexibility. It burns with flame and smoke, and a horribly fetid odour. Sicily is its only known locality. Plate XX. fig. 78.

Amber.

This beautiful substance, like Coal, is of vegetable origin, having once been a *gum,* exuding from certain trees, of which we see many instances at the present day; but has since become indurated. The proofs of this are, that in Prussia, where there are regular mines of Amber, it is found hanging from fossilized trees in the form of stalactites, and frequently contains different kinds of insects imbedded in it; sometimes only their legs or wings, as though the unfortunate flies, when caught by it, had been glad to release themselves at the expense of a wing or a few of their legs. Amber is of different shades of yellow, sometimes transparent, and of a rich reddish tint, sometimes translucent and of a delicate straw-colour (Plate XX. fig. 79). It possesses electricity to a remarkable degree, the discovery of which in this substance gave rise to the science.

At such times as the celebrated Goodwin Sands are so dry that they may be trodden with safety, we have frequently visited them, and have picked up several rolled pieces of Amber of considerable size; and have selected a portion of one of these for our figure. On two occasions we have found small pieces on the sands between Ramsgate and Pegwell Bay; these were of a rich red tint.

Mellite.

This is one of the few combustible minerals that assume a crystalline form. Its form is an obtuse octohedron; and its colour yellow. It has only been found in two or three localities, viz., Thuringia, Saal, and Switzerland, and is a rare mineral.

Retinasphalt

Consists of Resin, Bitumen, and earthy matters, one of which is Alumine. If held in the flame of a candle, it burns with a bright flame and strong odour. In colour it is brown, and has a resinous lustre. It is found at Bovey, in Devonshire, and at Wolchow, in Moravia; the specimen figured (Plate XX. fig. 80) being from the former locality.

Highgate Resin.

The first discovery of this substance was made during the erection of the Highgate Archway, where it was found in detached nodules, associated with fossil vegetable matter, in the London Clay deposit. Since then it has been found at Chalk Farm, and many other places where that stratum has been cut through for the formation of railway tunnels. It is usually of a dirty brown colour and resinous lustre, but one specimen we have seen is of a light yellow colour. When applied to the flame of a candle, it burns with a clear flame and considerable smoke, and yields an aromatic odour. A nearly transparent variety, of a pale yellow colour and exactly the appearance of Resin, has been found at Wolchow, in Moravia.

This superficial examination of minerals is now concluded. We trust, however, that the learner will not be contented with the information he may have acquired during his perusal of this little work, but that, having travelled thus far in the pursuit of this charming study, he will not permit his ardour to relax until he has mastered the real difficulties which will necessarily beset the path of the more advanced student of mineralogy.

"For, from the birth
Of human kind, the sovereign Maker said,
That not in humble nor in brief delight,
Not in the fleeting echoes of renown,
Power's purple robes, nor Pleasure's flowery lap,
The soul should find contentment; but, from these
Turning disdainful to an equal good,
Through Nature's opening walks enlarge her aim,
Till every bound at length should disappear,
And infinite perfection fill the scene."—*Akenside.*

THE END.

INDEX.

LIST OF PLATES.

GLOSSARY.

Acicular. This term is derived from the Latin *acicula*, a little needle: hence long and slender crystals are said to be acicular. See the figure of *Titanite*, Plate XII. fig. 46.

Alloy. When two or more metals occur united together in a natural state, they are said to form a native alloy. Osmium and Iridium always occur in this condition. For manufacturing purposes most metals are artificially alloyed.

Amalgam. The union of Quicksilver with another metal forms an amalgam. The only native amalgam known consists of Mercury united to Silver.

Amorphous. Possessing no particular form. Native Minium illustrates this character.

Anhydrous. Containing no water. See *Anhydrite*, p. 191.

Arborescent. Growing like a tree: *Native Copper* is commonly arborescent.

Arenaceous. In the form of sand.

Arseniate. The combination of Arsenic acid with a base; as in Arseniate of Copper, Lead, Iron, &c., those metals are the bases.

Borate. The combination of Boracic acid with a base.

Botryoidal. Resembling a bunch of grapes. See figure of *Calamine*, Plate XVIII. fig. 70.

Brittle. This term is applied to those metals which are not malleable; Arsenic, Antimony, Bismuth, and Manganese, are, amongst other metals, distinguished by this character.

Capillary. From the Latin *capillus*, a hair.

Carbonate. The union of Carbonic acid with a base.

Chatoyant. A French word, signifying a resemblance to the eye of a cat.

Chromate. A combination of Chromic acid with a base.

Cleavage. See 'Structure,' p. 44.

Compact. A mineral is called compact when it does not admit of *cleavage.*

Conchoidal. Like a shell: *Obsidian* has a conchoidal fracture.

Dendritic. This term is synonymous with *arborescent.*

Disseminated. When one mineral occurs imbedded here and there in another, it is said to be disseminated in it.

Diverging. This is observed in minerals of fibrous structure, but whose fibres, instead of running parallel to each other, as in *Gypsum,* radiate from a central point, as in *Natrolite* and others.

Double-refraction. See *Iceland spar,* p. 179.

Drusy. This term is applied to minutely crystallized substances, the crystals being aggregated together, and presenting a nearly even surface.

Elastic. Those minerals which resume their original form after being bent, are elastic. *Mica* is elastic.

Flexible. *Talc,* which retains any form into which it is bent, is an example of flexibility.

Fluate. The union of Fluoric acid with a base. *Fluor* is a Fluate of Lime, Lime being the base.

Foliated. From the Latin *foliatus,* consisting of leaves. *Talc* and *Mica* are usually foliated. See, also, our figure of native Gold, Plate XV. fig. 60.

Fracture. See p. 46.

Frangibility. This term relates to the ease or difficulty of breaking a mineral. See p. 46.

Geode. A hollow ball; Geodes of *Agate* are generally lined with crystals of *Quartz* or *Amethyst.*

Granular. Consisting of grains.

Hydrate. Hydrates contain a large proportion of water.

Iridescent. A mineral whose external surface presents a display of changing colours, is iridescent. Our figure of *Anthracite* exhibits this character.

Lamellar, or *Laminar*. Composed of thin plates. A mineral which can be fractured into thin plates is said to be of lamellar structure, and the plates are termed laminæ.

Lenticular. A term applied to crystals which resemble in form a common magnifying glass or lens. See figure of Carbonate of Iron, Plate X. fig. 40.

Malleable. Those metals which become extended by being beaten with a hammer are malleable.

Mammillated. This term signifies the same as 'botryoidal.'

Matrix. The substance in which a mineral is found. *Quartz* is most commonly the matrix of Gold.

Opake. Possessing not the slightest degree of transparency.

Phosphorescent. Minerals which give out light by the application of heat or friction, are phosphorescent. See *Chlorophane*, p. 191.

Plumose. Resembling a feather.

Prism and *Pyramid*. The different parts of a crystal. In a crystal of *Quartz*, the six planes that run parallel with each other form its prism, and the triangular planes which, meeting in a point, terminate the crystal, form its pyramid. There are many different kinds of prisms and pyramids.

Pseudomorphous. Some minerals are occasionally found assuming forms which belong to other substances; these are termed pseudomorphous.

Pulverulent. In the form of powder.

Reticulated. From the Latin *retis*, a net. The term is used when the fibres of a mineral are parallel, and are interwoven at right angles by other parallel fibres, so as to resemble net-work. See Ruby Copper, Plate XIV. fig. 56.

Semi-transparent. A mineral is semi-transparent when an object can only be indistinctly seen through it.

Specific Gravity. The relative weight of one substance compared with another. See p. 48.

Specular. Those minerals whose surfaces are brilliant and reflect images, are termed specular, from the Latin *speculum*, a looking-glass. *Sulphuret of Antimony* possesses this character.

Stalactitic. This term is derived from the Greek, and signifies a drop or icicle. *Chalcedony* and *Calc-spar* are often stalactitic. See Plate I. fig. 3.

Structure. A term relating to the cleavage of a mineral. See p. 44.

Sulphate. The union of Sulphuric acid with a base.

Sulphuret. A combination of a metal with sulphur.

Tabular. Derived from the Latin *tabula*, a table. Crystals which are nearly flat are said to be tabular.

Toughness. Many minerals, when struck with a hammer, become bruised and depressed in the attempt to break them: these are said to be tough.

Translucent. A degree of transparency.

Transparent. Those minerals are transparent through which an object can be distinctly seen. *Rock crystal* and *Iceland spar* are transparent in a high degree.

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November, 1850.

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