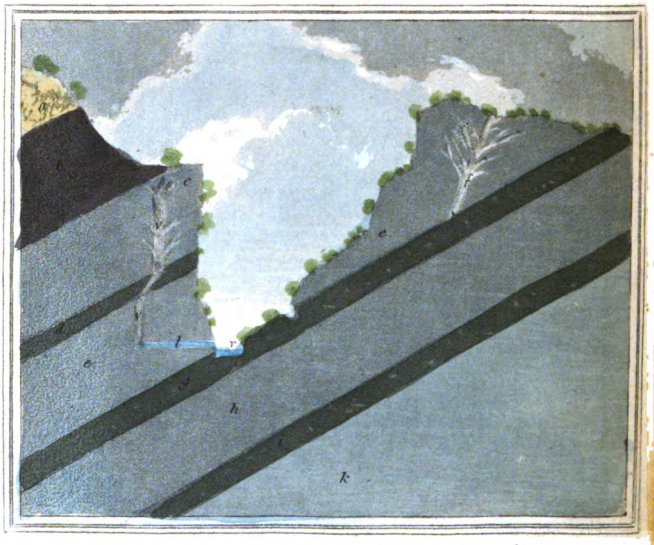
A BRAZILIAN MINER, WASHING THE ALLUVIAL SOIL
(RAKED FROM THE RIVULET) FOR GOLD & DIAMONDS.



SECTION OF THE STRATA, AT MATLOCK HIGH TOR, DERBYSHIRE.

FAMILIAR LESSONS

ON

MINERALOGY AND GEOLOGY;

EXPLAINING

THE EASIEST METHODS OF DISCRIMINATING

MINERALS,

AND

THE EARTHY SUBSTANCES, COMMONLY CALLED

ROCKS,

WHICH COMPOSE THE PRIMITIVE, SECONDARY, FLOETZ OR FLAT, AND ALLUVIAL FORMATIONS:

To which is added,

A Description of the Lapidaries' Apparatus, &c.

WITH

ENGRAVINGS AND COLOURED PLATE.

BY J. MAWE,

Author of the New Descriptive Catalogue of Minerals, &c. &c.

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PREFACE.

AT a period so distinguished as the present for the intellectual zeal of our countrymen, it is not wonderful that Mineralogy should have attained its due elevation in the rank of physical sciences: our universities, awakened to the importance of cultivating this branch of knowledge, have diffused through their various channels no small degree of information on this interesting topic. The science indeed owes much of its present success to the labours of the present Professors established at Cambridge and Oxford; and from the unabated enthusiasm of Dr. Clarke, and the Rev. W. Buckland, we may attribute much of its present popularity. Mineralogy, as it is universally useful, will soon be almost universally understood. The possessor of landed estates, and the man of science, the manufacturer and the artisan,

may all render Mineralogy subservient to their respective interests; and the object of these Familiar Lessons is to unlock, as it were, a casket of useful knowledge, and to present to the *learner* a compendious view of the beauty and value of its contents.

The author has carefully avoided obscure terms and technical phraseology, studiously aiming at simplicity in description. His endeavours to become explicit, may have unavoidably betrayed him into a repetition of expression. It is his chief desire that an acquaintance with our mineral resources may be cultivated rather as a recreation than a study; that the produce of our mines may be regarded as an object of interest, and that the traveller may be able to recognise the substances that compose the ground on which he treads.

Mineralogy may be contemplated in two points of view: we may consider it as closely connected with the more common affairs of life, and consequently inviting us to pursue it from its utility; or by affording to us continual examples of mathematical regularity, and of the undeviating order of Nature, it may, like Astronomy, accustom the student to sublime speculations, and thus become the means of enlarging and dignifying the faculties of his understanding.

Rare specimens are by no means necessary to obtain a competent knowledge of Minerals. A careful perusal of a small and select collection, will benefit the student more than many hundreds expended in mere rarities, though such are, indeed, beneficial to the private or public dealer, who may artfully introduce them to the opulent amateur!

In estimating the value of a science, and in comparing objects of utility with each other, the intelligent reader will not put the grass-hopper or butterfly in competition with the Horse or Ox.

> We may have too much *Tantalium*,
> As well as too much *Lead Ore*.

It is a painful, though perhaps a necessary duty, to inveigh against the extravagant prices demanded for foreign minerals brought to this country; but our intercourse with the continent would now be the means of a great influx, were it not for a heavy duty which is laid upon them; these may be regarded at the present moment as the great obstacles to the progress of the science.

The author, well aware of defects, solicits the assistance of the better informed Mineralogist, and will feel

himself greatly obliged by any useful communication on this subject. He is aware of the difficulties which attend any one who endeavours to simplify what is complicated, or to disentangle what is perplexed in any science: confessing his little pretensions to theoretical knowledge, he undertakes the present labour with great diffidence, being conscious of the excellent and learned elementary treatises from which he has received instruction and delight. The present little work is intended as a guide to more comprehensive publications, and the author will think himself amply remunerated, if it should become instrumental in promoting the interest of the science.

The excellent books published by Mr. Phillips have tended greatly to facilitate and extend the study of Mineralogy.

To those who possess minerals they may be unacquainted with, the author offers his best service, and will freely give them any information they may desire.

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FAMILIAR LESSONS

ON

Mineralogy.

To explain what is meant by Fossils or Minerals, and how to distinguish one substance from another, is the subject of the following pages.

Minerals are produced in the earth, and commonly situated in what are termed veins, which, when worked, are called mines, whether at the greatest depth we have penetrated, or in the alluvial soil on the surface. Be it a Diamond, a Coal, or any Metallic substance, it is a Mineral. The Gems are usually called stones, and crystallizations, fossils; yet all are ranked under the term Minerals. A distinct piece is commonly called a specimen, and a number of various substances, a collection.

It is true, that this science is not marked by those distinguishing laws, that are the leading features of the Sister Sciences, yet a general knowledge may be attained with little difficulty, although the way to set about it may appear clouded and a little obscure; when, how-

ever, this mist is once cleared, a brilliant display of Useful Knowledge is opened to our senses, and by advancing step by step, the summit will be gained.

To suppose that any one unacquainted with minerals can discriminate them, would be as unreasonable as to expect that an unlettered man should discriminate classical authors without seeing the title-page of their works.

Without further preface, I will endeavour to point out the most easy method by which a learner, who possesses a few minerals, may have the means of proving to himself what they are.

Suppose a person to be in possession of a piece of Lead Ore, a piece of Calcareous Spar, or Limestone, and a few Pebbles that have been found on the sea shore; these are selected as being the most common of all substances, and which may be said to be generally met with; and further, I will for example, suppose him to ask the following question:—

QUESTION. *How can I satisfy myself that this is Lead Ore? and this Calcareous Spar? or that Limestone?* *

To the first question I reply, break a small portion off from the Lead Ore, and observe the fragments and their brilliancy, (remarks on these will be noted hereafter) place a bit not larger than a pepper-corn on a piece of

* The learner should provide himself with a little instrument called a blow-pipe, a magnet, a few small bottles with acids and tests, and a small steel mortar; with the assistance of these much may be done by himself, but in the first instance one lesson from a practitioner will be worth a volume of letter-press.

charcoal, then with the blow-pipe blow through the flame of the candle, directing the jet of flame proceeding from it upon the Lead Ore * ; it will almost instantly discharge sulphurous vapours, and in half a minute melt into Lead. If the experiment is attended withthis result it furnishes a decided answer.

The ores of this metal are both various and numerous ; the most common is Blue Lead Ore, which occurs in great quantity, and from it the lead in commerce is produced. Others are of various colours, as pearl and silk white, green, brown, yellow, and red ; it also occurs earthy, &c. (See New Descriptive Catalogue.)

QUESTION. *How can I determine this to be Calcareous Spar, or that Limestone?*

Detach a small bit with a hammer, and observe its fragments ; try to scratch it with the point of a knife, and notice the effect ; then place a small particle under the flame of the blow-pipe, and it will in a minute burn to Lime, which may be known by its losing its transparency (if Calcareous Spar) by its styptic taste, or by throwing it into a glass of water, when it will fall to powder with a hissing noise. Or place a few fragments in a watch glass, and let fall a drop of acid into it, which will produce a violent effervescence. Calcareous Spar is always soft to the knife, and yields a white powder when scratched. Limestone is harder than Spar, it is in great abundance, forms mountains, and when fine enough

* Should the sudden heat cause the lead ore to break, and start from the charcoal, the flame must be more gently applied, or a little borax may be melted with it, which will envelope it.

to receive a polish, it is called Marble, which never can be mistaken for Spar. These easy experiments, performed in a few minutes so satisfactorily, cannot fail to lead the learner forward; they are every thing to the beginner, and may be considered the first and second letters of the alphabet.

The exterior form of fragments, fracture, nice discrimination, tact, &c. belonging to minerals, cannot be known as it were by magic, or attained all at once: books afford but little information to the beginner, and indeed for him, what are considered the best books, may be deemed the worst, as they often disgust by their prolixity, and by their continued use of harsh phrases and technical terms almost impossible for him to understand. Such works, though highly useful to the connoisseur, and to the experimental mineralogist, are quite unfit for the generality of those who are yet unacquainted with minerals.

Let it be supposed the learner has received some shining yellow *Pyrites**, which being very heavy, he believes to be Gold, or to contain gold.

QUESTION. *How am I to proceed to know what it is?*

In answer to this question let the learner attempt to cut the mass with the point of a knife; if it is Gold, it will be soft and may be cut like lead, or if he strike it gently with the small end of a hammer, it will be indented, Gold being malleable; if he melt a small par-

* How many, having met with this common substance, both abroad and at home, have treasured it with the greatest secrecy, believing they had discovered a Gold mine, &c.

ticle with the blow-pipe, its colour will remain the same. But if it be brittle and hard to the knife and hammer, it is a proof that it is not Gold; or if he place a few fragments upon a hot fire shovel, or under the flame of the blow-pipe, and the sulphur burn away, leaving scoria that is attracted by the magnet, this proves it to be a combination of Sulphur and Iron, which is answering this apparently important question with great facility: or if he puf a few of the particles into a watch-glass, and drop a little acid upon it, and hold it over the flame of a lamp or candle until it boils, if it is Gold, no alteration will take place; but if not, an effervescence and change of colour will be the result, which shews that the substance is acted upon by acid; the contents may be thrown into a glass of water, into which if he let fall a few drops of prussiate of potass, the liquid will become a beautiful blue. The Iron of the Pyrites being dissolved by the acid, and held in solution in the water, is as it were regenerated, and precipitated in the form of Prussian Blue, after which the water becomes again clear. This elegant and easy proof cannot fail to give pleasure to the learner, and shews that the steps to the attainment of some knowledge of Minerals is by no means difficult, and will not fail to prepare and encourage his mind for other experiments.

Gold is generally obtained from the alluvial soil, in small particles called grains or Gold Dust, seldom so large as a pea.

The Gold mines of Brazil and Africa are on the surface; the simple act of washing peculiar places sepa-

rates the Gold from the Gravel, and by this means great quantities are found. In Brazil alone, above twenty tons weight are annually procured, which forms a large share of the circulating medium of Europe. The mining district is called Minas Gerais; the reader will learn with surprise that it does not contain one subterraneous excavation. What is there termed a mine, is a peculiar place or superficies of greater or less extent, where the surface is raked from or dug to the solid rock, which consists of rounded Pebbles, earthy matter, sometimes Precious Stones, besides Gold and Diamonds, of which it is the great receptacle.

In Africa Gold Dust is an article of commerce, and considerable quantities are exposed for sale. It is often adulterated with those varieties of Pyrites which are the nearest to it in colour, and not unfrequently with Brass filings, which the merchants appear not to know how to detect, and from the want of this sort of knowledge, many have suffered great loss; some of the better informed negroes make a trade of "trying Gold," and are called "Tryers." Merchants and captains pay them particular attention, and respect when they are employed on this business, as from their slight knowledge they save their employers from imposition; on these days the poor negro is admitted to the captain's table.

Gold, if impure, may be detected by nitrous acid, as before described.

Platina is found also in grains, the same way as Gold; it is of a white colour, more like Silver, hence

called Platina, being the diminutive of Plata, meaning silver in the Spanish language.

Pyrites often contains a large portion of Arsenic, and is then called Arsenical Pyrites. Its colour is pale yellow, almost white, and may be known by its white fumes and peculiar smell of Garlic when under the flame.

Rounded stones from the gravel pit, or gathered from the sea coast, may, with little attention, be generally known and determined.

How many pick up pebbles of Crystal, believing them to be Diamonds, and so little are Diamonds known, that it is difficult to convince them they are not so, even after they have been cut and polished.

As it is well known that Diamonds cut glass, many imagine that a Crystal or Pebble, gathered from these sources, and hard enough to *scratch* glass, must be a Diamond, *or something approaching to it.* This is not to be wondered at, when it is considered how few have seen rough Diamonds, or have ever reflected that there is a difference between scratching glass and *cutting it.*

The Diamond cuts * it so, that it breaks in the line frequently under the very act; other substances merely scratch it. Pebbles, compared with Diamonds, are at least one-third less in weight. Diamonds in their rough state are generally very small, and have almost always

* Some have said the Diamond poisons glass, for it often separates the instant it has performed its office; perhaps from the action of the air.

a sort of shining metallic hue and a crystalline form, exhibiting planes and angles different from those of any stone. The beginner, without confining himself to these marks of discrimination, may procure a fine file, and rub the substance with a little pressure; if it be a pebble, the file will with difficulty leave an impression; or he may try it on a piece of Lead charged with Emery, or upon a Lapidaries wheel, any one of which will wear down the Pebble, but will not produce the smallest effect upon the Diamond.

When cut and polished, the rays of light will pass through the Pebble, whereas in the Diamond, the rays are, by its great powers of refraction, reflected (as it were) to the surface, which gives it this highly marked difference in society, *viz.* Diamonds are best seen and known by the beholder, who may, at any distance, distinguish the reflected ray of light; but other stones are best seen by the wearer, or those who are nearest to them.

After due attention to these remarks, the Crystal cannot be mistaken for a Diamond.

Pebbles *, rounded substances from these sources, are commonly hard and siliceous, as Crystal, usually called Quartz, Chalcedony, Agates, and Jaspers; their varieties are numerous. They all give fire when struck with steel, do not yield to the knife, but are slightly affected by the file, and when broken, have generally a shining and uneven fracture; the fragments are splintery, sharp edged.

* From the sea coast, Gravel, &c.

The Crystal may be known by its transparent appearance, although the exterior may be dull. Quartz is a variety of Crystal, but differs from it in colour, being less transparent, often opaque, and of various hues of brown and yellow, sometimes milk blue; its fracture is shining, and fragments splintery as crystal*.

Agates are commonly very rough on the exterior; of brown and blueish colours, and rounded; when broken, they exhibit lines generally curvilinear and angular, of different shades of colour and texture; sometimes they are composed of Quartz, and not unfrequently are hollow and crystallized; the Scotch Pebble belongs to this class. Agates may be said to form innumerable varieties, and rank amongst the most beautiful class of polished stones.

The *Chalcedony* generally has rather a peculiar appearance, agreeable to the eye from the pleasing softness of the colour, which is commonly pale blue. It is of fine texture, and semi-transparent, with lines of opaque white. It sometimes forms Agate, is often stratified or zoned, and is of great beauty; other varieties are stalactitic and frequently marked by low half-globular projections (mammillated). It is of various colours, the latter variety is frequently brown and yellowish, not unlike that of horn. *Cornelians* belong to this class, also *Oriental Agates*, *Mocha Stone*, *Sardonyx*, &c. The learner will not fail to remember the leading fea-

* See Quartz, New Descriptive Catalogue.

tures which form the characters of this beautiful series, after seeing and examining some of its varieties.

Jaspers do not fall short of the preceding families, either in extent or variety; they may be known by their colour, which is commonly brown, yellow, or red, of various shades, and sometimes green, often striped, veined, arborescent, moss-like, or as if blotched. The Egyptian variety, or Brown Jasper, is most peculiarly marked, frequently presenting figures, profiles (lusus naturæ) even likenesses, and most curious and whimsical appearances, some of which have been sold at great prices.

Jaspers generally occur larger than the preceding varieties, with their exterior rounded, and generally of the colours before-mentioned; they are held in great estimation by those who form collections of polished specimens, and many ladies and gentlemen have a small apparatus for cutting and polishing these productions, which may be brought upon a parlour table without any inconvenience, and afford a most agreeable evening's employment and amusement; all these varieties are hard enough to receive a good polish, but often Jaspers are softer than either Agates or Quartz. These substances (more particularly Quartz) are usually met with on the sea coast, or in Gravel, including Flint, which is so common and well known as not to need any description. *Flint* often forms a large portion in the alluvial soil, particularly in the vicinity of Chalk.

Rounded pieces of *Granite*, *Green Stone*, and *Porphyry*, occur less frequently in this situation, though they are not uncommon, therefore it may not be improper to notice them in this place.

Granite is composed of three distinct substances, viz. Mica, Quartz, and Feldspar, which the learner will easily discriminate, after once having had the substances pointed out and explained. (See Granite.)

Green Stone is composed of Hornblende and Feldspar: it is often very hard, and of a dull green colour.

Porphyry is a substance that equals Jasper in hardness, and is generally of a brown or red brown colour, speckled with whitish spots. These spots are very seldom round, almost always angular.

Limestone, *Slate*, *Sandstone*, and semi-indurated *Argillacious* substances, rarely occur in *Gravel*, or amongst the Pebbles of a surf-beaten sea-coast; because they are not sufficiently hard to resist the action of attrition, and are soon broken down, forming sand or dust.

A little thought on these substances, after looking at them with attention, will convince the learner that he is making some progress, and he will feel pleased at being enabled to proceed with greater facility.

The learner may now be led to inquire—*How he can discriminate Ores of Copper?*

Ores of Copper are found in abundance, and in great variety, but it is not my intention in this little work

to endeavour to explain all their appearances, but merely to describe the substance generally.

Ores of Copper have commonly a yellow appearance, the poorer Ores much resembling Pyrites, but are softer to the touch of the knife. Copper Ores, that are richer, are of a Gold yellow, some are irridescent, exhibiting a pretty and variable display of colour, and are called Peacock Copper. These varieties have a deeper and more flame-like tinge than common Pyrites.

Copper Ores are also frequently green, and in delicate fibres; sometimes compact, beautifully zoned, of lighter and darker shades, exhibiting great variety; these are called Malachite, which is not unfrequently mixed with blue.

Copper Ores are often of a grey colour, not unlike Iron, also brick-red, black, even soot-like; but for fear of tiring the learner with prolixity, I will explain the easiest method of detecting them, previously observing, that Copper is not uncommon in its native state. When it appears foliated, massive, branch like, &c. pieces of pure Copper of this description, are often found in veins, particularly in Cornwall; this sort of Copper so much resembles the general Copper of commerce, that it needs no other description.

That the learner may satisfy himself of an Ore of Copper, let him place a small particle of it upon a piece of charcoal, with a little borax, directing the flame from the blow-pipe upon it, which will soon melt: if it be a rich Ore, it will be reduced to a bead of pure Copper, colouring the slag green, or red brown; it is sometimes necessary to repeat the melting. A more easy method of detecting Copper is as follows:

Reduce a small particle to powder; put it into a

watch glass, with a few drops of nitrous acid; if no action takes place, apply a little heat, by holding it over the flame of a lamp; the Copper will soon be acted upon and dissolved by the acid, then add a few drops of water, and stir it with the point of a knife, or any piece of clean iron, when the Copper will leave its solution, and precipitate upon it (coating the knife), covering it, and giving it the appearance of Copper; or the contents of the watch-glass may be thrown into a glass of water; to which add a few drops of liquid ammonia, and it will become a beautiful blue.

This pretty experiment, so convincing in effect, will add considerably to the learners confidence.

Even water passing through a vein of this metal, often contains a large portion of it in solution; and the water is collected in reservoirs with great care, into which Iron of any description is then thrown, and becomes coated with Copper, which is scraped off, and the Iron is again plunged into the water; this is repeated as long as any Copper remains in solution, and frequently by this method several tons are extracted. The Copper thus produced is very pure, and when melted is used for the best purposes.

The before-named substances are amongst those which most generally occur in this country; it is not my intention, nor would it suit the learner in this early stage, to enter into their peculiarities, or more minute discriminations, that may take place hereafter.

As *Silver* has been met with in various parts of Cornwall and Devonshire, the learner will naturally enquire—

QUESTION. *How he can know substances containing Silver?*

Native or *Virgin Silver*, as it is sometimes called, occurs in delicate curled fibres, of almost a white colour, and filling little cavities in Quartz, nests; these fibres are tough and flexible, often surrounded by a black, earthy, soot-like substance. Silver is frequently branch-like in strong ramifications, or leaf-like, passing through Calcarious and other substances, in long serrated wire-like branches, detached or connected, and frequently interwoven, crossing each other net-like. These Silvers have often a fine rich metallic lustre, of a tin-white colour, and sometimes tarnished.

Silver in this state, *Native Silver*, cannot be mistaken after having been once examined, but it may be proved to be so by the touch of the knife, as it yields to it, being little harder than lead; it is malleable, and indented by the smallest blow of the hammer, and melts into a beautiful white globule.

It greatly resembles Tin in this state, but may be easily known from that metal by its being much heavier, and by the cracking noise which Tin makes when bent, or by its burning away under a continued heat, whereas Silver remains unaltered.

By due attention to these remarks, Silver may be discovered, and as the Ores of Silver are frequently combined with other metals, the following easy experiment will detect it.

If it be a rich ore it will be soft to the knife or hammer, and melt under the blow-pipe with little difficulty, and by repeated fusing with borax, a bead of Silver may

be produced; the combinations will be driven off by heat, or absorbed by the borax.

Or a few small particles of the Ore may be put into a watch-glass, into which drop a little nitrous acid, then hold it over the flame until it is dissolved, after which dilute it with water, and stir it about with a bright Copper wire; if any Silver is present, it will precipitate upon the Copper, covering it with Silver, in like manner as Iron, is before described to be covered with Copper; or add to the solution one drop of muriatic acid or common salt, and the Silver will precipitate in a thick and dull white cloud.

These experiments will open the mind to further investigation. They may be performed with ease and elegance, by merely possessing the few articles before mentioned.

Ores of Iron. *Iron* presents itself in abundance, and exhibits a great variety of appearances.

Clay, Sandstone, and Jaspers, frequently contain a considerable proportion of Iron, which gives to them their red colour. In some stages it is more subject to decomposition than in others, and the more Iron they contain, the more coloured (generally red brown) the substance becomes. Many clay-like stones appear ochreous on their exterior; on breaking them, two or three stages of decomposition are often instructively and beautifully marked, elucidating its change; whereas the centre remains perfect, unaltered, hard, not having yet been affected by either water or air, the action of which has given the surface so different an appearance.

Other Ores of Iron, as those called *Hematites*, are red, often black red, and fibrous; they are heavy, and frequently appear as if polished; they are also sometimes encrusted with red dusty matter, which soils the fingers.

There are yet others, as *Loadstone* and shining *Specular Iron Ores;* some have the appearance of aggregated granular particles of Iron or Steel, but this series, so interesting to the uses of man, is leading me beyond the bounds I had prescribed myself.

Iron may generally be detected by placing a small particle (of Iron Ore) under the flame of the blow-pipe; it will not melt, but after it has been kept red-hot a few moments, the magnet will exert its unerring power, and attract it: or, reduce the particles to powder, put it into a watch-glass, to which add a drop or two of sulphuric acid, and expose it to the flame of a lamp, and throw the contents into a glass of water, into which pour a little tincture of galls, and you will have Ink; or the beautiful blue, if prussiate of potash be used instead of the tincture of galls.

The common Iron Ore of England, is *Clay Iron Stone*. It is almost always found near Coal, which is so necessary for reducing the Ore to a state of purity. So common as Iron is, yet how few know any thing of the process it undergoes before it becomes malleable. It is one of the most difficult metals to melt, and more art and labour is requisite to conduct a small Iron furnace, than to melt all the Gold produced in Brazil.

Here is a substance of a dark colour, that you have told me is *Manganese*.

How can I assure myself that it is so?

Manganese, like the preceding article, (Iron) forms many varieties, and is distributed in great abundance. It may generally be known by its earthy black appearance, and is commonly called *Black Wad*, which often contains fibres embedded in it, of a metallic lustre. Other varieties are composed of acicular fibres, sometimes aggregated, and have a bright Iron-like splendour. It is very frequent in Devonshire, and when examined, may be distinguished from Iron, or any other substance.

Exposed to the flame of the blow-pipe, with borax, a purple glass is produced.

Manganese may also be known by putting a little muriatic acid to a small quantity of the powder, and on holding a piece of printed cotton, &c. over the fumes, the colour will be destroyed; dilute the substance with water, and on immerging a coloured cotton, the same will be bleached.

I cannot sufficiently recommend an acquaintance with the preceding substances, and the different methods of discrimination. For if the learner has once familiarized himself with the characters of Minerals, and with the means of detecting what they are, he will then have gained the first steps to the knowledge of Mineralogy as a Science, from which too many have started back, and could not prevail upon themselves to proceed.

I have therefore endeavoured to introduce the subject under such appearances, as may invite the learner to further exertions. For as our Chemists, our Artists, and our Manufacturers, at least equal, and in most cases

excel those of neighbouring nations, why should we not equal them in the knowledge or science of Mineralogy, which partakes so largely of the great recommendation of all science, *Utility*.

The common use of *Tin* naturally presents itself to the notice of the teacher; it is not so generally distributed as many other Minerals, but exists in abundance where it has hitherto occurred. It is one of the heaviest Minerals and one of the lightest Metals. It consists of few varieties; its ores may generally be known by their great weight; it is sometimes of a resinous colour, but commonly approaching black, and its crystals occur in clusters, presenting planes in different directions. It is hard, and with difficulty scratched by the knife. It occurs in veins, some of which are so delicate, as not to be thicker than the blade of a knife. It also occurs in small massive pieces, radiated, and striated; hence called Wood Tin.

The Ores of this metal may, after having been pulverized, and mixed with borax, be reduced to Metallic Tin; but care must be taken not to continue the heat too long, as it will burn away: a little morsel of soap, melted with it, may assist the operation. Ores of Tin cannot be described, so as to give a perfect idea of them; they resemble Ores of Iron in many cases, also Ores of Blende; but after their difference is explained, and pointed out to the learner, he will be enabled to distinguish them.

I shall now proceed to describe the *Ores of Zinc.*

Ores of Zinc form two distinct substances, as *Blende* or *Black Jack*, and *Calamine*.

Ores of Blende are commonly black, brown, or yellow, of different shades, often appearing in clusters (confused crystallizations) upon the surface of specimens, and may be known by the touch of the knife, being soft; and by scratching it, a lighter coloured powder is produced; the yellow variety, when strongly rubbed, yields phosphorescent sparks. These Ores are always light and soft when compared with Tin, by means of which they may be readily distinguished, and under the flame of the blow-pipe Zinc evaporates in white fumes.

Calamine. This Ore of Zinc has generally a stone-like appearance, commonly porous, not unlike burnt bones, and of a brownish yellow colour; it is heavy, and some pieces when struck, have a metallic sound; some varieties are electric, and give fire with steel. Like Blende, it is in great abundance in Derbyshire, and is used to convert Copper into Brass; on being exposed to great heat, and the vapour being made to pass below (condensed) into water, Metallic Zinc is formed, which, until some years past, was imported into this country from China and Holland.

A very pretty experiment is performed with a small particle of this metal, which, though so generally known, I will detail, for the purpose of shewing the great affinity of metals.

Example. Lead is acted upon by vinegar, and forms acetate or sugar of lead, which, when dissolved in water,

forms a white precipitate, and a perfectly transparent solution. If a piece of Zinc, suspended by a thread, be immerged in the fluid, it will be covered almost instantly by the finest flakes of lead, regenerated in its metallic state, which may be seen approaching the Zinc in all directions.

This beautiful, amusing, and instructive experiment, cannot sufficiently be admired; it is a lesson upon attraction and affinity, which cannot fail to please the learner, who has not heretofore seen it performed.

When Mercury, commonly called Quicksilver, occurs in the state of Ore, how can it be known in its rough and natural appearance?

Quicksilver exists in semi-indurated Clay, in Sandstone, and other earthy productions; it often occurs in small and large fluid globules, commonly attended with a red substance; large quantities are obtained in the fluid state. The Ores, from which the greatest quantity of Mercury is obtained, are called Cinnabar, which, when rich, are extremely heavy, compared with Iron. They are of a red, and brown red colour; some varieties are dull, others bright and shining; they may always be known, if rich, by their great weight, or from the knife leaving a full red streak upon them, or by exposing a particle to the flame of the blow-pipe, white fumes will arise, and a piece of Gold, as a guinea, or a piece of bright Copper, as a half-penny, held over the vapour, will be coated with Mercury, which condenses upon it; and the more it is rubbed the more it will have the appearance of Silver, which cannot easily be removed, but by burning it off. Quicksilver, as a Metal, is always fluid in our atmos-

phere; it may be rendered solid by producing artificial cold.

Perhaps the learner is not acquainted, that the metal called *Cobalt* forms the beautiful blue colour on China, also earthenware, and may be desirous to know how to distinguish Ores of that metal.

The Ores of Cobalt are not confined to one peculiar sort: they, like many of the preceding, consist of several varieties, some of which are rich, and yield a great quantity of colouring matter, which is highly valuable; others are too poor to pay the expence of being worked. The Ores are generally combined or accompanied with arsenic. They have a whitish grey colour, and metal-like lustre, sometimes tarnished, and approaching to black.

On examination, some of these ores have more or less intermixture of peach-red efflorescence; others are dark, earthy, sometimes of various colours, as black, blue, and green; the latter varieties often occur in Sandstone.

A very small particle, placed under the flame of the blow-pipe, generally emits fumes of arsenic, after which, if a little borax be melted with it, a deep-coloured blue glass will be produced; Cobalt, melted with Silex, is called smalts. Many amusing experiments may be made with Cobalt, which Parks's excellent Chemical Catechism explains.

Ores of this metal have lately been found in the alluvial soil in Cheshire.

Antimony is much used in making Printer's types, in Medicine, &c.

It does not form so many varieties as several of the preceding. It is generally of a lead colour, but lighter than Lead Ore. It frequently occurs in long thin Crystals, like needles, diverging from a centre, and of beautiful colours, irridescent. It is also shining bright; this variety resembles Lead Ore; but it more commonly is of a dull lead grey, compact, or appears composed of fibres striated. The massive variety is sometimes covered with a yellowish heavy Ochre, from the decomposition of the metal, which is not the case with Lead. After having been closely examined, it will not be mistaken for Lead Ore; but the flame of the blow-pipe will immediately detect it, as it melts the instant it is exposed to heat, and appears as a dark coloured slag or scoria, swelling and evaporating in white fumes.

Perhaps the learner has never heard of the metals called *Bismuth* and *Nickel*; they are not common, and their use is rather confined.

Bismuth is a metal that is not malleable, though it is found in a native state, as Gold and Native Copper; but it does not resemble either.

Bismuth has a peculiar agreeable metallic appearance of various colours, resembling most the hue of a Pidgeon's Neck, changeable as the light strikes it; which peculiarity may serve to distinguish it from granular Lead Ore. It is soft, and melts the moment it receives the flame, into a white globule, which, if the

heat be continued, volatilizes, leaving a white deposit upon the Charcoal.

Bismuth frequently accompanies Ores of Silver, Cobalt, and Nickel, and as its varieties are very few, the learner will be enabled to determine them, after having discerned their peculiarities, by comparing them with other metallic substances.

Nickel is a metal less known than the preceding, and it is not likely the learner, who has never seen it, should know it before he has heard its name; however, if he has noticed the preceding characters of metals, he will know, on seeing it, that it is not one of them.

Nickel is massive, and compact, lighter coloured than Copper, though approaching to it. It is hard, difficultly scratched by the knife, and is very heavy; any further description could avail little or nothing, but when seen, it would be perceived not to agree with any other substance. It produces a fine apple-green colour in nitrous acid. It melts rather difficultly, emitting arsenical fumes that smell of garlic. The above characters are quite sufficient to distinguish it from the metals that it is often associated with.

Uranium, *Uranite*, is more easily known than the preceding.

Uranite cannot be mistaken for another substance, if its characters are carefully examined. It is of a beautiful grass-green colour, rarely yellow-green, and generally appears in delicate quadrangular crystals, many uniting together, forming a cluster often half an inch or an inch across. It sometimes occurs in an

ochrous state, both green and yellow; another variety, called *Pitch Ore*, which is black, and often accompanied with the ochre, is extremely heavy, and of rare occurrence.

Wolfram is a common Mineral in Cornwall, though hitherto of very limited use. It is of a dark colour, approaching to black, brittle, and hard. It yields a red brown streak to the knife, and is extremely heavy. It differs from Ores of Iron in these particulars, and is one of those Minerals of which words cannot convey a perfect idea to the learner. It is rarely met with, except in these countries which produce Tin; it is a Tungstate of Iron.

The following Tungstate of Lime is nearly allied to the preceding.

Tungstein is a heavy opaque white coloured Mineral, sometimes yellow brown; it often occurs in fragments, is very compact, and may be known by its great weight.

These Minerals are not of common occurrence, and for more particulars the reader had better refer to the New Descriptive Catalogue, or an Elementary Work.

The same remark applies to the following; viz.

Titanium, which is a Mineral more generally diffused than the preceding, and appears under a variety of forms, some of which may be known by their beautiful capillary appearance in rock crystal. It is generally of a brown or red brown colour, sometimes lighter, and as

delicate as hair; it also presents itself in regular forms, as thick as a quill. Another variety is found embedded and wedge-like.

Menachinite belongs to Titanium; it is found in grains of a black colour, intermixed with sand.

Gold Ore is frequently asked for, and many yellow substances are believed to be Ores of Gold; but here is a Mineral that contains that precious Metal, without the smallest appearance of it; it is called *Tellurium*.

Tellurium is a whitish coloured shining Mineral, disseminated superficially, in small and delicate leaves and fibres, of a polished steel colour, often appearing map-like, and from it is named Graphic Ore.

It is sometimes yellowish, and there is a variety that approaches to black; the latter is rich in Gold, and occurs in larger foliæ; they both yield to the knife, and a bead of Gold may be obtained from the richest variety, by melting it with borax. The Graphic variety cannot be mistaken, and the others may easily be discriminated. Tellurium is of rare occurrence.

Molybdena is a Mineral not very abundant, though it occurs in many situations; it is generally in small patches, foliated, of a lead colour; it greatly resembles Tellurium, but its leaves are more flexible, and it does not melt under the flame of the blow-pipe; it is generally imbedded in Quartz, and has hitherto only been found in rocks of the earliest formation.

The following three varieties belong to Tantalite, and may be said of late discovery.

Tantalium. Tantalite generally appears imbedded in Granite; it is of a black colour, sometimes streaked, and greatly resembles Wolfram and Ores of Iron, but it is not magnetic.

Yttratantalite often occurs imbedded in angular fragments, but more generally forming concretions of a black colour; it is nearly allied to the preceding, and to the following.

Gadolonite is of a pitch brown colour, often surrounded with a red brown coloured substance, and imbedded in Quartz.

These substances are extremely rare, and their uses hitherto so very limited, that I did not, at the commencement of this work, mean to have given them a place in it, nor the following:

Cerium, which is also of late discovery.

Cerite is of a red brown colour, dull appearance, and moderately heavy; it does not melt under the blowpipe, but changes to a yellowish colour.

REMARKS.

HAVING given this brief description of Metals, it may not be improper to say something relative to the situation they respectively occupy in the Earth, before they are brought from it, and afterwards subjected to those necessary operations, in order to become useful.

Gold often occurs in Transylvania and Siberia, in veins of other substances, where it is foliated, dendritic, and disseminated; rounded lumps of it have been found in Ireland, Sumatria, South America, &c. but these, as well as Gold dust, are generally met with in alluvial soil.

Platina (though more rare) is found in the same manner. Throughout the Gold district of Brazil I did not see one vein of Gold; and although that precious Metal may sometimes appear in short ramifications (in specimens), yet I have not seen or heard any thing like what is understood by a vein of any regular continuance filled with Gold *.

Silver, Native Silver, and Silver Ores, occur with Quartz, Calcareous Spar, &c. filling fissures (veins) in

* A specimen of Gold, in my possession, ten ounces in weight; also the finest Crystals of that substance hitherto seen.

the stratum, also accompanying other Metals, and not unfrequently combined with them. Silver is often rich in Gold, and Gold is frequently alloyed with Silver. In the North of England, and more particularly in Devonshire and Cornwall, the Lead Ore contains a considerable proportion of Silver, which is extracted from it. Some varieties of Ore have produced above a hundred ounces of Silver in the ton of Lead. The Lead Ore is accompanied with Fluor Spar, filling and forming what are termed veins, in which excavations are made to great depths, and their produce brought to the surface.

Copper Ores, Iron Ores, Lead Ores, Tin, &c. are extracted from veins of large magnitude, also from those of smaller dimensions; some are called strings, generally branching from the principal veins; these Ores are frequently very difficult to obtain, and which, in many cases, require a great deal of skill, and the occupation of the miner. After they are brought from their subterraneous abode, they are dressed, that is, broken to small pieces and separated from other substances which may adhere to them, and then submitted to the furnace, before they can become useful.

The most instructive collections for beginners are composed of those varieties which are in general use, viz. *Gold*, *Platina*, *Silver*, *Copper*, *Iron*, *Tin*, *Lead*, *Zinc*, *Cobalt*, *Manganese*, *Antimony*, and *Bismuth*. Such is the ingenuity of the present age, that they are offered to our use continually, nay, most of them are present on a common dinner table in one shape or other; t is necessary to observe that these metals present great

variety, which must be seen and examined before their character can be so known as to enable the beginner to discriminate one of them from another.

The other metals, as *Nickel*, *Arsenic*, *Molybdena*, *Uranium*, *Cerium*, *Titanium*, *Tellurium*, *Irridium*, *Tungsten*, *Palladium*, *Osmium*, and *Tantalium*, are of less importance. Several of them may be said to be of rare occurrence, and cannot be so interesting to the learner as the preceding.

ON

Geology.

EARTHS are commonly understood to be composed of substances neither metallic nor inflammable, though many of this class contain various proportions of the former *, and a few are combined with the latter.

The beginner must inform himself of the names of those substances generally called *Earths*; they are but few, and those most commonly met with are only five, viz. the *Silicious*, *Calcarious*, *Argillaceous*, *Magnesian*, and *Barytic;* to which is added the *Strontian;* none of which have hitherto been met with in a state of purity, being always associated with one or more substances, either chemically combined or mechanically compounded.

These I purpose to treat of in the following pages, and to endeavour to explain their general characters, and the peculiarities which may distinguish them from each other in the common state of their ordinary appearances.

* *Iron*, for example, forms the colouring matter of a great many substances, as Red Sandstones, Clays, Gypsum, &c. &c.

There are three other Earths which are very little known, viz. *Zirconia*, which has only been found in the Zircon and Jargoon, also *Glucine* and *Yttra;* but these very seldom occur, and the beginner, who is desirous to know more of them, may consult an elementary work *.

The surface of the globe, mountains, vallies, the bottom of the deep, and the whole united mass of the terrestrial orb, are comprised in the general term EARTH, and are believed to be composed of the four † first named, blended or combined in all the degrees and forms which the Infinite Power, who created it, has thought fit to present it to our view.

As Silicious substances are in greater proportion than any of the others, I will endeavour to shew how they may generally be known.

Silicious Earth or *Silex* ‡, occurs in great abundance in Granite, which is composed of Quartz || and Felspar, a substance dissimilar to the former, and also of Mica, very different to both; these are understood to have been the first chemical deposits, when Earth obeyed the Almighty Fiat, separated from chaos, and formed (the greater part of) the globe, the immense mountains of *Granite* and *Granitic Rocks*, which sometimes alternate

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* *Barytes, Strontian, Zirconia, Glucine,* and *Yttra.* These Earths are very limited; the first is not uncommon in this country, the next may be said to be seldom met with, and the three others are of rare occurrence. Zirconia exists in the Zircon. Glucine exists in the Emerald, and Yttra in the Gadonolite.

† *Silicious, Calcarious, Argillactous, and Magnesian.*

‡ Silex lat. Flint. See Phillips's excellent work.

|| The word Silex has given way to that of Quartz, which will in future be used in this little treatise.

with others, supposed to be of the same Primitive—the earliest formation.

Granite forms the highest mountains, some of which are the most rugged and peaked that have hitherto been explored, also the general tract of Alpine countries; and the deepest ravines *, having frequently immense tracts of various formations, betwixt its lofty points, forming mountains of different elevations, rocks, hills, and vallies of great extent, or ravines more or less confined. (See plate A.)

Of this almost universal formation (Granite), the substance called Quartz, forms a predominant part, and may be known from its associates, *Felspar* and *Mica*, by observing the following characters. As some varieties of *Granite* are very small grained, consequently the component parts are more difficult to be distinguished than in others, therefore, I recommend to the beginner, first to examine specimens of the large-grained Granite, in which the three substances may be distinctly seen, and to notice with attention the constituent parts separately, as Quartz, Felspar, and Mica.

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* Imagine a valley of any extent, betwixt two lofty points of Granite, to have been subject to repeated influx and inundations, which have brought together as into a reservoir both animal and vegetable remains; also, the decomposed particles of its confines; such a tract would present a very different appearance from that of *Granite*, and would constitute what is termed the filling up or flat formation *, consisting of stratified and homogeneous deposits.

* Ger. Floetz ferman. See plate.

Quartz (Silex), the immediate subject of our inquiry, has generally a shining lustre, is of a light colour, and not unlike glass; the fracture is uneven, irregular, not of any determinate form; it is often imbedded in Felspar, and when broken across, sometimes resembles Hebrew characters. It is often opake, approaching to white, and not unfrequently smoaky of different shades of brown; these are its usual appearances, though it is sometimes yellow, pale or deep pink, and approaching to red, also violet, blue, &c. It is hard to the knife, but a good file will make an impression.

Quartz * appears massive, also in regular and irregular forms, compressed or aggregated. If diaphanous and very fine, it is then called Crystal, or *Rock Crystal*, some varieties of which are of various colours, as has been before stated. Silex is also in great abundance in other Rock formations besides Granite; Quartz forms extensive veins, patches of great magnitude, skirting or covering Rocks, and there are few metals that it is not associated with.

Silex is so universally diffused, that it would be difficult to say where it is not. Flint, Chalcedony, Agates, Jaspers, Aggregates, Petrified Wood, Hornstone, Felspar, Clays, Mica, &c. &c. partake largely of this substance; and the very numerous and extensive class called Sandstones, coarse and fine, and of almost every denomination, is composed of it, whether reduced to Pebbles, Gravel, to large-grained Sand, to Sand, and

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* Melts with Soda (Potash) and forms glass.

to the finest particles called dust, in which state it enters succulent vegetables, as the stems of rice, &c. to which it adheres in the early stage of their growth, and is perhaps conducive to the perfecting of the plant.

Felspar * is considered the second constituent of Granite †, and in some varieties it is more abundant than Quartz, though not quite so hard.

When a piece of Granite is broken, the Felspar in it generally appears as if split or divided, having a smooth flat fracture, and a regular form, or a tendency towards it, which is not the case with Quartz.

Felspar is commonly of a grey colour, and has a shining silk-like lustre; it is often pale red, and then forms Red Granite. It rarely occurs transparent, or blue, or green; what is called Labrador, or irrediscent Felspar, is very beautiful; it exhibits the finest colours, as blue, green, red, yellow, &c. in the same specimen.

Felspar is in distinct or aggregated crystals, or disintegrated; it also occurs massive. It is often in decomposition, when it becomes dull, earthy, and passes into Clay. If these characters are well noticed, Felspar will easily be distinguished, particularly in Granite.

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* This substance, properly speaking, belongs to the Argillaceous Class, but as it associates with Quartz, to form Granite, I have thought it best to describe it here.

† *Quartz*, *Felspar*, and *Mica*, are understood to form Granite, but it often contains a large portion of Hornblende, which, in some cases, resembles Mica. Tourmaline and Schorl is commonly imbedded in this Rock, also Precious Stones are found in it, &c. &c. &c.

Mica, the remaining constituent of Granite, is of a yellowish colour, and has a strong metallic lustre; often appears as if composed of leaves, divides, separating as thin as fine paper, and is extremely elastic. In mass it has frequently a smoaky brownish tinge, but in laminæ is generally so transparent, as to be used to cover objects for the microscope, and is used for windows in Russia; hence called Muscovy glass. It is often seen in soil, as at the bottoms of rivulets, in South America, and many have brought this substance from abroad, believing it to be Gold! Mica is soft, easily scratched by the knife, and produces a white flaky powder.

Mica belongs to the Magnesian class, but as it forms a constituent of Granite, I have thought it best to explain its characters to the beginner, after those of Quartz and Felspar, as they commonly are associated together.

The next in abundance of Earthy substances in nature is *Limestone*.

Primitive Limestone occurs in the Granitic formation, and is supposed to be of the same origin. This Limestone is granular, as Dolomite and some varieties of statuary marble; or compact, as that from the Isle of Tiree. It does not contain any animal remains or vegetable impressions; as a Primitive Rock it is not very abundant, neither is it considered so in the Transition formation, where it sometimes contains traces of organic remains (petrifaction).

In the Secondary, or what is termed the Flat Formation, Limestone is very generally distributed, forming

mountains of less magnitude, vallies, and plains; it has a regular stratified appearance, shewing signs of deposit at different and distant periods. This Limestone appears in great part to be formed of Marine petrifactions.

These mountains, though of small extent, present perpendicular and very rugged features, as if separated from each other by some violent concussion, dislocating their strata, which, in many situations, is thrown in great confusion. In it, fissures of great depth and magnitude appear, some of which are filled with metallic substances, as Lead Ore, and are generally accompanied with Calcarious Spar *.

Those Limestones called Marble, extend to innumerable varieties; the black is much esteemed; the best in this country is in Derbyshire, near Ashford, belonging to the Duke of Devonshire, where mills are erected for working it; also at Derby.

Chalk belongs to this order, and pervades a considerable extent of country, as may be seen in Phillips's excellent work. It is too well known to need any description.

Gypsum, Alabaster, is Lime combined with sulphuric

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* Calcarious Spar is usually of a yellowish colour, more or less diaphanous; it is doubly refractive, and when transparent, shews that power in proportion to its thickness. If a pin be put underneath it, two will appear, distant from each other in that proportion as the Specimen is thicker or thinner; when broken, its fragments have a regular rhombic form.

acid. It is very abundant in Derbyshire and Nottinghamshire, and forms a considerable extent of country, filling cavities in the Red Marl, and rising into low hills*. It is soft, may be scratched by the nail, which sufficiently distinguishes it from Marble.

The Argillacious order is considered next in abundance; it commonly appears in the form of Clay, and is more or less indurated.

Primitive Schistos, or *Clay Slate*, belongs to it, which often presents itself, alternating with Granite; it abounds with veins filled with Quartz, Fluor, &c. also many and various metallic substances. Clay slate is of a dull dark colour, bluish black; it is earthy; splits freely, absorbs moisture, and cannot be mistaken after being once examined.

Primitive Porphyry belongs to this order; it is of a red brown, with angular patches of light Felspar, or dull green, and migrates into lighter or darker shades; that called Egyptian Porphyry is the hardest, and may guide the beginner in discriminating other varieties.

Green Stones, from containing a great portion of Felspar, belong to this order; and though they are so

* Lime, combined with Fluoric Acid, forms the beautiful fossil, called Fluor; that variety from which such elegant and beautiful vases are made in Derby, is peculiar to one mine. Fluor has generally a cubic form. Fluoric Acid attacks and corrodes glass, which no other acid acts upon.

intermixed with Hornblende, which is frequently in minute particles, yet the Felspar may be known by its lustre and flaky appearance.

Varieties of *Basalt*, *Trap*, *Grau-wacce*, *Toad-stones*, *Shale*, &c. are ranked in this order.

These substances, when decomposed, (to which many varieties are so subject) form Clay. The Felspars produce the finest, which is used to make China and the best earthenware. Clay-slate, Shale, and the more earthy varieties, when decomposed, form common potters' clay, which is used for coarse earthenware, or for bricks. The beginner may discriminate common Argillacious substances, merely by wetting or breathing on them, when they give out an earthy odour*.

After the preceding Earths, so universally distributed, the *Magnesian* claims our attention; it does not occur by any means, in so great a proportion as the others; on the contrary, it may be deemed scarce.

Magnesian Class. The Serpentines belong to this order; they occur at the Lizard, in Cornwall, in a tract of several miles in extent; another variety is found in Scotland, and it occurs in various other parts. Many of the Traps and Amygdaloids contain portions of Magnesian Earth, which may be known by being slippery

* Adamantine Spar, and what are termed Oriental Stones, as the Sapphire, are chiefly *Argill*, but for more particulars the learner may consult an Elementary Work.

or greasy to the touch; Mica, Talc, and the soap-like substances, Steatite, and many Clays, Asbestos, &c. belong to this order.

Hornblende, a substance generally diffused, forms a part in Granitic Rocks, as Gneiss and Sienites, also in Serpentine; it may be known from Mica on being gently struck with the small end of a hammer, so as to abrade it, or scrape it with a knife, and a dull green powder will be produced; it contains a large portion of Iron; it is very abundant in Basaltic Rocks, Trap, Amygdaloids, Green Stones, &c; when in decomposition it is red, ferruginous, and frequently colours Clay, particularly if it is associated with decomposed Felspar.

Barytes forms so small a portion of the Earth's surface, that it rather belongs to the class of fossils, and though by no means scarce in this country, yet it is so limited, as not to admit of the most distant comparison with any of the preceding; it is commonly found in veins, does not compose any other formation, and may be known by its great weight; it yields to the knife, and is frequently massive; of an earthy texture, and resembling Chalk; it is also crystallized and transparent. It is considered an alkaline earth; its properties are well explained in Parkes's Chemical Catechism.

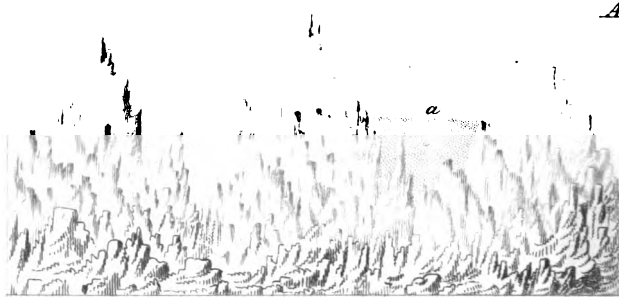
A variety, called *Carbonate of Barytes*, is more rare; it has generally a striated and diverging fracture; is very compact, and, as Common Barytes, may be known by its great weight.

Strontian is an Earth newly discovered; it differs but little from the preceding, but it is not so heavy, and is generally of a sparry texture; often of a very light blue colour, and is then called *Celestine;* it occurs fibrous, and also of a dull earthy appearance.

Another variety, called *Carbonate of Strontian*, is light green, striated; it is often accompanied with Earthy Barytes, and may be deemed rare.

The chemical properties of these may be seen in Parkes's Catechism, and a more particular description of them in the New Descriptive Catalogue of Minerals.

A

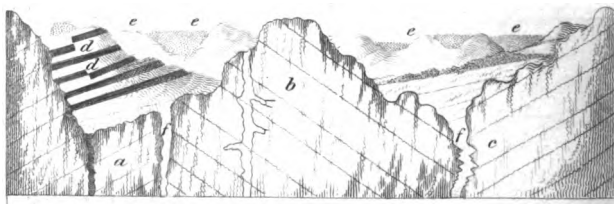


Primitive Rocks.

B

Primitive Rocks & Secondary.

C



Stratified Rocks Floetz Formations and alluvial deposit.

Cruft sculp.

Observations

ON

THE PRIMITIVE FORMATION.

After having described the Earths as they commonly occur, it will be proper to explain what is meant by the word formation, when applied to Earthy substances.

Geologists agree that there are certain Rocks more ancient than others, and have denominated those which are considered oldest, *Primitive Rocks*. Thus, those of Granite, &c. are said to be of the Primitive Formation, whilst others are (said to be) of the Secondary or Transition Formation, and a third class are styled the Flœtz or Flat Formation, being formed upon the Primitive or Secondary, and bounded by rocks of that description.

It is not my intention to point out where these Rocks are to be found, except in particular cases, nor do I think it necessary to enumerate *all* their varieties, but to explain to the beginner the characters by which they may be known, after having examined a few specimens without entering into the geometric form of the substances which compose them; therefore, as Granite is considered the first or oldest formation, I shall com-

mence a general and brief description of some of its varieties.

Although the Crystals of *Quartz*, *Felspar*, and *Mica*, are commonly so confusedly aggregated, and intermixed with each other, yet they often occur distinct, particularly on the surface of pieces wrenched from hollows or cavities.

Granite, large grained, is composed of large crystals of Quartz, Felspar, and Mica, distinctly or confusedly aggregated, as the Grey Granite, on Dartmoor.

Granite, common, neither large nor small grained, is composed of Quartz, Felspar, and Mica, in regular proportions.

Granite, small grained, occurs often with Garnets imbedded in it.

Granite, composed of dark smoky Mica, sometimes appears almost black; the Mica predominating.

Granite, GRAPHIC, is composed of long crystals of Quartz, imbedded in Felspar, and when broken across, exhibits Hebrew-like characters, hence called *Literatus*; the Mica in this variety is in distinct patches.

Red Granite, so called when the Felspar predominates and is of a red colour, is common in Scotland; the Cathedral, on the Isle of Icolmkil, is built of this variety.

Granite, the Felspar of which is decomposing, is

quite soft, and passes into Clay; in this variety the Felspar is sometimes in regular crystals, but more commonly disintegrated; the Mica and Quartz appearing unaltered *.

Granite, composed of Felspar and Quartz, approaching granular, with Hornblende disseminated, and a small portion of Mica, having large and perfectly defined crystals of Felspar imbedded. A variety of this has been called moor stone in Cornwall, and some have named it Porphyritic Granite; it may be seen in the pavements of London, particularly after rain, the crystals of Felspar protruding above the surface. This variety differs much in the proportions of its component parts; it often approaches SIENITE. Garnets, Tourmaline, and Schorl, are frequently imbedded in it.

White Stone, is a fine-grained variety, consisting chiefly of opaque Felspar, sometimes having the appearance as if in decomposition; it is associated with Quartz and Mica, and is merely a variety of Granite.

Gneiss, is Quartz, Felspar, and Mica, lying parallel, particularly the Mica, forming thin beds, and has been called Slaty Granite.

Another variety is, by some Geologists, called Gneiss,

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* Felspar contains more or less Alkaline matter, which subjects it to decomposition, some varieties contain a considerable portion.

This Alkali, meeting with Iron (and perhaps other metals) may act in a manner that we are unacquainted with, and be the cause of various appearances.

when Hornblende forms a constituent, without regard to its lying in laminæ.

Sienite is Felspar with Hornblende; it is commonly of a dull red colour, as at Mount Sorrel, in Leicestershire; is extremely hard; it is also grey, dark green, &c.; it is not very abundant, and commonly taken for Granite. The colossal figures in Egypt are said to be *Sienite*. *Clay Slate* occurs, filling cavities in this substance.

Sienite, when composed of more Hornblende than Felspar, is often called Green Stone, of which there are many varieties.

Hornblende, though a constituent of Sienite, and various Greenstones, forms in itself Rock Formation, and is sometimes accompanied with a small portion of Felspar, and then called Hornblende Rock. Hornblende varies in colour from light dull green, to almost black green.

Topaz Rock is a variety of Granite, of a slaty texture, like Gneiss, with Topazes imbedded in it. The Felspar is frequently decomposed, forming Clay.

Mica Slate, is Mica and Quartz laminated, or Mica in small particles, having a slaty texture; it is abundant, and frequently Garnets, Schorl, &c. are imbedded in it. Mica Slate has often an undulating and curved appearance; in some cases it appears as if wholly composed of Mica. This variety is composed of fine particles, which pass into Clay Slate.

Quartz Rock is both massive and granular; it frequently contains Mica, and sometimes Talc, a substance resembling Mica, often large portions of Tourmaline and Schorl, and is then called Schorl Rock. Garnets and Pyrites are frequently imbedded in it.

The following Primitive Rocks probably were not formed at the precise epoch of the preceding.

Clay Slate is next in abundance to Granite, and often alternates with rocks of that order, forming mountains, filling hollows, &c. It is called Killas in Cornwall, and in it many metallic veins occur, particularly those of Tin and Copper, also Lead; the latter is commonly rich in Silver. Clay Slate is generally of a dark colour and earthy; it is also slaty and shining, sometimes appearing as if composed in great part of fine particles of Mica; these varieties soon decompose. Slate used for roofing and paving, which the learner may have observed, is of various colours, belong to this order; in it Pyrites and Rock Crystal are frequently imbedded.

Flinty Slate is hard, of a black colour, and compact; splits slaty, and occurs with Clay Slate; it differs from Flint by being opaque, and is of a different texture; frequently contains small veins of opaque white quartz.

Porphyry. What is commonly understood to be Porphyry is a hard red brown substance, enveloping, or containing crystals imbedded in it, which are generally Felspar of a light colour; this variety is called Red Egyptian Porphyry. Green Porphyry is of

a dull dark green, with crystals of Felspar of a light green colour, and has been called Oophites. Brown Porphyry, as that from Sweden, resembling the Egyptian, though it is not so red.

There are other varieties of Porphyry, as Pitch Stone Porphyry, Green Stone Porphyry, Hornstone Porphyry. Any clay-like indurated paste or mass, enclosing distinct crystals of another substance, is commonly called Porphyry.

Jaspers of various colours and descriptions often fill fissures in this formation.

Serpentine is not very abundant in this country, and when associated with Primitive Rocks, it is considered of the same formation. Serpentine is commonly dark coloured, brown red, with reddish marks, or dull green, variegated; it occurs also lighter or darker, often spotted, sometimes with splendent shining Hornblende. Some varieties appear compact, like Talc; but after examining a few specimens, it may generally be known by its variegated colours, and being soap-like to the touch; when breathed upon, it gives an earthy odour. It is soft to the knife. Veins of Talc, Steatite, and Asbestos, frequently occur in it.

Primitive Trap. The substances of this formation are composed of minute crystals, almost wholly of Hornblende, and then are of a dark colour, approaching black; they are very hard and compact; some varieties contain a larger proportion of Felspar, which may be distinguished by its lustre, and being of a light colour. It differs every way from Sienite, which is probably owing to the chemical state of the Hornblende.

Green Stones, composed of Felspar and Hornblende, belong to this formation, when associated with Primitive Rocks, and may be distinguished from those (Green Stones) of the Secondary Formation, by being more distinctly crystallized, and harder.

Primitive Limestone is granular, as Dolomite and Statuary Marble, or compact, as the Limestone from Tiree, where it occurs of a beautiful flesh-red colour, enveloping Sahlite and Titanium. It effervesces with acid, and always yields to the knife. Another variety, from Scotland, is of a clouded pale green; it is extremely hard, and of close texture. The learner will know, before he has read thus far, how to discriminate Limestone from any other substance.

Primitive Gypsum is soft, yields to the nail; it is both granular and compact, appearing with Primitive Rocks. The Italian Alabaster is said to be Primitive. As a formation it is of little importance, and occurs filling cavities of small extent.

Every day new substances are discovered, imbedded in Granite or Granitic Rocks, as Tantalite, Lithon, Spodumene, Fettstein, Zircon, &c. &c.

The Primitive Formation may be supposed to have been pointed, perpendicular, split in all directions, and without any regular order, presenting the most rough and barren appearance before vegetable was created, and before decomposition could take place. Such mountains may be supposed to be represented in plate A, which is intended merely to give the learner an idea of rugged Alpine scenery. A valley may be sup-

posed filled with deposits, as Blue Clay, Sand, &c. as *a*. The greater part of the Globe yet being covered by Sea, great alterations and changes of the Earth must be constantly taking place.

This short account of what are termed Primitive Rocks, when understood, will enable the learner to determine and distinguish them from those of other formations; but it is necessary to observe, that hollows, rents, or fissures, in this formation, may be filled, not only with metallic ores, but with varieties of their own Rock species, also Porphyry, Jaspers, Hornstones, Green Stones, Calcarious Earths *, &c. &c.

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* Granite, Sienite, Mica Slate, and Clay Slate, are more metalliferous than the others.

Observations

ON

THE SECONDARY FORMATION.

SEE B. PLATE A.

THE Globe being formed, Land and Water separated, the natural result of TIME, would evidently produce great changes; thus the disintegration and decomposition of the Primitive Rocks, both above and below the sea, the action of the atmosphere, and various deposits of which we have no idea, must have produced other formations before, and in part after, the Creation of Animal and Vegetable Substances; but it is a received opinion, that they were not in abundance during that epoch. The substances belonging to, and arranged in this formation, are termed, by Geologists, Secondary Rocks, and may be considered partially mechanical as well as chemical deposits; they are called *Grau-wacce*, *Transition* or *Secondary Limestone*, *Transition Trap*, and *Transition Flinty Slate*.

Grau-wacce is a mechanical deposit*; that is, it is supposed to be an aggregate, composed of the debris of the Primitive Formation, whether coarse, fine, compact, slaty, granular, &c. Grau-wacce must, therefore, be considered extremely different in its appearance and texture, as, from its nature, its constituent parts are very various. Its colour is generally dark, dull, often greyish, and most commonly its base is argillaceous, cementing together grains of sand differing in size, angular and rounded Pebbles, also patches of indurated Clay or Flinty Slate, and has sometimes, when composed of fine particles, a slaty texture; it is hard, and may be considered a deposit of considerable extent, and highly metalliferous. It is difficult to describe Grau-wacce, so as it may be known. It is necessary to see some well-defined specimens before a correct idea of it can be obtained.

Secondary Limestone is generally considered that which is associated with other Rocks of the same formation, connected with those of the Primitive; this Limestone is perhaps a deposit more mechanical than chemical, and is scarcely to be called granular; its texture is fine, and its colours very variable, and frequently strongly contrasted, as red, black, white, yellow, &c.; it is abundant in Devonshire, both at Torbay and Plymouth, where it exhibits marks of stratification;

* Chemical formation has been explained in Granite. An indurated mass, or rock formed by the disintegration of others, or intermixed with organic remains, is called a Mechanical deposit.

some of it when polished, is very beautiful, the streets of the town of Dock are paved with it, where some of the finest specimens may be found. In the north of Devonshire, near Castle Hill, this variety of Limestone occurs, filling large cavities in Grau-wacce Slate. In it are many sparry white veins, and abundance of Pyrites. Marine Fossils and Petrifactions occur, but not of the same description, nor in any degree so abundant, as in the Limestone of the Flat Formation. As a Limestone, the learner will discover it either by the test, or by burning a small particle of it to Lime.

Patches and beds of Green Stone sometimes occur in it.

Secondary Trap. This formation may be considered to consist of what is more commonly termed Green Stones, which are very abundant. The constituents, Felspar and Hornblende, are less crystalline than in the Primitive.

Green Stones form great variety, some of them are in part mechanical as well as chemical deposits; they differ from Sienite, the component parts being less distinct, and more blended together. They are commonly of a green colour, and frequently contain veins of Quartz; they are sometimes dark, approaching black.

A substance belonging to this order, of an earthy dull appearance, and vesicular, is called Wacce. Cellular substances (scoria-like) have often been supposed to be of volcanic origin, without considering that such vesicles may have been formed by air or water, or by the decomposition of some substance which may have been absorbed.

Amygdaloid is another variety, containing nodules of Agate, Jasper, Chalcedony; also Zeolite, Green Earth, Hornblende, and is often vesicular. It occurs hard, soft, and earthy, according to its stages of decomposition; further description will avail the learner but little; specimens must be examined, to be known. This variety of Trap is considered to be formed with Grau-wacce, and occurs, filling cavities and skirting the Primitive Formation.

Trap is the Swedish term for ladder; some Green Stone Rocks, Basaltic Rocks, and Hornblende Rocks, commonly appear as forming steps, hence Trap, ladder. This appearance is caused from the action of the atmosphere. It is particularly visible at Staffa, various parts of Scotland, and other places.

Transition Flinty Slate, is a silicious flinty substance; it occurs in thin strata, with Grau-wacce and secondary Limestone; it is compact, and marked by alternate lines of a dark and lighter colour.

Of this, the Secondary Formation, the Grau-wacce may be said to be the only one that is metalliferous, at least in this country. Grau-wacce is no doubt more extensive than has hitherto been suspected, and it is a query, if many Authors, who have met with substances (as they always will do) which they could not rank under any of the precise names or classes that Werner has assigned to them, have not called such, Grau-wacce or Green Stone!

The engraving B, plate A, is intended to shew Primitive Rocks, blunted by decomposition, and the Transition Rocks, forming from their disintegration upon their bases.

It is by no means improbable but that many more varieties will be ranked in this formation, when our ideas become unfettered, and our reason has fair play, in opposition to theory, which it is now the fashion to follow.

Nor is the following arrangement free from objection.

FLŒTZ OR FLAT FORMATION.

C, Plate A.

This formation is supposed to be more recent than either of the preceding, and may be said to be formed by deposit, chiefly mechanical, from the debris of the others, and the result of organic remains, resting upon the Primitive or Secondary, having been formed at various epochs, and by various operations of nature, filling or rendering more flat extensive valleys between elevated Rocks of the Primitive order. This formation is very general throughout a great part of the globe, and shews evident signs that it has been formed under water, after which violent convulsions must have taken place, from the visible great irregularity of the strata.

It is my intention to endeavour to explain the substances which compose this formation, so that they may be known from others, rather than attempt to account for the manner in which they were produced,

The plate C is intended to exhibit the appearance of stratified rocks, as Limestone, *a*, *b*, *c*, also a section of a vein of Lead Ore; the figures *f*, *f*, shew the separation and dislocation of the stratum.

The beds of Coal are represented by *d*, *d*; they are independent of each other, having indurated Clay or Sandstone between them. The surface *e*, *e*, *e*, *e*, is intended to shew the Clay basins, Sand hills, Gravel, and Alluvial Deposits.

The Coal formation is attended by petrified stems of Plants, and numerous Vegetable impressions; also fresh water Shells, which indicate its origin to be very different to the preceding.

Following the Wernerian arrangement, the first deposit belonging to this formation is

Old Sandstone, or Sandstone of the first flœtz formation. It is supposed to rest upon some of the preceding, and is composed of ferruginous Clay, Sand, &c. frequently having more the appearance of decomposed Clay Slate than Sandstone. It is commonly red-coloured, and approaching earthy.

First Flœtz Limestone is a regular stratified rock of great thickness, containing numerous Petrifactions, as Shells of various species, Anomia, and Entrochi. Its colours are various shades of grey, blue, &c.; it is hard and compact, though in this stratum granular Limestone has occurred in beds and patches. The learner will distinguish it to be a Floetz Limestone, from being almost composed of marine remains, before he attempts to de-

termine its relative position. This formation, consisting of innumerable varieties, is of very great extent; patches of other substances have occurred in it.

First Flœtz Gypsum sometimes contains crystals of Quartz and Boracite, and frequently associates with rock salt; in texture it is so like other varieties of Gypsum, that it cannot be known, except when seen in its situation.

Second or Variegated Sandstone, is a deposit of fine granular sand, in great regularity, and often coloured red, yellow, and brown; it is moderately coherent, and contains a considerable portion of oxide of iron.

Second Gypsum. This consists of varieties more or less compact; it occurs filling cavities in the Sandstone formation, accompanied with red marl; it is frequently fibrous, and less hard than the preceding varieties; in Gypsum no Fossil Remains nor Metallic Substances have been observed hitherto.

Shell Limestone is, as its name explains, a Limestone almost composed of Shells, of more recent formation; its colours are various; it is sometimes sparry and foliated, but more generally earthy; it is abundant in Gloucestershire, and in it are beds of the Oolites (roe stone); it may easily be known from any of the preceding varieties by being less compact.

Third Sandstone. This formation is of considerable extent, and may be considered that on which the Coal rests.

Its appearance, where it forms the surface, is generally rugged, exhibiting rocks of great irregularity. In it are beds of different texture; some are laminated with Mica, and are used for paving, roofing, and other purposes; lead ore sometimes, though rarely, occurs in it.

Rock Salt is generally of a red brown colour, rarely blue, sometimes perfectly transparent, and has commonly an ice-like appearance; it rests upon Sandstone, and is often associated with Gypsum, great variety of Grit Stone, Clay, and semi-indurated earthy substances are formed above it.

Chalk. This formation is of great extent in this country, also on the continent, particularly in France; the margin of the English Channel is in several places formed of this substance, which is too well known to need any explanation; in it are regular beds and nodules of Flint. This singular variety of the Limestone formation, contains innumerable petrifactions, particularly marine, of almost every description, but no metallic ores have hereto been discovered in it, except pyrites.

Coal. This substance, so useful and of such high importance to this country, is too general to require particular description. Coal is compact, as Canal Coal, or Foliated Shining and Slaty; there are also earthy varieties. Canal Coal has in many cases a wood-like structure. Foliated Coal frequently contains thin layers of Charcoal, in delicate fibres. Coal is commonly formed in beds of different thickness, from two to five or six feet and more. Each bed is separated by Sandstones,

bituminous clay, more or less indurated, both of which are frequently blended together.

Sandstones, of the Coal formation, are very various in their texture and composition; some are hard and tolerably compact, others are soft and earthy; they generally contain mica, which is more abundant in some than in others.

Peculiar Sandstones above Coal, are general indications of its position, from whence may be conjectured its depth; for it is reasonable to suppose, that if certain Sandstones attend Coal in one situation they *may* do the same in another.

FLŒTZ TRAP FORMATION.

The substances comprehended in this order, are in general supposed to be coeval with the Coal Formation, which they frequently obstruct and dislocate, throwing the beds into great disorder. They often occur in large fissures, called *Whin Stone Dykes*, and in smaller, called veins, frequently traversing Rocks of the Primitive, Secondary, and Flœtz Formations; there can be little doubt that some of the varieties belong to older formations.

It is in this order that volcanos are supposed to have their origin and their existence: the learner must be aware that there is a great difference betwixt Rocks altered by Fire, and what is termed Lava.

The general characters of some of the following substances have been before noticed, therefore I will be brief, and explain those which are understood to belong to this formation.

Basalt. When a simple substance resembles an indurated ferruginous Clay, of a dark colour, approaching black, and is often columnar. Some Geologists consider this order to be of Volcanic origin, or having undergone the action of fire. In it crystals of Hornblende, Olivine, and Augite, frequently occur.

Trap, frequently confounded with Basalt, is a compound of Black Iron Sand, Hornblende, Felspar, Marl, fine particles of Mica, &c. cemented by a Clay base, which often contains small nodules of Zeolite, Chalcedony, Lithomarge, Calcarious Spar, &c. Its constituent parts are frequently very numerous, being formed from the debris of the older Rocks; veins of Carbonate of Lime occur in it. In decomposition it assumes various appearances, often resembles the scoria from a furnace, and soon decomposes into Clay.

Clink Stone appears a very fine compound of various substances, and cemented by an argillaceous base, sometimes containing crystals of Felspar, and forming a sort of Porphyry. It is of slaty texture, colour various, generally dull, bluish, or dark green, approaching black, sometimes waved, sounds like metal when struck.

Whin Stones. The substances belonging to this order are very various in colour, texture, and composition;

they may be considered chiefly mechanical deposits, consisting of Hornblende, Sand, particles of various substances, as Felspar, Quartz, Marl, Clay, &c. They are hard, difficult to break; some varieties in decomposition form Amygdaloid, and pass into Clay.

Trap Tuff is formed by fragments of the preceding varieties, as Basalt, Amygdaloid, Sandstone, &c. rendered massive by an earthy or clayey cement, and is a coarse aggregate.

Green Stone. Of this order it is difficult to say where they begin or where they end, as any substance with a greenish tinge is commonly called Green Stone. Those belonging to this formation seldom contain distinct crystals of Felspar; more generally it is granular, and often has homogeneous appearances. Agate, Chalcedony, and Jaspers, sometimes are found in it.

Pitch Stones are said to belong to this order; they are very light, of shining Pitch-like appearance; some varieties are red. It also occurs enveloping Felspar, and is then called Pitch Stone Porphyry.

They appear to be nearly allied to Obsidian.

VOLCANIC SUBSTANCES

Are those which are wholly or in part altered by fire. They consist of great variety, and are peculiar to those

countries where volcanos are met with, or have at some former period existed. The substances that flow from them are termed Lava, which are either compact, slag-like, or cellular.

Earthquakes, that have shaken the globe, ingulfed whole districts, and changed the appearance of nature, forming mountains where plains existed, and have thrown the whole system into the greatest confusion, are generally supposed to be the result of Volcanos.

THE ALLUVIAL DEPOSIT

Consists of loose Stones, Sand, Clay, Loam, &c. This formation may be said to cover the general surface of the Earth, as it comprehends every description of soil and disintegrated earthy substance. It is sometimes of great depth, and regularly stratified. In it occur Vegetable remains petrified, also Wood Coal, Peat passing into Coal, Bones, Shells, &c.

Alluvial soil is often moved with great violence by water, and its finer particles are carried away by wind, in such cloud-like appearances, as to form plains where hills before existed; nor is it uncommon that herds of cattle are entombed in it.

In this Deposit Diamonds and Gold are found in Brazil, Africa, and India; the same formation produces immense quantities of Tin in the Island of Banca, also in Cornwall, where Gold is frequently found in small particles.

This, the Alluvial Formation*, demands more investigation; it is naturally composed of the debris of the solid contents of the globe, and substances found in it have led to important discoveries.

The theory which the author has followed in the foregoing pages is considered to be the least objectionable, and as he is desirous that the learner should distinguish the various substances belonging to each order, it will be best for him to follow the beaten path, until he is enabled to discover a better road. Many have projected theories, some of which are more accredited than others; but none are free from great objections.

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* The word formation is meant to convey to the mind of the learner that the crust of the earth has been formed at different and distant periods, hence each period is called a formation, as the Primitive, Secondary or Transition, Floetz or Flat, and Alluvial.

Geological Collections may be obtained at a cheap rate, with the name and description of each specimen, explaining to what formation it belongs, by which the learner will be enabled to determine the substances he may generally meet with. These collections, on a small scale, will be interesting to those who read books upon Geological subjects, and may be purchased at from Two to Ten Guineas. The time necessary for selecting, arranging, and describing, forms a considerable part of their cost.

Description

OF

COLOURED PLATE.

A BRAZILIAN MINER WASHING THE ALLUVIAL SOIL FOR GOLD.

THIS plate is taken from a view in Cerro de Frio, in Brazil. The situation is a ravine, through which a stream of water runs, called Mielho Verde; it is bounded by rocks of Granite.

In the summer season a part of the bed of the rivulet becomes dry, and often the course of the stream is changed by placing planks, &c. in such a manner, as to lay bare the other part in order to remove the Gravel or soil which has been deposited after heavy rains; for this purpose people are employed in digging, raking, and carrying it away to the nearest plain, where they throw it into a heap. It is generally observed that the soil nearest the solid rock is most abundant in grains of Gold and Diamonds, consequently the surface of the rock is scraped, and not an atom of the Alluvial Deposit suffered to remain. When the rains commence, and the water is in sufficient abundance, the most skilful miners are employed in carefully washing this soil in

small conical bowls; the operation is performed as follows: the bowl being in part filled with water, about ten or twelve pounds of the Gravel is put into it, which is continually stirred about until the pebble stones are washed clean; as the water becomes muddy from the earthy matter being held in solution, it is poured off, and fresh is continually added, until the whole is washed, so as no longer to render the water turbid; then the larger stones are thrown away, and the smaller ones picked out with great care, below which the Diamonds will be found, and at the bottom the grains of Gold will appear, generally accompanied with Iron Sand. The Diamonds are more easily distinguished when wet, having a peculiar semi-metallic lustre, and are about one-third heavier than Pebbles of the same size.

Gold, whether in larger or smaller grains, being ten times heavier than Pebbles, or the earthy substances in which it may have been imbedded, falls to the bottom of the bowl as soon as the earth is washed from it.

The plate represents a smuggler at the heap, by stealth, as, wherever Diamonds are found, the crown claims the property. Frequently men go ten or twelve miles in the night, and take a sack of this Gravel, which they wash at home secretly. This is what is called hand-washing. There are other modes practised on a larger scale, which are more expeditious, but not so economical. I have seen eight men procure upwards of twenty ounces of Gold in four hours, from a portion of soil not above two tons, which was taken from a deep hole which occasioned an eddy in the river.

COLOURED PLATE,

SECTION OF THE STRATA AT MATLOCK HIGH TOR.

THE Section of the Strata at Matlock High Tor, represents the general strata of Derbyshire, from the coarse Grit down to the lowest Limestone. The reader may suppose himself on the road, and looking down the river; then the broken mountain of Masson and the Cumberland mine will be on his right hand, and the perpendicular face of the High Tor will be on his left; above which, further back, and out of sight, is the stratum of coarse Grit stone (*a*). This Grit is generally of a light grey colour, lying below the Coal; it is composed of angular and rounded fragments of Quartz with Felspar disseminated, and in crystals, having the decided characters of a mechanical aggregate; in it are a few traces of Schorl and Mica, but the Felspar being crystallized, allows reason to suppose it is in part a chemical deposit, which is often the case in compound rocks of this description; it is of considerable thickness —in some places upwards of fifty fathoms. Valleys are bounded by it on one side, whilst Limestone forms the other, which indicates that the strata have undergone great revolutions. This stratum rests upon Shale, and where they approach each other, the Grit becomes lamellar, soft, and often contains thin beds of Shistos.

Bituminous Shistos. *Shale* (*b*) forms a stratum equal in depth to the preceding; its colour is dark, almost black; it is earthy, and though tolerably hard, yet, when exposed on the surface, divides in laminæ and decomposes into Clay; it has the appearance of being entirely a mechanical deposit, containing some fossil shells and vegetable remains, as stems of trees, impressions of plants, and Clay Iron Stone. Some varieties are so bituminous as to burn, and have been used in limekilns. It appears a compound of fine sandy particles, ferruginous Clay, and Marl, with a great proportion of decomposed vegetable matter. In it are many sparry veins, and frequently fissures of considerable magnitude, filled with Lead Ore and Calcareous Spar, which have been worked in this stratum. This Schistos or Shale rests upon Limestone, and where they are in contact, they partake of the qualities peculiar to both.

The First Limestone (*c*), which forms the summit of Matlock High Tor, exhibits marks of regular stratification, and is of a grey colour, appearing almost composed of marine remains; in it are numerous veins, filled with Lead Ore and beautiful crystallizations, which commonly divide the stratum in an east and west line; but there are others that cross them, and of course have a more northerly and southerly direction. The veins are often obstructed, and cut off by the abrupt intervention of the Toadstone stratum below; (*v*) is a mine or vein of Lead Ore now worked.

Toadstone, Trap (d). This stratum may be seen about the middle of the High Tor, and divides the Limestone; its colour, when compact, is dark and dull brown, never black: it appears to be composed of Hornblende, Clay, Feldspar, Marl, and ferruginous sandy matter; it is very hard, and in it are traces of Jasper, Chalcedony, and crystallized Quartz: it sometimes forms angular masses, and then has a Basaltic appearance: it varies in thickness, and is sometimes irregular; in it are thin and delicate sparry veins, but no trace of marine or organic remains. No Lead Ore, or regular vein bearing that metal, has been discovered in this compact variety, which appears to be formed by an entirely different deposit, that does not exhibit one trace belonging to the formation of the stratum above or below it. It is ferruginous, and in decomposition forms Amygdaloids of great variety, which finally pass into (perhaps Wacce) disintegrated earthy Greenstone and Clay.

Toadstone does not admit water to pass through it, and when in contact with Limestone, the appearance of both are greatly altered; above and below their junction several feet of each exhibits very different characters from those of their usual appearance. It is difficult to determine if the miners have not mistaken the change of the character of Limestone, when in contact with Toadstone, or if the continued action of water may not have caused some Lead Ore to have passed from the vein and penetrated into the Toadstone, either mechanically, or from being held in solution. It is my desire to state facts, rather than conform to theories. The book of nature is open, and I recommend every one to read for himself.

Underneath the first Toadstone is what is termed the

Second Limestone (e). In its general appearance is not unlike the first: it is composed of marine remains, and in it are beds of Magnesian Limestone; the veins of Lead Ore that were intersected by the Toadstone, appear again, with all their former richness and characters; *(l)* is a level driven from the edge of the river to carry off the water from the mine: this Limestone varies in thickness, and is divided by a second stratum of Toadstone, which forms the bed of the river *(r)*, rising to the west, and appearing above the celebrated Rutland cavern, formerly called Old Nestor Pipe,* *(f)* which is situated in the Second Limestone. Not a vestige of the First Limestone, nor the great Stratum of Shale, nor that of Grit, appear on the west side of this ravine.

The Second Toadstone (g) does not differ from the first, so that one can be distinguished from the other, except in some peculiar stage of decomposition; when forming a part of the surface, it appears slaty rather than stratified; it varies in thickness, and, like the first stratum of this substance before described, it cuts off the veins of ore by dividing the Second and Third Limestone.

Third Limestone (h). This stratum is generally darker coloured than the second, and contains a portion

* Pipe is the usual term for a flat vein: this vein branches, and from it the famous Rutland cavern appears. This cavern is by much the grandest, and most romantic of any in this neighbourhood, the roads being perfectly even; it is easy of access, and produces some fossils peculiar to it, and others of great beauty.

of flinty chert: some of its beds are composed of different marine remains; in it are *patches* of Toadstone, independent of that stratum above or below it. This Limestone is of great thickness; it forms a considerable extent of surface, and contains numerous veins of Lead Ore, which are, as the former, abruptly intersected by

The *Third Toadstone (i)* which forms a stratum like the others before named, and with the same characters; its thickness varies, and in some cases, after sinking a hundred fathoms, it has not been cut through: it forms a considerable extent of surface in the mountainous districts, and rests upon the

Fourth Limestone (k). This stratum is the lowest of the Derbyshire series; it forms a considerable extent of surface in the north of Derbyshire; in it are many veins of Lead Ore, also deep fissures, and great caverns: its beds are generally of greater thickness, and less variable than the preceding varieties; it has never been cut through; therefore it may be truly said, that we do not know, or at least are doubtful, upon what substance it rests.

The Limestones of Derbyshire form beautiful Marbles, which are in great estimation, particularly those from Rucklowdale and Wetton, the latter having a porphyritic appearance, and the former exhibiting figures of Coral, Madrepore, Entrochi, &c.; but above all, the Black Marble is most precious: it is superior to any *now* found in Italy; its beautiful black rivals the antique, and it admits of so high a polish, as to reflect like a mirror, for which purpose it is sometimes used. It forms beautiful chimney pieces, slabs for tables, &c., and of it the most

elegant vases are formed, which are so hard as to admit of being engraved, representing the figures of the Grecian Roman Schools.

The finest of these various Marbles are from the Quarries of the Duke of Devonshire, on whose princely estate are mills* for sawing and polishing these valuable substances, from whence they are conveyed to Derby, where a most extensive assemblage of the finest chimney pieces and slabs are on sale at *Mr. Brown's*, the proprietor of the establishment.

Collections, forming a series of Geological Specimens, from the uppermost Coal formation to the lowest Limestone, may be had at the *Museum* at Matlock, consisting of Thirty varieties, arranged and described, for One Guinea; or Fifty larger, and containing Specimens from the veins of Lead Ore, at Two Guineas. The finest Crystallizations of Calcareous Spar, Fluors, &c. at various prices.

The Geologist is particularly recommended to make Matlock his rendezvous for some days, as in its vicinity he will find such variety of strata, so many various productions, caverns easy of access, particularly the Rutland, in which the Toadstone appears: the mountain in which it is situated is called the Heights of Abraham, it is traversed in all directions by numerous veins of Lead Ore, respecting which, and particulars relative to

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* At Ashford is the Peak of Derbyshire.

the Mineralogy of the neighbourhood, every information may be obtained at the Museum.

The beauties of the scenery at Matlock have been described by Moore, an artist of great merit and ingenuity, who has published a small work, entitled, *Picturesque Excursions* in the neighbourhood of Matlock; it contains eight plates, and is expressly calculated to lead the artist to the most interesting situations for the employment of the pencil.

The pedestrian, about to make a mineralogical excursion, will do well to provide himself with a blow-pipe, a knife, containing forceps, file, and magnet, a small steel mortal, a pocket acid bottle, and a proper hammer; these are made so portable as not to be any incumberance, and will be the means of affording amusement in the evenings, when he will examine what he has collected during the day; a little borax, as a flux, may be added, and then he will be tolerably complete.

Small cases, fitted with *proper* bottles for the acids, and chemical tests, to which are added, blow-pipe, mortar, knife, &c. from three to six guineas, may be had of the author; also, the best books on Mineralogy and Geology, and whatever belongs to those sciences.

Collections of Minerals, formed of interesting and instructive specimens, more or less select, or numerous from five guineas to one hundred.

The celebrated Professor Werner has classed the Metals and Earths as follows. The varieties belonging to each may be seen in any elementary work, or in the New Descriptive Catalogue.

CLASSIFICATION OF METALS.

Platina.	Zinc.
Palladium.	Tin.
Irridium.	Bismuth.
Gold.	Tellurium.
Mercury.	Antimony.
Silver.	Molybdena.
Copper.	Nickel.
Iron.	Arsenic.
Manganese.	Tungstein.
Titanium.	Tantalium.
Lead.	Cerium.

CLASSIFICATION OF EARTHY MINERALS.

These are arranged in what are called Families, and each are divided into Species and Sub-Species, comprising great Variety.

Diamond.	Azurestone.
Zircon.	Felspar.
Ruby.	Clay.
Schorl.	Clay Slate.
Garnet.	Mica.
Quartz.	Lithomarge.
Pitchstone.	Soapstone.
Zeolite.	Talc.

Hornblende.	Fluor.
Crysolite.	Gypsum.
Basalt.	Boracite.
Dolomite.	Baryte.
Limestone.	Strontian.
Apatite.	Hallite.

SALINE MINERALS—Earthy Salts.

Alum.	Epsom Salts.

ALKALINE SALTS—Salts of Soda.

Natron.	Rock Salt.
Sulphate of Soda.	Borax.
Reussite.	Native Boracic Acid.

SALTS OF AMMONIA.

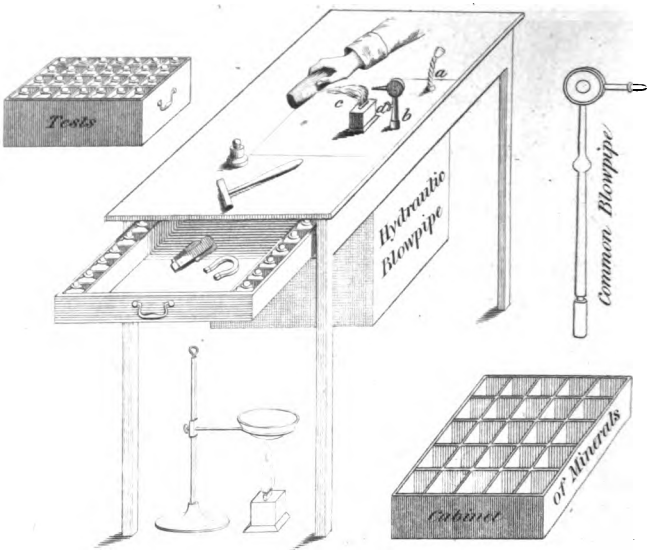
Muriate of Ammonia.	Sulphate of Ammonia.

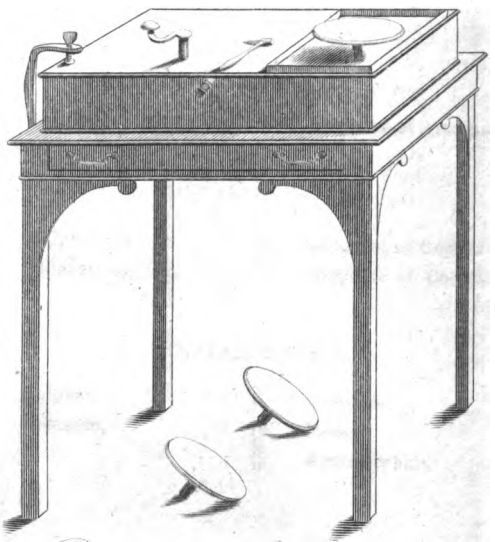
METALLIC SALTS.

Sulphate of Iron.	Sulphate of Copper.
Sulphate of Zinc.	Sulphate of Cobalt.

INFLAMMABLES.

Sulphur.	Graphite.
Bitumen.	Resin.
Coal.	Retin-Asphalt.





New Invented Lapidaries apparatus for slitting & polishing Agates &c.

DESCRIPTION

OF THE

Portable Lapidaries' Apparatus,

BY WHICH

THE OPERATION OF CUTTING, POLISHING, AND SLITTING

PEBBLES, AGATES, JASPERS, &c.

MAY BE PERFORMED.

THE agreeable amusement of collecting Pebbles, Jaspers, Agates, &c. has of late become so fashionable, that almost every one who visits the coast has been employed in searching for these pretty productions, and forming collections of them; but great disappointment has frequently taken place, owing to the want of a convenient method of cutting and polishing these beautiful substances. To obviate which, a Portable Apparatus has been contrived, so as to render the operation easy, and which will afford both instructive and agreeable employment.

This compact Lapidaries' Apparatus is contained in a small box, and may be placed on any parlour table: the method of using it is explained as follows, viz.:

First, secure the box to the table (with the cramp) that it may be steady, and then it will be ready for work. A japanned tin pan, with a hole in the centre, accom-

panies the box, which is to prevent the operator's dress from receiving the water, &c. ejected from the mill when at work *.

Next put the tin pan over the spindle, and screw † on the lead-mill marked A, place the pot, with fine corn emery and water, in one of the corners, and with the brush charge the mill; then turn the handle with the left hand, resting the right on the edge of the pan, and apply the stone, taking care not to lay on too heavy; the mill works best when turned with considerable velocity, in which case it will be necessary frequently to dab the mill with the brush from the emery pot; almost instantly a plane will be produced: in this manner facets are cut upon Amethysts, &c. when the stone is sufficiently worn down. The cutting mill is unscrewed, and the polishing mill, marked B, is screwed in its place, which is used with rotten-stone a little wet; the substance to be polished is applied the same as in cutting; if it be hard, it will soon receive a fine lustre; but if it be soft and porous, it will take more time. It is necessary to look frequently at it, in order to know how the polish proceeds. A few drops of water must be applied at intervals.

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* There are six mills, one of lead, one of pewter, and a plate of soft iron for slitting—a wood mill, one covered with cloth, and one covered with list (soft) to polish shells, &c.

The spindle is spiral, that when the string becomes slack, it may be moved a pulley higher.

† The mills are screwed on and off by firmly holding the pulley within the box with the left hand, to prevent it turning, whilst the right hand screws or unscrews the mill wanted.

It is advisable for the learner to see a practitioner perform the different operations, as that would be a lesson worth a volume of description!

The Slitting Mill is more delicate than any of the preceding, and will require care, that it may run true on its centre. Many are not aware how a piece of Agate or Crystal can be cut into slices, being so much harder than the best tempered steel; for this purpose the Slitting Mill is made of a thin iron plate, the edge of which is armed or charged with Diamond dust*. The particles of Diamond soon become *set* in the iron plate, and form teeth; then, with a tolerable quick motion and copious supply of oil, it will cut (with management) whatever stone is applied to it.

The same mill charged with emery will cut marble and soft substances, using milk instead of water; it is advisable the learner should make himself master of slitting soft stones of this sort, before he begins with Diamond powder.

These are the mills generally used, but to render this apparatus more complete and amusing, three others are added—one is covered with cloth, and is intended to be used with putty of Tin, and a little water. Marble, Spar, and other stones, that do not give fire with Steel, may be polished upon it.

The mill covered with list is intended to be used, as the preceding, with putty and water, to which a little soap may be added; it is useful in polishing substances with unequal surfaces, as some varieties of shells, &c.

The plain wood-mill may be used with sand or fine

* *Diamond*, commonly called *Diamond bort*, must be reduced to powder in a mortar, then prepare about one-eighth of a grain, by rubbing it with a few drops of oil upon a piece of Iron or Agate; after which it may be applied with the finger to the edge of the plate, or mill.

Diamond bort, either in the rough or pounded state, fit for use, may be had of the Author.

emery; it is applicable to various purposes, as cleaning rusty Iron, rubbing down Marble, Spars, Gypsum, or Shells. Other mills may be added, with brushes or leather, for various uses.

If a piece of Clay is placed upon the lead, when upon its spindle, it will make an excellent potter's wheel, and cups or saucers may be made at pleasure. It forms a good substitute for the grindstone, and may with great ease be applied to many useful purposes.

It is not necessary to state that the tools should be kept in nice order, clean, and always ready for use.

Cat-gut forms the best strings, and is screwed into a steel hook and eye; the inner ends are afterwards burnt with a red-hot wire or knitting needle, to prevent its drawing out; it rarely occurs, that fresh string is wanted.

The expence of this Apparatus, with emery, putty, &c. complete, is from five to six pounds.

EXPLANATION

OF THE

HYDRAULIC BLOW-PIPE.

THE article of this name is a vessel made of iron plate, tinned, in the form of a parallelapipedon, which must be half filled with water. In it a partition is so placed, as to divide it into two chambers, having a vacancy at the bottom. A tube is placed in the corner *(a)*, that by blowing down it the water becomes displaced from one chamber into the other, which acts with such pressure through the vacancy, as to force a continued stream of air through the nozle *(b)*, which being directed across the flame of the lamp *(c)*, a jet of heat is produced equal to a forge. The mineral to be examined should be small, and placed on a piece of charcoal, then held in contact with the point of the flame. By keeping the water at the highest elevation, the greatest degree of heat is produced. The stream of air may be increased, diminished, or stopped, by turning the valve *(d)*. The plate shews the apparatus let through the surface of a table, the drawer with chemical tests, mortar, hammer, magnet, &c.

This article, with the acids and chemical tests, steel mortar, forceps, knife, &c. may cost from five to ten pounds, as it is more or less complete.

The SMALL BLOW-PIPE * is a most useful instrument, and though many varieties have been made, yet on the broad scale of real utility the mouth blow-pipe is perhaps the best. It is difficult to describe the knack of keeping a continued blast for a minute or two; it is acquired by a little practice, and every one can blow for a few seconds; one lesson on the mode of using it would be more satisfactory than any description: a violent heat may be produced in a few seconds, and if well managed, will melt, or be the means of determining almost all the metals, &c. without difficulty. It is so portable, so useful and instructive, that the traveller should not be without it.

It must *always* be understood, that the substances submitted to the flame must be small, not larger than a pepper corn; disappointment frequently occurs from attempting to melt larger particles.

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* A small steel mortar is indispensable for the blow-pipe, to reduce substances, both before and after examination. A spirit lamp is useful, as it emits flame without smoke; a good magnet to detect iron, the acids and a few bottles containing tests.

The New Descriptive Catalogue explains the effect of the blow-pipe, upon the different substances.

THE END.

BARNARD AND FARLEY,
Skinner-street, London.

ERRATA.

FOR	READ	FOR	READ
Tungstein.....	*Tungsten.*	Yttratantalite.....	*Yttro-tantalite.*
Gadolonite.....	*Gadolinite.*	Irridium.....	*Iridium.*
Silicious.....	*Siliceous.*	Calcarious.....	*Calcareous.*

DIRECTIONS TO THE BINDER.

Coloured Plate, to face the Title.
Primitive Rocks, to face page 41.
Plate, Portable Lapidaries' Apparatus, to face page 73.