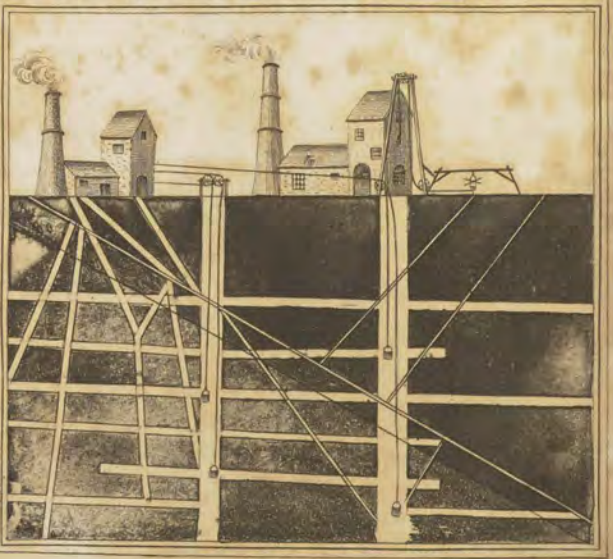

JS

Cat 2/84 #10.00 RB

in biblio

VIEW AT CAPE D'OR NOVA SCOTIA.

TRANSVERSE SECTION OF A MINE IN CORNWALL.



To His Excellency The
Duke of Northumberland
with the Authors
Respectfull Compliments

AN INTRODUCTION

TO THE

STUDY OF MINERALOGY;

OR,

Student's Pocket Companion.

BY

J. R. BAKEWELL, ESQ. F.G.S. C.E. &c.

LONDON:

PRINTED FOR SHERWOOD, GILBERT, & PIPER,

PATERNOSTER-ROW.

1829.

LONDON:

PRINTED BY R. GILBERT,
ST. JOHN'S SQUARE.

PROSPECTUS.

THIS little volume gives an account of the various *minerals* which are found upon and below the surface of the earth; it names the *countries* in which they are found, and the *rocks* or *soils* with which they are associated; it points out the most easy method of *ascertaining what metals* are contained in the *different ores*, and likewise what *acids*, *tests*, and *fluxes* are used in *analyzing* and *assaying* them; it specifies the degrees of heat at which the metals are fused, and gives the specific *gravities* both of the *ores* and *metals*; it names the pure metals, and the proportions of them which are used to

form the *compound metals;* it gives the mixtures for the *soders,* and also an *improvement for cast-iron;* it contains a *classification* of the *minerals,* and a *tabular view* of the pellucid *gems,* arranged according to their colours, &c.; a *familiar* description of the *common blow-pipe* and the *manner of using it;* copper-plate engravings of the *longitudinal and transverse* section of a *tin and copper mine,* &c. &c. &c.

June, 1829.

PREFACE.

Among the various indications of a mind susceptible of attaining general knowledge, appears that which consists in the delight afforded by the study of Mineralogy.

It has been my endeavour throughout the following pages, as far as possible, to present the learner with a compendious view of the importance of this science. The proprietor of estates, the artisan, and the manufacturer, may all make it subservient to their respective pursuits and interests. I shall, therefore, give

that brief description and concise explanation of the several minerals, which have come under my notice, by which an entertaining and useful knowledge of this science may be acquired, without fatiguing or distracting the mind with an enumeration of the minute and endless varieties with which nature furnishes us.

Mineralogy is a science of modern date, which having made rapid advances within a short time, has become a subject of general interest; it cannot, therefore, but be considered a necessary branch of education. These circumstances have attracted the attention of some of our first writers, to whom we are much indebted for a systematical analysis of this science. As it is not my intention to occupy the time of my

readers by perusing a long Preface, I shall conclude by expressing a hope, that the simple experiments which are dispersed throughout the following little work, will both interest and instruct the student; and that my object in writing it, viz. to facilitate an acquaintance with an elegant and refined pursuit,—will meet with the approbation of the accomplished portion of the community.

J. R. BAKEWELL.

London, June, 1829.

AN

INTRODUCTION

TO THE

STUDY OF MINERALOGY.

MINERALOGY is that science which treats of minerals; it arranges them into distinct classes, describes them, and investigates their properties.

Minerals may be defined to be bodies destitute of life and organization, dispersed in the bowels of the earth, and upon its surface; they are commonly deposited in what are termed veins, which when worked, are called mines, whether at a great depth below the surface of the earth, or in the alluvial soil.

A distinct piece of mineral is denominated a specimen, and a number of pieces, a collection.

This science, it is true, is not marked with those distinguishing laws which are the prominent features of the sister sciences, but though this be the case, a general knowledge of it may be obtained with but little difficulty.

I will now point out the most easy method by which the learner, who has a few minerals in his possession, may discover their properties, and determine what they are. The metallic ores are very easily distinguishable from other minerals by their specific gravities, which are seldom less than four times the weight of water. By weighing the specimen hydrostatically, it may be known from any other substance.

Calcareous Spar, or Cale Spar.

Spar is one of the most common productions in the mining counties of England; it is a brittle, shining substance. Spar is not a very definite term, as crystal, and quartz, are often called by this name.

Calcareous spar (carbonate of lime)

may be known by placing a few pieces of it upon a hot fire-shovel, when it will become opaque, and burn to lime, which may be known by its styptic taste, or when a piece is dropped into a glass of water, by its falling to powder, with a hissing noise. This spar has a smooth, shining, glass-like surface, and when reduced to powder, it effervesces with acids, even with strong vinegar; if transparent, it has the property of presenting two images at the same time of any object seen through it, whence it has been called double refracting spar. This experiment may be tried by putting a pin underneath a piece of this spar, and the two images will appear more or less distinct from each other.

Rock Crystal.

Rock crystal is generally found in six-sided prisms, terminated by a short pyramid; its fractures are generally shining and uneven, and are often curved, the fragments are short and irregular; when not crystallized, it has the appearance

of a piece of broken glass, but it is not so heavy. Heat has no effect upon crystal, unless it be reduced to powder, and mixed with potassa or soda, when the heat will melt the mixture, and form glass.

Shining yellow pyrites.

Shining yellow pyrites, commonly called by miners, Mundic, is the most abundant of minerals; it is often found in lime-stone, coal, and spar, and in almost every mine. Jasper, clay, and sandstone, frequently contain some of this metal, (it is this which gives them their red and yellow colour,) and the more the iron in them is decomposed, the more deeply they become tinged with brown and yellow.

Pyrites is massive, and of a yellow colour, resembling gold; it is sometimes found crystallized in brilliant groups, detached cubes, &c. Pyrites may easily be distinguished from any of the other substances which it resembles, by the application of a knife or a hammer. Try

to cut the specimen, if it be gold, it will yield to the knife like lead, or if struck with the hammer, it will be indented, because gold is malleable, and pyrites, on the contrary, brittle and hard; and if a small piece of the specimen, placed on charcoal, and acted upon by the flame of the blow-pipe, melt, and retain its yellow colour, it is gold, but if it decrepitate, and burn with a fine blue flame, emitting sulphur, and be reduced to a dark coloured scoria, which yields to the attraction of the magnet, it is pyrites; this proves pyrites to be a combination of sulphur and iron; if, to a few pieces put into a glass tube, a little nitric acid be added, and the whole held over the flame of a candle until it boils, if these be gold, no alteration will take place; but if pyrites, a considerable agitation and change of colour will be produced, which shews that the substances have been dissolved, more or less, by the acid. If the solution be thrown into a glass of water, and a few drops of Prussiate of potassa be added,

the liquid will assume a blue colour, the iron contained in the pyrites being dissolved by the acid, and held in solution; it is precipitated by the test in the form of Prussian blue, after which the water becomes perfectly clear.

PLATINUM.

Platinum is found in Choco, New Granada, in the province of New Barbacoas, and also in the grey copper, and silver ores, of the Guadaleanal, in Spain.

It is found in the sands of rivers, and usually in grains in a metallic state; its colour is steel grey, approaching to silver white; in its general appearance it much resembles clean iron filings; it may be known by its hardness, and being the heaviest substance in nature, by its specific gravity, which varies from 16· to 17·7.

The strongest of the pure mineral acids has no effect upon platinum, nor has the strongest fire, unless urged by a stream of oxygen gas. Platinum is one

of the most compound minerals; pure platinum is never found in a natural state; the ores which are imported do not contain more than from one half, to three-fifths of the metal, the remaining portion is gold, iron, lead, palladium rhodium, iridium, asmium, and silver. The whitest grains are the most valuable, as they generally contain the most gold. Platinum may be melted by a burning lens, or dissolved in chlorine, or nitro muriatic acid; if mixed with arsenic, and then exposed to a great heat, it readily fuses. Platinum may be distinguished from other metals, by adding a solution of muriate of ammonia to a solution of the metal in nitro muriatic acid, this will instantly produce a yellow-coloured precipitate. The solutions of platinum are of a deep brown yellow-colour.

No *solution* of ores or metals can be tested until it becomes perfectly clear; therefore, if there be any sediment after the metal is dissolved, the solution must be poured off into another vessel.

Platinum is dissolved in nitro-muriatic acid.

Tests for Platinum.

If recent muriate of tin be added to the solution of platinum, it will produce a bright red precipitate.

If potassa, ammonia, and some of their salts be added,—a yellowish precipitate.

If proto-sulphate of iron, and salts, with base of soda,—no precipitate.

If muriate of ammonia,—a yellow precipitate.

If ferrocyanate of potassa be added to the liquid containing the yellow precipitate, it will change the yellow colour to green.

GOLD.

Gold is found in many parts of the world, as Brazil, Mexico, Peru, Africa, Sumatra, Japan, Transylvania, Hungary, Italy, at Wicklow, in Ireland, and in some other countries.

Gold is found associated with the primary and transition rocks, argillaceous

schistus, and clay, accompanied with felspar, calcareous and heavy spar; in quartz, galina, pyrites, &c.; in porphyry, scienite, and the lowest sand-stone; it has been found in coal, volcanic rocks, the sands of rivers, &c.; it is found in the crystallized, ramose, massive, and granular forms.

Gold is of a light yellow colour, inclining to red, and is the heaviest of all metals, except platinum: it is neither very elastic nor very hard; it has neither taste nor smell; it possesses less tenacity than platinum, silver, iron, or copper; and but few metals have more lustre. The malleability and ductility of gold are such, that it is beaten into leaves which are but the three hundred thousandth part of an inch thick. When gold is alloyed with other metals, it is not in such quantities as to destroy its malleability; it may be easily detected. The specific gravity of the ores varies from 12· to 19.

The brass yellow coloured gold contains a little silver and iron.

The greenish yellow,—a little platinum.

Argentiferous gold,—a large portion of silver.

Hexahedral or native gold,—a small portion of silver and copper.

By the use of the blow-pipe the whole of these ores are reducible to a metallic state: all the alloys (silver excepted) may be separated by adding a little crude flux or nitre, and continuing the action of the flame.

Gold, when combined with tellurium, lead, or iron, is known by the name of graphic gold ore.

If gold be alloyed, pour nitric acid upon it, then hold it over the flame of a candle until red fumes (nitric vapours) evaporate; if the gold were pure, the liquid would not be discoloured; but if the liquid be green and black, and discharge bubbles of air, then, after the ebullition has ceased, and the residue is washed with water, add more nitric acid, and the same effect will be produced; and by repeating this operation till the

effervescence ceases, the gold will be left pure. The reason of this is, because nitric acid dissolves iron, copper, brass, &c. but has no effect upon gold, which nothing but nitro muriatic acid can dissolve. The essential oils, æther and naphtha, will either of them take the gold from its solution in nitro-muriatic acid, and will leave it by evaporation: this is not the case with any other metal, except platinum.

If proto-sulphate of iron be added to a solution of gold in nitro muriatic acid, it will produce metallic gold. The fine purple colour used in the arts is made by adding proto muriate of tin to a solution of gold in aqua regia.

Tests for Gold.

If recent muriate of tin be added to a solution of gold, it will produce a purple precipitate.

If potassa or soda,—a yellow precipitate.

If hydro-sulphurites,—a black precipitate.

IRIDIUM.

Iridium is seldom found, except combined with platinum; it is usually met with in grains of a dark colour, which are hard and brittle. Pure iridium is white, and forms a malleable compound with gold, silver, and copper. The specific gravity is 19·50.

Iridium is dissolved in nitro muriatic acid, and its solution is of a reddish colour.

Tests for Iridium.

If ammonia be added to a solution of iridium, it will produce a yellow precipitate.

If tincture of galls, it will destroy the red colour of the solution.

TUNGSTENUM.

Tungstenum is found in Sweden, Saxony, and in Cornwall in England; it is associated with granite, gneiss, slate, and mica slate.

Tungstenum is hard, and of a steel colour; it may be known by its specific gravity, which is 17·50.

The ores of tungstenum are of various colours, viz. plum-blue, green, pearl-grey, ash-grey, yellow-grey, green and yellow-white, yellow-brown, red, &c.

If a small piece of the ore be put on charcoal, and acted upon by the flame of the blow-pipe, it will crackle, and become opaque, but will not melt without borax being added, it will then form white opaque glass.

The ores of tungstenum are dissolved in muriatic acid.

Tests for Tungstenum.

If tincture of galls be added to the solution of tungstenum, it will produce a brown red precipitate.

If prussiate of potassa,—a dark yellow precipitate.

If alkalies,—a white precipitate.

If sulphuretted hydrogen,—no precipitate.

MERCURY.

Mercury (quicksilver) is not peculiar to any one soil, but is found in quartz, semi-indurated clay, argillaceous schistas, calcareous spar, and many other earthy productions; it is sometimes found in sand-stone, and in globules, attended with a red substance.

Pure mercury has the appearance of melted silver; in this state it has neither taste nor smell: it is so extremely divisible, that it may be strained, by moderate pressure, through the pores of leather; it is the only metal that is found in a fluid state.

Mercury, in its natural state, cannot be mistaken. In the temperature of our atmosphere, it is a white fluid metal: it is the heaviest of all metals, except platinum, gold, iridium, and tungstenum.

The best ores of mercury are called cinnabar, and when rich, are extremely heavy; some of them are of a light brown red colour, some dull, and others

bright and shining; those termed hepatic cinnabars are generally of a lead grey colour. The specific gravity of the ores varies from 6·05 to 10·05. The pure metal, at 30 degrees of heat, is 13·619. The rich ores may be known by their weight, or by a knife's leaving a deep red streak; the ore of mercury may also be known by exposing a piece to the flame of the blow-pipe, when the mercury will exhale in white fumes, which may be condensed on a plate of gold or of bright copper held over the vapour; the plate will assume a silvery appearance, and by rubbing it, it will become bright: the mercury cannot be removed but by burning it off.

I do not know of any better way to ascertain the purity of mercury than by mixing it with iron filings, and distilling it, as this mixture can be distilled like water.

The ores of mercury are dissolved in nitric acid a little diluted.

The presence of this metal, when in solution, may be known by immersing

a plate of gold or of copper in it, which will produce metallic mercury.

Tests for Mercury.

If ferro prussiate of potassa be added to a solution of mercury, it will produce a white precipitate.

If hydro-sulphurets,—a black precipitate.

If a plate of iron,—a dark powder, changing when triturated to fluid mercury.

If fresh lime water,—an orange precipitate.

If Gallic acid,—an orange yellow precipitate.

LEAD.

Lead is found in Germany, Saxony, and France; in Flintshire in Wales; and in Cornwall, Devonshire, Yorkshire, and Derbyshire in England.

The ores are found associated with the primary and transition rocks, except trap and serpentine; they are associated also with porphyry, sienite, the lowest

sand-stone, clay, coal, &c., but never with limestone. Lead is someimes found crystallized with fluor-spar, quartz, &c.

The colours of lead ore are white, green, blue, yellow, red, grey, &c.; they usually appear either metallic or slightly transparent, and contain from three-tenths to eight and a half tenths of the pure metal and a portion of silver, varying from a twelfth to a three-hundredth part of the weight of silver. The specific gravities of the ores vary from 3· to 7·160.

Lead has several varieties.

Galena or lead-glance contains lead and sulphur.

Bournonite,—lead, copper, antimony, and sulphur.

Carbonate of lead,—lead, carbonic acid, and water.

Muriate of lead,—lead, oxygen, and carbonic and muriatic acids.

Phosphate of lead,—lead, oxygen, and muriatic and phosphoric acids.

Arseniate of lead,—lead, oxygen, arsenic, and muriatic acid.

Sulphate of lead,—lead, oxygen, and sulphuric acid.

Molybdate of lead,—lead, oxygen, and chronic acid.

Native minium (oxide of lead),—lead and oxygen.

The oxide of lead will fuse into litharge, commonly called glass of lead: it is of a yellowish colour.

Lead ores, being soft and brittle, can be cut with the knife. If a small piece of lead ore, placed on charcoal, be acted upon by the flame of the blow-pipe, it will immediately discharge sulphureous vapours, and, in less than half a minute, melt into lead, leaving a white and yellow powder upon the charcoal. Lead, mixed with sulphuric acid, forms an insoluble compound; hence this acid is sometimes used to detect the presence of this deleterious metal; a solution of sulphuretted hydrogen is also used as a test for lead.

If a small quantity of the flowers of sulphur, mixed with a little potassa or soda, and melted on the point of a knife,

by the flame of a candle, be applied to the surface of a stone, previously moistened, and containing white lead, it will make a black spot on the stone.

Lead ore is dissolved in diluted nitric acid, and precipitated with zinc, a piece of which, if put into the solution, will become coated with lead.

Tests for Lead.

If ferrocyanate of potassa be added to the solution of lead, it will produce a white precipitate.

If an infusion of galls or sulphate of soda,—a white precipitate.

If water, impregnated with sulphuretted hydrogen,—a black precipitate.

SILVER.

Silver is found in almost every country, particularly in Mexico, Peru, Saxony, Bohemia, the Hartz, Norway, Siberia, Guadaleanal in Spain, and in Cornwall and Devonshire in England.

Silver is found associated with pri-

mary and transition rocks, in porphyry, sienite, in the lowest sand-stone, and in various soils, as clay, clay-slate, mica slate, &c. Silver has been found, in Cornwall, in a tin and copper mine, in its native state. The ores of lead contain a portion of silver. The ores of silver are of a white, yellow, lead-grey, ash-grey, light lead, and blue-black colour. Their specific gravities vary from 5· to 10·4.

Silver, after having been once examined, cannot be mistaken. The different varieties of silver ores are numerous, being eleven in number, besides several sub-species.

The auriferous silver contains silver and gold.

The sulphuretted silver,—silver, iron, and antimony.

The native silver,—silver and a small portion of antimony.

The bismuthic silver,—silver, lead, bismuth, and sulphur.

The white silver,—silver, lead, antimony, and sulphur.

The carbonate of silver,—silver, carbonic acid, and antimony.

The muriate of silver,—silver and muriatic acid.

Native silver seldom contains more than from an hundredth to a fiftieth part of alloy. It is not difficult to ascertain whether an ore contain silver or not, as being but a little harder than lead, it is easily cut with a knife; and if a little of the ore be pulverized and dissolved in nitric acid, then if a little muriatic acid or common salt be added, if the ore contain silver, the acid will instantly combine with the whole, and will precipitate the silver from the nitric solution in white flakes of muriate of silver; and if muriate of lead be mixed with it, the whole of the precipitate must be digested in diluted nitric acid, which will dissolve the lead without acting upon the muriate of silver. In order to know the quantity of silver contained, the precipitate must be heated until it becomes red hot and then weighed; every hundred grains of this

precipitate will contain seventy-five grains of pure silver.

The ores of silver are frequently found combined with other metals: the following experiments will prove that the ore contains silver; if it be rich ore, it will be soft and can easily be cut with a knife; it will also melt with little difficulty, and, by repeated fusion with borax, the silver will be produced; the combination will either be driven off by heat or else mixed with the borax and form a slag. When the ores contain a large portion of copper, the copper will shew itself in melting, by giving the borax a green colour, and burning away with a green flame, if the heat be continued. Copper may be precipitated from a solution, by immersing a rod of iron, which will be quickly coated with metallic copper. Sulphur, arsenic, antimony, and bismuth are easily evaporated; the two former may be detected by the smell, and bismuth will leave a yellow-white oxide.

Silver is dissolved in nitric acid; its solution is white, and will stain the skin, making it black.

Tests for Silver.

If the alkalies be added to a solution of silver, they will produce a dark olive precipitate.

If ferocyanate of potassa,—a white precipitate.

If muriatic acid,—a white precipitate.

If tincture of galls,—a brown precipitate.

If hydro-sulphuret of ammonia,—a brownish black precipitate.

If a plate of iron or copper,—metallic silver.

Silver is not acted upon by the fixed alkalies.

BISMUTH.

Bismuth is found in Saxony, Siberia, and in Cornwall in England.

The ores of bismuth are found associated with primary and transition rocks, excepting trap, serpentine, and limestone; and in mica slate.

Pure bismuth is called by workmen tin glass; if melted, and suffered to cool, it expands.

The ores vary in colour from silver-white to lead-grey and yellow; they contain a portion of sulphur in them.

The specific gravities of the ores of bismuth vary from 4· to 6·120; that of pure bismuth 9·756 to 9·822.

The oxide (or subsalt) of bismuth, which is white, and appears like small glittering scales, is sold by perfumers as pearl powder, and is used by ladies for whitening their skin; but as once using this renders a repeated application of it absolutely necessary, I cannot recommend it to them.

There are a few varieties of bismuth, viz.—

Carbonate of bismuth, which contains bismuth, oxide of iron, carbonic acid, and water.

Sulphuret of bismuth,—bismuth and sulphur.

And bismuth ochre,—bismuth and oxygen.

If bismuth be exposed to the action of the flame of the blow-pipe, it will be instantly melted into a white globule, and if the heat be continued, will leave a white deposit upon the charcoal; eight parts of bismuth, mixed with five lead and three of tin, will melt in boiling water: so tea-spoons made of this mixture will melt in hot tea.

The ores of bismuth are easily fused with the blow-pipe, at a low heat, and melted on ignited coals.

The ores of bismuth are dissolved in nitric acid; the solution is white, and by adding water to it, it will throw down a fine white oxide.

Tests for Bismuth.

If alkali be added to a solution of bismuth, it will produce a white precipitate.

If ferrocyanate of potassa,—a yellowish precipitate.

If Gallic acid,—a greenish yellow precipitate.

NICKEL.

Nickel is found in Saxony, Spain,

France, Siberia, and Cornwall in England; it is found in Germany also, and called by the Germans, Kupfernickel.

Nickel is found in the primary mountains, except limestone, trap, and serpentine; it is also found in transition mountains, and in sand-stone; it is sometimes found in capillary crystals of a shining metallic appearance.

Native nickel is of a brass yellow colour; it is attracted by the magnet.

Pure nickel is white.

Kupfernickel is hard, and of a dark colour, similar to the ores of copper.

The ores of nickel are of a yellowish, greenish, grey and black colour: the specific gravities are from 6·4 to 7·8; pure nickel is 9·.

Some of the ores of nickel contain arsenic, cobalt, iron, &c. and others contain copper, bismuth, silver, alumina, and quartz.

Pure nickel, which is of a white colour, is difficult to melt.

The pure oxide of nickel is not affected by the action of the blow-pipe, except it

is mixed with borax, and then it will fuse into glass of a yellowish colour, which becomes nearly white as it cools.

Most of the ores of nickel when acted upon by the flame of the blow-pipe give sulphureous and arsenical fumes.

Copper alloyed with nickel forms a compound metal which resembles gold, called petit-or.

If 30 parts of copper, 13 of nickel, and 17 of zinc be melted together, they will form an alloy which resembles silver in colour, but is a much stronger metal.

The most easy method of obtaining pure nickel is to pulverize the ore and add sulphuric acid, this will produce a crystallized sulphate, which is to be dissolved in water, let this be again crystallized and dissolved, then add caustic alkali, which will precipitate the oxide of nickel, and if this oxide mixed with oil and one twelfth of resin be formed into a paste and then subjected to a strong heat in a covered crucible, it will produce the pure metal.

Nitric acid will dissolve nickel.

Tests for Nickel.

If ammonia be added to a solution of the salts of nickel, which is of a green colour, it will produce a green precipitate; and by adding more ammonia it will be re-dissolved.

If ferro prussiate of potassa be added to a solution it will produce a green precipitate.

If hydro sulphuret of ammonia, a black precipitate.

COPPER.

Copper is found in Germany, Sweden, Norway, France, Spain, America, and several parts of Great Britain, viz. Ireland, and the counties of Cornwall and Stafford in England; at Cape D'Or I have found copper of the purest quality.

Copper is found associated with primary and transition rocks, in porphyry, sienite, lime-stone, sand-stone, and alluvial ground. In Nova Scotia I have found the carbonate of copper, which resembles coal or petrified charcoal, in sand-stone, and also grey copper ore,

which contained from three fifths to four of pure copper.

Copper, when found in its native state, is generally massive, in different forms, veins, &c. and commonly associated with granite or with fluor spar.

Native copper has a metallic lustre, and is of a yellowish red colour.

The ores of copper are more or less hard to the knife; the softest is best.

There are a few varieties of copper ores.

Copper pyrites is the most abundant of them, its colour is bronze yellow; copper pyrites and peacock copper ore contain about one fifth of copper.

Azure blue coloured copper (blue vitriol) is soluble in water.

To extract copper from the ore, place a small piece of the ore with a little borax on charcoal and apply the flame of the blow-pipe, and the ore will soon melt, and if rich it will produce pure copper, colouring the borax green, brown, or green and brown. Again, pulverize the ore, put the powder into a glass tube, and add a little nitric acid, which will soon

dissolve the powder, then add a little water and dip the point of a knife or of a piece of clean iron into the solution and it will be coated with copper.

Copper ore, if dissolved in nitric acid diluted with water may be precipitated with iron; in this way copper may be extracted from the ores.

All copper ores contain more or less of sulphur, iron, and other metals combined with the copper. Whenever we meet with a mineral of a blue or green colour we may suspect the presence of copper, which can be detected by means of the blow-pipe or nitric acid.

The different varieties of copper ores.

Glance copper and buntkupfererz copper contain copper, sulphur, &c.

Copper pyrites,—copper and iron.

Tenatile,—copper and arsenic.

Red and black oxide of copper,—copper and oxygen.

Sulphurite of copper (blue vitriol,)—copper and sulphuric acid.

Muriate of copper,—copper and muriatic acid.

Phosphate of copper, —copper and arsenic acid.

Blue and green carbonates of copper, —copper, carbonic acid, and water.

The blue and green carbonates of copper, which are the most beautiful of the copper ores, are of a green and azure blue colour. The ores of phosphate of copper are of a dark green colour with black spots, and may be known by their easy fusing, and their leaving a brown slag.

When the flame of the blow-pipe is applied to muriate of copper, it first shews a beautiful blue colour, and afterwards an emerald green.

Copper ores are dissolved in nitric acid, the colour of which it changes to green or blue.

Tests for Copper.

If a plate of iron be put into the solution of copper it will precipitate the copper into a metallic state.

If potassa be added to the solution it will produce a green precipitate.

If the infusion of galls,—a brown precipitate.

If ferrocyanate of potassa,—a red brown precipitate.

If ammonia,—an azure blue precipitate.

ARSENIC.

Arsenic is found in Saxony, Germany, Bohemia, and some other countries. The arsenious acids also are brought principally from Saxony, Germany, and Bohemia.

Arsenic is found associated with the primary and transition mountains and porphyry; its ores are found combined with acids, sulphur, and oxygen.

Arsenic is a brilliant metal of a blue white colour, and it is easily tarnished; some of the specimens are of a scarlet or orange red and of a yellow colour. Pure arsenic is brittle and soft. The specific gravities of the ores vary from 2·6 to 6·6.

Arsenic may be known by its rapid volatilization and its strong smell of garlic when heated; it will melt in the

flame of a candle, or if thrown on a red-hot plate will exhale white fumes.

Arsenical pyrites contain arsenic, sulphur, and iron.

Native arsenic,—arsenic and a little iron.

Arsenic ~~of~~ and sulphur forms a yellow and red paint.

Metallic arsenic is soluble in nitro muriatic acid, and by adding alkalies to a solution the metal will separate in the form of an oxide. In order to extract the metal from the ores let the ores be pulverized, mixed with charcoal powder, and exposed to a gentle red heat in a subliming vessel; when the fumes cease to rise the vessel may be removed and suffered to cool; the arsenic will be found in the head of the vessel in a metallic state, and may be easily collected.

MOLYBDENUM.

Molybdenum is found in Bohemia, Sweden, Carinthia, and Scotland, and in Cornwall in England.

Molybdenum is found associated with granite, gneiss, slate, and mica slate.

This mineral is but little known except as mineralogical specimens; it has not, I believe, been yet applied in the arts. The colours of the ores are lead grey, pale grey, and wax yellow.

The lead grey coloured ore is soft and of a greasy feel, and if rubbed on a piece of paper will give it a blue grey colour.

The specific gravities of the ores vary from 4·6 to 6·6; that of the pure metal is 8·6.

The ores of molybdenum are dissolved in nitric acid.

MANGANESE.

Manganese is found in France, Germany, America, and in Somersetshire, Cornwall, and other parts of Great Britain.

Manganese is found associated with primary and transition rocks, occasionally with the lowest stratafied rocks, and in primitive countries.

The strong affinity which manganese

has for oxygen, is the reason why it is never found in a metallic state.

Manganese frequently contains delicate fibres of a bright iron like lustre, it soils the fingers ; some kinds of it have a metallic appearance, and are heavy. The ores are soft to the knife, and easily distinguishable from other minerals.

Calcareous spar, and quartz, derive their pink colour from this metal, and there is no doubt but that it is this which gives the beautiful colours to the amethyst, and other gems.

The specific gravities of the ores varies from 2· to 5·, that of the pure metal is 7·99.

There are five kinds of manganese, viz. fibrous grey, radiated grey, foliated grey, compact grey, and earthy grey.

The grey oxide of manganese, has a metallic lustre, and is sometimes found earthy.

Siliciferous oxide of manganese is sometimes found in veins of gold, and has a yellowish or reddish tinge, this ore is called white manganese.

The phosphate of manganese has been found in a granite rock in France; this mineral will scratch glass.

Manganese may be discovered by putting a small portion of the ore when pulverized into a glass tube, add a little muriatic acid, and hold it over the flame of a candle, and if it contains manganese, a disengagement of gas will ensue, which may be known by the emission of a suffocating odour, or by holding printed linen, previously damped, over the fumes, when the colour will be discharged from the linen.

A small piece of manganese, with ten times its bulk of borax, placed on charcoal, and fused with the blow-pipe forms a globule of a violet colour; if it be suffered to cool, and then gently re-melted, the colour will vanish; by again melting it with a little nitre, the colour will be re-produced; this may be seen by drawing it while in a fused state into fibres.

Manganese cannot be reduced to a metallic state by means of the blow-pipe.

Manganese is of the first importance in making glass, bleaching, and glazing black earthenware. A violet colour may be given to flint glass by melting it with a large portion of the black oxide of this metal.

Manganese is dissolved by muriatic acid.

Tests for Manganese.

If ferro prussiate of potassa be added to the solution of manganese, it will produce a white precipitate.

If an infusion of galls,—a white precipitate.

If alkales,—a white precipitate, which on being exposed to the air, will turn black.

COBALT.

Cobalt is found in Saxony, and some other countries, and in Cornwall in England.

Cobalt is found associated with some of the primary rocks, but neither in limestone, trap, nor serpentine; it is

found in transition rocks, and in sandstone.

Some of the specimens of cobalt ore resemble those of lead, but are much harder; these ores commonly contain a portion of arsenic; some are of a whitish grey colour, and have a metallic lustre, sometimes approaching to black, others have a peach blossom, red, dark earthy, and various colours.

Some of the ores are rich, and yield a great quantity of colouring matter, used for painting and enamelling.

When the oxide of cobalt is used for colouring glass, five grains are sufficient to give a blue colour to a ton of it.

The cobalt ores are of various kinds, viz. cobalt, pyrites, red cobalt, cobalt ochre, and sulphate of cobalt.

The ores of cobalt contain nickel, copper, arsenic, iron, sulphur, sulphuric acid, and water.

Cobalt is dissolved in nitrous acid; the iron contained in the solution may be precipitated by adding ammonia, and separated from the solution by filtering.

If nickel be mixed with the ore, it may be precipitated by adding a solution of potassa, this also can be separated by filtering.

Tests for Cobalt.

If ammonia be added to the solution of cobalt, it will produce a blue precipitate.

If potassa or soda,—a blue precipitate.

If hydro-sulphuret of ammonia,—a black precipitate.

If ferro prussiate of potassa,—a green precipitate.

If arseniates, carbonates, or phosphates,—a red precipitate.

TIN.

Tin is found in Galatia, Malatia, Bohemia, and Saxony, and in Asia; and also in Cornwall in England.

Tin is generally found associated with primary rocks, granite, gneiss, slate, and mica slate, but never in lime-stone; it is often found in veins or beds, and sometimes it is associated with copper and

iron pyrites, but never with either lead or calcareous spar.

Tin is one of the oldest metals: its specific gravity varies from 4·6 to 7·.

The ores of tin are of various colours, viz. dark brown, light brown, black, grey and yellow; they are hard to the knife.

Some of the specimens are called stream or wood tin, tin stone, &c.

Tin pyrites contains tin, copper, iron and sulphur, and is often called bell metal.

Tin stone,—tin, iron, silica, and oxygen.

Wood tin,—tin, iron, and oxygen.

The ores of tin are easily melted before the blowpipe.

Any of the ores of tin may be melted by being pulverized, mixed with powdered charcoal and oil, and then exposed to a red heat.

Tin ores are dissolved by any of the mineral acids.

Tests for Tin.

If nitro muriate of gold be added to a solution of tin, it will produce a fine purple precipitate.

This is the best test for tin.

If muriate of platinum,—an orange precipitate.

If ferrocyanate of potassa,—a white precipitate.

If per chloride of mercury,—a black precipitate.

If a plate of lead,—metallic tin.

IRON.

Iron is found in many parts of the world; it shews itself in great abundance in different parts of England, Ireland, and Wales; an acre of the best ground in the south of Wales, produces about 1600 tons of iron stone.

Iron is found associated with every kind of rock, and is generally found near coal.

The gravities of the ores of iron vary from 2· to 6·2; that of the pure iron is 7·207.

There are many varieties of iron ore.

That which is most common in England, Ireland, and Wales, is the clay iron stone, and as this often contains veget-

able impressions, I consider it to be a deposit.

Those found in Germany are the hamatite; in one of the mines in that country, I once found a vein of copper crossing the vein of iron; the hamatite iron ores are of a red, black, or brown colour, kidney shaped, and of a fibrous or radiated structure; they are very heavy, and have often a polished metallic appearance; they are brittle, and slightly magnetic, but not very hard, and are sometimes found crystallized in various forms.

The oxydated or specular iron (black oxide of iron,) is of a steel grey colour, it is slightly magnetic; it is sometimes found crystallized, having a metallic lustre, and is found in primitive mountains, and mica slate, and on account of its cleaving into plates, is called micaceous specular iron ore.

Bog iron is of a dark brown colour, and has an earthy fracture.

The clay iron stone is of a grey, reddish brown, and sometimes of a light grey

colour; some of it is of a slaty texture, its ores are found in veins and nodules, accompanied with clay slate.

Carbonate of iron has some shades of brown, and has generally a glistening pearly appearance very unlike metal; it is found in chalybeated waters, which may be known by the dark olive coloured felm which appears on the surface.

The ores of iron are various; the

Red, brown, and black iron ores contain iron and oxygen.

Carbonate of iron,—iron, oxygen, and carbonic acid.

Iron pyrites,—iron and sulphur.

Bog iron ore,—iron, manganese, oxygen, and phosphoric acid.

Clay iron stone,—iron, manganese, oxygen, &c.

Pitchy iron ore,—iron, manganese, oxygen, sulphuric acid, &c.

Sulphate of iron,—iron, oxygen, sulphuric acid, &c.

Arsenite of iron,—iron, oxygen, and arsenic acid.

I have found iron ores to contain from

a half to nine tenths of pure iron. The iron stone of Wales contains about three tenths of iron, and that of Germany from three tenths to four tenths and a half of iron.

Flaematite iron ore is composed of ninety four parts of oxide of iron, three of silica, two of water, and one of lime. It is used for making burnishers, &c.

Emery is a combination of alumina, iron, and silica. It is found in native masses.

The presence of iron in an ore may sometimes be detected by the magnet; but this is not always the case, unless it has been heated red hot and the sulphur driven off. Prussiate of Potassa is the usual test for iron. When iron is in the state of peroxide, it will cause a blue-coloured precipitate, but if partially oxidized, the precipitate will be grey. Succinate of ammonia will precipitate oxide of iron from its solution. Sulphate of iron (green vitriol) is soluble in water: it has a strong feruginous taste.

The oxide of iron is rendered soluble

by an excess of carbonic acid. This may be shewn by adding a few grains of quick lime to a small quantity of this water; the lime will combine with the carbonic acid, and the oxide of iron will be precipitated.

In assaying the ores they should be first calcined and pulverized, then take two parts of the ore, one of fluor-spar, one of charcoal, four of salt, and one of black flux; mix them all together, and expose this mixture for an hour to a strong heat, in a covered crucible. If the operation be well conducted, the iron will be found at the bottom of the crucible. By this process will be ascertained what quantity of iron is contained in the ore.

The only flux used for smelting iron on a large scale is lime. Six furnaces, kept at work for making iron from the ore, will employ three thousand persons annually. Pulverized iron ore can be dissolved by diluted nitric acid.

Tests for Iron.

If ferro prussiate of potassa be added to the solution of iron, it will produce a blue precipitate.

If liquid ammonia, with proto salts,—a black precipitate.

Or sulphuretted hydrogen,—a black precipitate.

ZINC.

Zinc is found in Sweden, Saxony, Bohemia, and North America, and in England and Wales, dispersed through the lead mines.

Zinc is found in some of the primary and transition rocks, in porphyry, sienite, the lowest sand-stone, and sometimes in coal strata.

Zinc is one of the most abundant of metals, and has various kinds of ores.

Blende, or black jack, is of a black, brown or yellow colour, sometimes crystallized; it is soft to the knife, and, when pulverized, forms a white powder. Some of the specimens are yellow, and,

when rubbed with a pin, emit phosphorescent sparks. The ores of Zinc are neither as hard nor as heavy as those of tin.

Calamine is earthy, and is sometimes found like bone. Its weight will lead to the detection of its metallic nature.

The ores of zinc may be known, by applying the flame of the blow-pipe; the zinc will evaporate in white flakes; they may also be known by dissolving them, when pulverized, in mineral acid, and can be precipitated with ammonia, which will be of a white colour. At the temperature of our atmosphere, water will act but slowly on zinc.

The presence of zinc may be known also by mixing the ore, when pulverized, with filings of copper, and then melting that mixture by means of the flame of the blow-pipe, and, if the ore contain zinc, this operation will produce brass. As there is a considerable quantity of sulphur in *blende*, you must not try your experiments with this ore, unless it be

first heated till nearly red hot, to drive off the sulphur.

The varieties of zinc are

Blende, which contains zinc and sulphur.

Calamine,—zinc, oxygen, and carbonic acid.

Electric calamine,—zinc, oxygen, and silica.

Red zinc,—zinc, oxygen, iron, and manganese.

White vitriol,—zinc, oxygen, sulphuric acid and water.

Brass is composed of copper and zinc; twice as much copper as zinc is required for common brass, and a still larger proportion of copper must be used for making the best brass.

Zinc ore, when pulverized, can be dissolved in the mineral acid.

Tests for Zinc.

If ferrocyanate of potassa be added to a solution of zinc, it will produce a white precipitate.

If a solution of galls,—no precipitate.

ANTIMONY.

Antimony is found in Saxony, France, Spain, Siberia, the Hartz, America, and in Cornwall in England.

Antimony is found in the primary and transition mountains, except trap and serpentine; it is found in porphyry and sienite; when pure it is of a bluish white colour and brilliant, and, when broken, shews a reddish fracture.

The ores of antimony are soft to the knife; their colours vary from light lead to dark lead grey.

The specific gravities vary from 4·4 to 6·86.

Antimony is sometimes found in long thin crystals, not unlike needles, and of irridescent colours, of a shining bright appearance, much resembling lead ore; it is sometimes of a dull metallic grey colour and composed of acidular fibres. Some of the ores are covered with yellow ochre, arising from decomposition.

The varieties of antimony ores are but few, viz.—

Native antimony, which contains a little arsenic, iron, and silver.

Red antimony,—antimony, oxygen, and sulphur.

Grey sulphuret of antimony,—antimony and sulphur.

White antimony,—silica and oxides of antimony.

In order to obtain pure antimony, the ore must be dissolved in nitro-muriatic acid, which may be precipitated with water mixed with double its weight of tartar. The precipitate, on being mixed with black flux and then melted, will produce pure antimony.

If a small piece of the ore of antimony, placed on charcoal, be acted upon by the flame of the blow-pipe, it will instantly melt, and appear like a dark slag or scoria, burning away in white fumes, emitting sulphureous and arsenical odours. This will form a white oxide, and if borax be mixed with the oxide, and the flame of the blow-pipe be con-

tinued, it will form a yellowish coloured glass.

Antimony is dissolved in muriatic acid: by adding water to the solution, a sub-muriate of antimony will fall.

Tests for Antimony.

If a plate of iron or of zinc be put into a solution of antimony, it will produce a black precipitate of metallic antimony.

If sulphuretted hydrogen,—an orange precipitate.

URANIUM, OR URAN MICA.

Uranium is found in Saxony and Bohemia, and in Cornwall, in England.

The ores are found in granite, gneiss, slate, and mica slate, in flakes.

The colours of uranium are grass-green, emerald-green, siskin-green, sulphur-yellow, black, and lemon yellow: the pure metal is of a steel colour, and is brittle.

The specific gravities of the ores vary from 3· to 6·56.

The black pitch-like ore is heavy, and accompanied with ochre.

The ores are found combined with other minerals, viz.—copper, lead, iron, silica, and sulphur. If a small piece of the ore, mixed with borax, be placed on charcoal, and acted upon by the flame of the blow-pipe, it will melt, and form a yellowish coloured glass. Uranium is capable of yielding several useful colours for the arts.

The ores of uranium are dissolved in nitric acid ; the salts of this metal are of a greenish or yellow colour.

Tests for Uranium.

If alkalies be added to the solution, they will produce a yellow precipitate.

If ferrocyanate of potassa,—a light brown precipitate.

If hydro-sulphuret of ammonia,—a dark brown precipitate.

If hydriodic acid,—a reddish yellow precipitate.

CHRONIUM.

Chronium is found in America, France, and Siberia; it has been found combined with lead, iron, and oxygen; its colours are brownish black and red brown; when pure, the metal is white, brittle, and, in a slight degree, magnetic.

This mineral will take a good polish, which is not likely to change on being exposed to the atmosphere.

The specific gravities of the ores vary from 5· to 6·5.

If the pure oxide of chronium, pulverized and mixed with borax, be acted upon by the blow-pipe, it will fuse into glass of an emerald green colour; this mineral cannot be reduced into a metallic state by means of the blow-pipe; a most intense heat is required for melting it.

The ores of chronium can be dissolved by nitro-muriatic acid only, and but slowly even by this acid.

TELLURIUM.

Tellurium is found in Norway and Transylvania.

The ores of tellurium are brought to England from Pennsylvania, under the name of graphic gold ore.

Tellurium is a white shining mineral, somewhat like antimony; it is easily and readily distinguished, when heated, by a peculiarly pungent odour, resembling that of horse radish; that which contains a large portion of gold is as fusible as lead, though hard and brittle.

Some of the ores of tellurium contain three-tenths of gold; the best is of a silver-white or steel-grey colour, and is found in porphyry.

The specific gravities of the ores vary from 5·7 to 7·2; that of pure tellurium is 6·1.

The ores of tellurium contain other metals than tellurium.

Native tellurium has gold and iron combined.

Prismatic gold glance,—tellurium, gold, and silver.

Prismatic black tellurium,—tellurium, gold, copper, silver, lead, and sulphur.

The gold may be obtained by melting the ore with borax; the steel-grey colour ore burns with a green flame, pure tellurium with a blue flame.

Tellurium can be dissolved by nitro-muriatic, nitric, or sulphuric acid; and decomposed by distilled water.

Tests for Tellurium.

If tincture of galls be added to a solution of tellurium, it will produce a yellow precipitate.

If a solution of potassa or soda,—a white precipitate.

TANTALIUM, OR CALUMBIUM.

Tantalium is found in Sweden and in Massachusetts; it is a mineral not much known.

Tantalium has a green and a brownish black colour, and a shining or glistening lustre; it is brittle, as hard as felspar,

and resinous, inclining in appearance to the semi-metallic adamantine.

Calumbium, mixed with glass of borax, is soluble before the blow-pipe; but without borax it suffers no change, except in lustre. This mineral will scratch glass.

The specific gravity of tantalium or calumbium is 5·6. Calumbium contains iron and manganese.

Calumbium, in a metallic state, is insoluble by any acid; muriatic acid will act slightly upon the oxide of calumbium.

TITANIUM.

Titanium is found in Norway, Bavaria, France, Switzerland, and a few other countries.

The ores are found in granite, gneiss, slate, and mica-slate.

The ores are brittle and hard, and of various colours, being yellow, red, and black. The specific gravities vary from 3· to 4·4.

The pure metal is of a copper colour; it is difficult to procure, and therefore

but little known: it is not used in the arts.

The ores contain titanium, iron, manganese, silica, lime, uranium, and oxygen. It is difficult to fuse the ores with the blow-pipe, but they may be melted into a brownish black slag or scoria, which is sometimes attractible by the magnet.

The oxide of titanium is not affected by the magnet; if mixed with borax, and acted upon by the blow-pipe, it readily fuses into white transparent glass; if some more of the oxide be added to the glass, and placed upon charcoal, and again submitted to the action of the flame, it will produce a yellow colour, which will change when cold to blue, if phosphorus be added, and melted with it, it will change, when cold, to a violet colour.

SULPHUR.

Sulphur is found in every country, more or less; it is found in various forms, sometimes crystallized.

There are two varieties, viz.—native sulphur and volcanic sulphur.

If sulphur be melted and kept in a fused state at 310 degrees of heat, till it becomes thick and viscid; when cooled, then remelt it, and pour it into water, it will form a substance of a red colour, convenient for taking impressions from seals, medals, &c.

Sulphur is not soluble in water, but will mix with oil when it is warmed.

SILICIUM.

Silicium, silix, or silicia, is found in every part of the world; flint, quartz, sand, and many other substances, are composed of this mineral; it forms a considerable part of some of the gems also, and gives them their hardness. All minerals, and every kind of earth, are composed partially of silicia; it is the base of glass.

The various colours are given to glass by the different metallic oxides; a yellow colour is given to glass by the oxide of antimony, emerald green by the oxide

of chrome, blue by the oxide of cobalt, black by the oxide of cobalt mixed with that of manganese, ruby red by cassius, and so on.

CHALCEDONY.

Chalcedony is found on the sea shores. It is of a close texture, and of a pale white blue colour; it resembles white cornelian, and is often marked with white lines.

Many stones are found on the sea-coast, and almost all persons who visit the coasts, employ themselves in looking for prettily marked stones, with the intention of forming a collection of their beautiful varieties. The generality of the stones found on the sea-shore may be cut and polished without any inconvenience; this employment affords much instructive amusement.

LAPIS LAZULI.

This mineral is of a rich blue colour, and is susceptible of a very fine polish;

it will scratch glass; its colour is occasioned by the blue sulphuret of iron.

Ultramarine is made from the native production.

JASPER.

Jaspers are of various colours; red, brown, green, yellow, &c. They are tough and difficult to break, and contain a great portion of iron.

Jasper will receive a good polish.

TOPAZ.

The name *Topaz* is derived from Topazos, a small island in the Red Sea. The principal colours are pale yellow, yellowish white, greenish white, &c.

This mineral is harder than quartz or emerald and softer than corundum; it is easily frangible and will receive a fine polish.

AGATE.

This is a hard stone, and can be cut with diamond powder only; it will receive a high polish. There are various kinds and its colours are various.

Agate was first brought from Sicily, and took its name from the river Achate.

GARNET.

The colours of *Garnets* are dark red, cherry red, brownish red, bluish red, and red inclining to yellow. It can be melted by the application of the blow-pipe into a black scoria.

CERIUM.

The colours are of a brownish black and red-brown. This mineral is hard and easily frangible; it froths before the blow-pipe, and melts imperfectly into a black scoria. Acids have but little effect on this mineral.

THE DIAMOND.

Diamonds are found in the East Indies and Brazil, imbedded in ferruginous sand and in the alluvial soil; they are also found in the sand of rivers.

The colours of the diamond are various, as white, grey, yellow, blue, green, red, brown, greyish white, yellowish

white, bluish grey, and greenish grey. The primitive form of the diamond is that of a regular octoedron, but it is sometimes found in figures of a dodecaedrical form, and sometimes it forms a quadrangular prism, with diedriacal summits. When the diamond is rubbed, it shews positive electricity, and, on being exposed to the rays of the sun, becomes phosphorescent. The action of diamond upon glass is very extraordinary, frequently separating it in the operation of cutting; any other substance does but scratch it.

The diamond cannot be broken, nor have any impression made upon it by a file, or even a lapidary's wheel, unless its own powder be used; fire has no effect upon it, nor can it be melted but by a burning lens, unless imbedded in iron.

If a diamond, imbedded in a piece of iron, be exposed to a strong red heat, it will be dissolved, and make the iron into steel or carburet of iron. I tried this experiment some years ago, and had a piece of the steel made into a pen-knife,

which I have used constantly for ten or twelve years.

Diamond contains from ninety-five to ninety-seven parts of pure carbon, so that it is nearly pure carbon. There are about seven parts in the hundred of carbon in charcoal.

The specific gravity of the diamond in its native state is 3·5. The diamond may be known by its refracting the rays of light, which enter it, to the surface. It may be known by the application of a small file also, which cannot make any impression on the diamond.

The diamonds of a blue and of a red colour, being the most scarce, are the most valuable; those of a clear white are next. Diamonds are seldom found as large as a nutmeg. Nearly one half of the diamond is lost in cutting and polishing.

A rough diamond is considered worth 2*l.* per carat, or four grains, but if heavier than a carat, then twice the square of its weight in carats will give the number of pounds it is worth. The

value of a diamond weighing two carats is computed thus—$2 \times 2 = 4$, and this, multiplied by 2, gives 8; then 8*l.* is its value. As half the weight of the diamond is lost in cutting and polishing it, to find the value of a cut or wrought diamond, we must multiply the square of double its weight in carats by 2; so the value of a wrought diamond weighing two carats is computed thus—double its weight is 4, the square of double its weight is $4 \times 4 = 16$; this being multiplied by 2 gives 32, then 32*l.* is the value of a wrought diamond weighing two carats. Diamonds above the weight of twenty carats do not increase in this ratio.

For the other gems, see the Tabular Views of the Pellucid Gems.

LIME.

Lime is found in almost every country, and in great varieties. Its colours are brown, reddish brown, yellowish brown, greenish brown, bluish brown, grey, white, &c.

Lime consists of carbonic acid, silicia, alumina, iron, and water, and forms a part of many minerals.

Lime may always be known by the application of fire, or of muriatic acid, which will readily act upon it. It will dissolve and effervesce in acids.

Lime is used as a flux for iron and other ores.

The common carbonate of lime, or chalk, when ground and washed, forms whiting.

Primitive lime-stone, called marble, is capable of receiving a fine polish.

The magnesium or conglomerate lime-stone contains about one-fifth of magnesia.

GYPSUM OR SULPHATE OF LIME.

Gypsum is found in many parts of the world; its colours are various, viz.—white and yellowish, reddish and greenish, white, and blue. It is soft, and frangible.

All the varieties of gypsum, on being exposed to heat, are deprived of the

water which they contain, and will, therefore, fall to powder, and, if it be mixed with water and exposed to the air, it will soon harden again.

Gypsum consists of lime, sulphuric acid, and water.

Gypsum, when calcined, forms what is called Plaster of Paris. The finer varieties of the fibrous gypsum are used for making necklaces and earrings. No metallic minerals are found in gypsum.

COAL.

Coal is found in France, Spain, Germany, Russia, China, Van Dieman's Land, North America, and some other countries; in many parts of England, Ireland, Scotland, and Wales, and in the Isle of Anglesea.

Coal is found in veins or beds, associated with clay slate, (shale,) clay iron stone, sandstone, lime stone, grit, &c., and often contains vegetable impressions.

The largest coal field with which we are acquainted, is that in the south of

Wales; the extent of it is nearly 100 square miles, the coal is found in twenty-three veins, varying in thickness from eighteen inches, to nine feet, which produce 63,800,000 tons of coal per square mile; besides those veins there are several smaller veins.

From the few observations I have made in Ireland, I am of opinion that it contains as much coal as England and Wales together; though the general geology of Ireland is as yet unknown.

Coal contains a portion of iron, sulphur, carbon, &c. Some coal contains from one fifth to two fifths of bitumen; this coal is unquestionably of vegetable origin, and according to the different changes that the vegetable matter undergoes, the coal will differ both in quality and appearance. There is little doubt but that water is the principal agent in mineralizing and forming coal. A great variety of animal, vegetable, and metallic matter is found contained in water. Water is capable of holding,

imperceptibly in solution, a large portion of matter, viz. copper, iron, bismuth, manganese, lead, arsenic, metallic salts, ammonia, soda, potassa, alumina, lime, and magnesia; sulphuric, boracic, and carbonic acids; hydrogen and oxygen; also animal, and vegetable matter, &c.

Coal has a variety of names, viz. brown coal, black coal, paper coal, moor coal, earth coal, calumar coal, pitch coal, cannel coal, foliated coal, slate coal, slaty coal, &c.

I shall mention a few particulars of those coals most common in this country.

CANNEL COAL.

The colour of cannel coal is between violet and greenish black, it is brittle, and easily frangible; and is harder than gypsum, and being capable of receiving a fine polish, is often made into snuff boxes, &c.

This coal contains carbon, hydrogen, and earthy matter, and about one fifth of bitumen.

FOLIATED COAL.

This coal is generally black; it is frangible, softer than cannel coal, and not very brittle; this coal is generally found with slate coal, and may be distinguished by its resplendent lustre. Foliated coal frequently falls to pieces by the action of the weather, and often catches fire.

SLATE COAL.

Slate coal is very soft, and the most frangible of all coals, its streaks are shining.

FIBROUS BROWN COAL.

Fibrous brown coal is of a dark pale blackish brown colour, and sometimes reddish; it is soft, and burns with a clear flame, but will not give a great heat; this coal contains about two fifths of bitumen, and causes a bituminous smell while burning.

SLATY GLANCE COAL.

Slaty glance coal is of a dark iron

black colour; when exposed to a great heat it burns without flame; this coal is void of both sulphur and bitumen.

CALUMNAR GLANCE COAL.

This coal burns without either flame or smoke; it will give a strong heat, and will expand as it becomes hot.

A vein of coal three feet thick, produces about three thousand tons of coal per acre.

The expense of raising the coal from the mines in this country depends upon the depth from which it is taken, and varies from two to five shillings per ton.

The raising of coal from the mines, and taking it to the market, requires the labour of one man from three to five days per ton.

Coal may be considered to constitute one third of our enjoyments, as it supplies us both with light and heat; and I am of opinion that coals are to be found in many parts of the world which are, at present, unexplored.

THE SPECIFIC GRAVITIES OF THE METALS.

Platinum . .	21·336
Gold . . .	19·258
Iridium . . .	18·711
Tungstenium . .	17·094
Mercury, at 30° heat	13·619
Lead, from 11·352 to	11·445
Palladium . .	10·686
Rhodium . .	10·654
Silver . . .	10·474
Bismuth . .	9·822
Nickel . . .	9·001
Copper . . .	8·878
Brass, from 8·788 to	8·801
Arsenic . . .	8·311
Molybdenum . .	8·006
Manganese . .	7·991
Steel . . .	7·833
Cobalt . . .	7·811
Bar-Iron . . .	7·788
Tin	7·291
Cast Iron . .	7·207
Zinc . . .	7·791

Antimony . .	6·861
Uranium . . .	6·006
Tellurium . .	6·005

THE SPECIFIC GRAVITIES OF THE ORES.

Platinum,	from 16·	to	17·07
Gold .	12·	—	19·
Iridium .	—		19·5
Tungstenium	—		17·5
Mercury .	6·	—	10·6
Lead .	3·	—	7·16
Silver .	5·	—	10·4
Bismuth .	4·	—	6·6
Nickel .	6·4	—	7·8
Copper .	3·	—	6·
Arsenic .	2·6	—	6·65
Molybdenum	4·5	—	6·6
Cobalt .	2·2	—	6·7
Tin . .	4·6		7·
Iron . .	2·	—	6·
Zinc .	4·	—	6·2
Antimony .	4·4	—	6·86
Uranium .	3·	—	6·5
Tellurium .	5·7	—	7·2
Titanium .	3·	—	4·4

THE DEGREES OF HEAT AT WHICH THE METALS ARE FUSED.

	Fahr.	Wedgwood.
Cast Iron . .	17977.	160.
(Welding heat of Iron)	13427.	95.
Fine Gold . .	5237.	32.
Silver . . .	4717.	28.
Copper . . .	4578.	27.
Brass . . .	3807.	21.
Mercury boils at .	600.	
Water boils at . .	~~388.~~ 212.	

COMPOUND METALS.

Yellow Brass.

Yellow brass is composed of 32 parts copper, 12 zinc, and 1 tin.

Common Brass.

Common brass is composed of 16 parts copper, 8 zinc, and 1 lead.

Bell Metal.

Church bells are composed of 32 parts

copper, 7 tin, and 3 brass. Ship bells are composed of 16 parts copper, 4 tin, and 1 brass. House bells are composed of 32 parts copper, 9 tin, and 2 brass. Clock bells are composed of 20 parts copper, 6 tin, and 1 brass.

Gun Metal.

Large guns are composed of 64 parts copper, 16 brass, and 8 grain tin. Common gun metal is composed of 64 parts copper, 16 brass, and 7 tin. Gun metal for wheels that are to be cut, is composed of 32 parts copper, 2 brass, and 3 tin with 3 lead.

Pot Metal.

Pot metal is composed of 28 parts copper, and 12 lead with 2 tin.

Mixture for Speculums.

Speculums are composed of 32 parts copper, and 15 grain tin.

White Metal resembling Silver.

White metal is composed of 30 parts copper, 13 nickel, and 17 zinc. This

mixture, which is as white as silver, is much stronger than it, and is malleable; spoons, candlesticks, and a variety of other articles are made of it.

This mixture would answer well for making fire irons.

Improved Cast Iron.

A small portion of copper, added to cast iron, will make it malleable; and if one tenth of copper be added to cast iron, it will make it sufficiently malleable to be forged.

Mixture that will melt in Boiling Water.

Mix 8 parts bismuth, 5 lead, and 3 tin, together.

METALLIC CEMENTS.

Brass Soder.

Brass soder is composed of 16 parts copper and 14 zinc.

Tin Soder.

Tin soder is composed of 3 parts tin and 2 lead.

Plumber's Soder.

Plumber's soder is composed of 4 parts lead and 2 tin.

FLUXES FOR THE SMELTING OR ASSAYING OF THE MINERALS.

FLUX FOR SMELTING THE ORE OF SILVER.

Red tartar, red lead, nitre, borax, lime, salt, and fluor-spar ; or, soda four times the weight of the ore.

FLUX FOR SMELTING THE ORE OF SILVER WHEN COPPER IS COMBINED WITH IT.

Red tartar, red lead, nitre, fluor-spar, and lime.

FLUX FOR SMELTING THE ORE OF COPPER.

The ore must be first calcined. Red tartar, nitre, borax, fluor-spar, lime, salt, glass, charcoal, and sometimes sulphur ; or double the weight of black flux with a little salt.

FLUX FOR SMELTING THE ORE OF TIN.

Culm and borax, or, charcoal and linseed oil.

FLUX POR SMELTING THE ORE OF LEAD.

Red tartar, nitre, borax, fluor-spar, lime, and salt.

FLUX FOR SMELTING THE ORE OF IRON.

The ore, first calcined, is to be mixed with half its weight of fluor-spar, double its weight of salt, and a little of the black flux. The only flux used for smelting the iron ore on a large scale is lime.

THE BLACK FLUX, WITH INSTRUCTIONS FOR MAKING IT.

Take 4 oz. of nitre, pulverized, and 16 oz. of cream of tartar, pulverized; mix them together in an unglazed earthen vessel, heat the mixture gradually, and when it begins to burn, remove it from the fire, and put on a cover; keep the cover on till the noise ceases, then bottle the mixture, cork it up tightly, and keep it in a dark place, that neither the light nor the air may have access to it.

Such is the efficacy of these fluxes,

that, the whole globe might be melted by them ; and as Archimedes, the renowned mathematician, said to his countrymen, I will move the whole earth, if you will find me a place to stand upon ; so, I say, give me a crucible large enough, fuel sufficient, and a place for me to stand upon, and I will dissolve the whole globe.

CLASSIFICATION OF MINERALS.

METALS.

Platinum	Titanium	Nickel
Palladium	Lead	Cobalt
Iridium	Chrome	Arsenic
Gold	Zinc	Tungstenium
Mercury	Tin	Tantalum
Silver	Bismuth	Cerium
Copper	Tellurium	Cadmium
Iron	Antimony	Selenum
Manganese	Molybdenum	Wodanum.

EARTHY MINERALS.

Diamond	Felspar	Dolomite
Zircon	Clay-slate	Lime-stone
Ruby	Mica	Apatite
Schorl	Lithomarge	Fluor
Garnet	Soap-stone	Gypsum
Quartz	Talc	Boracite
Pitch-stone	Hornblende	Barytes
Zeolite	Chrysalite	Strontian
Azure-stone	Bay-salt	Hallitte.

SALINE MINERALS.

Alum	Sulphate of Soda
Epsom Salts	Reussite
Alkaline Salts	Rock-salt
Salts of Soda	Borax
Natron	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.

MOH'S

MINERAL SYSTEM, IN 1804.

CLASS I.—EARTHY MINERALS.

1 Diamond Family	8 Scharl
2 Zircon	9 Quartz
3 Chrysaberyl	10 Opal
4 Augite	11 Obsidian
5 Garnet	12 Zeolite
6 Spinel	13 Felspar
7 Hardstone (Hartstein)	14 Clay
	15 Clay-slate

16 Mica Family
17 Trap
18 Lithomarge
19 Balc
20 Talc
21 Actynalite
22 Lime-stone
23 Brown Spar
24 Marl
25 Aphatite
26 Fluor
27 Gypsum
28 Baryte
29 Salt-stone.

CLASS II.—SALINE MINERALS.

30 Family of Carbonats
31 Family of Nitrats
32 Family of Muriats
33 Family of Sulphats.

CLASS III.—INFLAMMABLE MINERALS.

34 Sulphur Family
35 Amber Family
36 Coal Family
37 Graphite Family.

CLASS IV.—METALLIC MINERALS.

38 Family of Native Gold
39 Mercurial Ores
40 Native Silver
41 Silver Ores
42 Native Copper
43 Copper Pyrites
44 Malachite
45 Copper Emerald
46 Native Iron
47 Iron Pyrites
48 Iron Stone
49 Iron Earth
50 Manganese

51 Family of Manakan
52 Lead Ore
53 Tinstan
54 Cobalt
55 Cobalt Ochre
56 Earthly Cobalt
57 Native Arsenic
58 Antimony Ores
59 Uranium Ores.

WERNER'S

MINERAL SYSTEM, IN 1815.

CLASS I.—EARTHY FOSSILS.

1. DIAMOND GENUS.

1 Diamond.

2. ZIRCON GENUS.

Zircon Family.

2 Zircon
3 Hyacinth
4 Cinnamon-stone.

3. FLINT GENUS.

Augite Family.

5 Chrysoberyl
6 Chrysolite
7 Olivine
8 Coccolite

9 Augite
a Granular
b Foliated
c Conchoidal
d Common
10 *Baikalite*
11 Sahlite
12 Diopside
13 *Fassiate.*

Garnet Family.

14 Vesuvian
15 Groussulare
16 Leucite
17 *Pyrenite*
18 Melanite
19 Allochroite
20 *Colophonite*
21 Garnet
a Precious
b Common
22 Staurolite or Grenatite
23 Pyrope.

Ruby Family.

24 Automalite
25 Ceylanite
26 Spinel
27 Sapphire
28 Emery
29 Corundum
30 Diamond-spar

31 Topaz.

Beryl Family.

32 Iolite
33 Euclase
34 Emerald
35 Beryl
a Precious Beryl
b Common
36 Schorlous Beryl
37 Tourmaline.

Pistacite Family.

38 Lievrite
39 Pistacite
40 Diaspore
41 Zoisite
42 Anthophylite
a Radiated
b Foliated
43 Axinite.

Quartz Family.

44 Quartz
a Amethyst
Common
Thick fibrous
b Rock Crystal
c Milk Quartz
d Common Quartz
e Prase
45 Iron-flint
46 Horn-stone
a Splintery
b Conchoidal
c Wood-stone
47 Flinty Slate
a Common
b Lydian-stone
48 Flint
49 Chalcedony
a Common
b Cornelian
Common
Fibrous
50 Hyalite
51 Opal
a Precious
b Common Opal
c Semi-opal
d Wood-opal
52 Menilite
a Brown Menalite
b Grey Menalite
53 Jasper
a Egyptian Jasper
Red
Brown
b Striped Jasper
c Porcelain Jasper
d Common Jasper
Conchoidal
Earthy
e Opal Jasper
f Agate Jasper
54 Heliotrope
55 Chrysoprase
56 Plasma
57 Cat's-eye
58 *Faser Kiesel*
59 Elaolite.

Pitch-stone Family.

60 Obsidian
61 Pitch-stone
62 Pearl-stone
63 Pumice.

Zeolite Family.

64 Prehnite
a Fibrous
b Foliated
65 Natrolite.

66 Zeolite
a Mealy Zeolite
b Fibrous ditto
c Radiated ditto
d Foliated ditto
67 Ichthyophthalni
68 Cubicite
69 Cross-stone or Crucite
70 Laumonite
71 Schmelztein

Azurestone Family.

72 Azurestone
73 Azurite
74 Blue-spar

Felspar Family.

75 Andalusite
76 Felspar
a Adularia
b Labrador
c Glassy
d Common felspar
Fresh
Disintegrated
e Hollow spar
f Compact felspar
Common
Variolite
77 Spodumene
78 Scapolite
a Red scapolite
b Grey ditto
Radiated
Foliated
79 Meionite
80 Nepheline
81 Ice-spar

4. CLAY GENUS.

Clay Family.

82 Pure clay
83 Porcelain earth
84 Common clay
a Loam
b Potter's clay
Earthy
Slaty
c Variegated clay
d Slate clay
85 Claystone
86 Adhesive slate
87 Polishing or polier slate
88 Tripoli
89 Floatstone
90 Alum-stone

Clay Slate Family.

91 Alum-slate
a Common
b Glossy
92 Bituminous shale
93 Drawing-slate
94 Whet-slate
95 Clay-slate

Mica Family.

96 Lepidolite
97 Mica
98 Pinite
99 Potstone
100 Chlorite
a Chlorite earth
b Common chlorite
c Chlorite-slate
d Foliated chlorite

Trap Family.

101 *Paulite*
102 Hornblende
a Common
b Basaltic
c Hornblende-slate
103 Basalt
104 Wacke
105 Clinkston
106 Iron-clay
107 Lava

Lithomarge Family.

108 Green earth
109 Lithomarge
a Friable
b Indurated
110 Rock-soap
111 Umber
112 Yellow earth

5. TALC GENUS.

Soapstone Family.

113 Native magnesia, or talc-earth
114 Meerschaum
115 Bole
116 Fuller's Earth
117 Steatite
118 Figure-stone.

Talc Family.

119 Nephrite
a Common Nephrite
b Axe-stone
120 Serpentine
a Common
b Precious
Conchoidal
Splintery
121 Schiller-stone
122 Talc
a Earthy
b Common
c Indurated
123 Asbestus
a Rock-cork
b Amianthus
c Common Asbestus
d Rock-wood

Actynolite Family.

124 Kyanite
125 Actynolite
a Asbestous
b Common
c Glassy
d Granular
126 *Spreustein or Chaff-stone*
127 Tremolite
a Asbestous
b Common
c Glassy
128 Sahlite
129 *Rhætizite.*

6. CALCAREOUS GENUS.

A. *Carbonates.*
130 Rock-milk
131 Chalk
132 Lime-stone
a Compact
Common
Roe-stone
b Foliated
Granular
Calcareous Spar
c Fibrous
Common
Calc-sinter
d Pea-stone
133 Calc-tuff
134 Schaum Earth, or Foam Earth
135 Slate-spar.

136 Brown-spar
a Foliated
b Fibrous
137 Schaalstone
138 Dolomite
139 Rhomb-spar
140 *Anthracolite*
141 Stinkstone
142 Marl
a Marl earth
b Indurated marl
143 Bituminous marl-slate
144 Arragon
a Common
b Prismatic

B. *Phosphates.*

145 Appatite
146 Asparagus-stone

C. *Fluates.*

147 Fluor
a Compact
b Fluor-spar

D. *Sulphates.*

148 Gypsum
a *Spumous Gypsum*
b Earthy gypsum
c Compact ditto
d Foliated ditto
e Fibrous ditto
149 Selenite
150 Muriacite
a Anhydrite
b *Gekrostein*
c Conchoidal Mur.
d Fibrous ditto
e Compact ditto

E. *Borates.*

151 Datolite
152 Boracite
153 Botryolite

7. BARYTE GENUS.

154 Witherite
155 Heavy-spar
a Earthy heavy-spar
b Compact ditto
c Granular ditto
d Curved lamellar ditto
e Straight lamellar heavy-spar
Fresh
Disintegrated
f Columnar-spar
g Prismatic-spar
h Bolognese, or Bolognian-spar

8. STRONTIAN GENUS.

156 Strontian
a Compact
b Radiated
157 Celestine
a Fibrous
b Radiated
c Lamellar
d Prismatic

9. HALLITE GENUS.

158 Cryolite.

CLASS II.—FOSSIL SALTS.

1. *Carbonates.*

159 Natural soda or natron
b Lake-salt
162 Natural sal-ammoniac

2. *Nitrates.*

160 Natural nitre

3. *Muriates.*

161 Natural rock-salt
a Stone-salt
Foliated
Fibrous

4. *Sulphates.*

163 Natural vitriol
164 Hair-salt
165 Rock-butter
166 Natural Epsom-salt
167 Natural Glauber-salt

CLASS III.—INFLAMMABLE FOSSILS.

1. SULPHUR GENUS.

168 Natural sulphur
a Crystallised
b Common
Earthy
Conchoidal
c Mealy
d Volcanic

2. BITUMINOUS GENUS.

169 Mineral or fossil oil
170 Mineral pitch
a Elastic
b Earthy
c Slaggy
171 Brown coal
a Bituminous wood
b Earth coal
c Alum earth
d *Paper coal*
e Common brown coal
f Moor coal
172 Black ditto
a Pitch ditto
b Columnar ditto
c Slate ditto
d Cannel ditto
e Foliated ditto
f Coarse ditto

3. GRAPHITE GENUS.

173 Glance-coal
a Conchoidal
b Slaty
174 Graphite
a Scaly
b Compact
175 Mineral charcoal

4. RESIN GENUS.

176 Amber
a White
b Yellow
177 Honey-stone

CLASS IV.—METALLIC FOSSILS.

1. PLATINA GENUS.

178 Native platina.

2. GOLD GENUS.

179 Native gold
a Gold yellow
b Brass yellow
c Greyish yellow

3. MERCURY GENUS.

180 Native mercury
181 Natural amalgam
a Semi-fluid
b Solid
182 Mercurial horn-ore
183 Mercurial liver-ore
a Compact
b Slaty
184 Cinnabar
a Dark-red
b Light-red

4. SILVER GENUS.

185 Native silver
a Common
b Auriferous
186 Antimonial silver
187 Arsenical ditto
188 *Molybdena silver*
189 Corneous silver ore, or horn ore
190 Silver-black
191 Silver-glance
192 Brittle silver-glance
193 Red silver ore
a Dark
b Light
194 White silver ore

5. COPPER GENUS.

195 Native copper

Family of copper Sulphurets.

196 Copper-glance
a Compact
b Foliated
197 Variegated copper ore
198 Copper-pyrites
199 White copper ore
200 Grey copper ore
201 Black copper ore

202 Red copper ore
a Compact
b Foliated
c Capillary
203 Tile ore
a Earthy
b Indurated
204 Azure copper ore

a Earthy
b Indurated or radiated
205 *Velvet copper ore*
206 Malachite
a Fibrous
b Compact
207 Copper green
208 Ironshot copper green
a Earth
b Slaggy
209 Emerald copper ore
210 Copper mica
211 Lenticular ore
212 Oliven ore
213 Muriate of copper
214 Phosphat of copper

6. IRON GENUS.

215 Native iron
216 Iron pyrites
a Common ditto
b Radiated ditto
c Liver or hepatic ditto
d Cock's-comb ditto
e Cellular ditto
217 Capillary ditto
218 Magnetic ditto
219 Magneticiron-stone
a Common
b Iron-sand
220 *Chrome ironstone*
221 *Menac ironstone*
222 Iron-glance
a Common
Compact
Foliated
b Iron mica
223 Red iron-stone
a Red iron-froth
b Ochery red iron-stone
c Compact
d Red hematite
224 Brown iron-stone
a Brown iron-froth
b Ochery brown iron-stone
c Compact
d Brown hematite
225 Sparry iron-stone
226 Black iron stone
a Compact
b Black hematite
227 Clay-ironstone
a Redde
b Columnar clay-ironstone
c Lenticular clay-ironstone
d Jaspery clay-ironstone

e Common clay-ironstone
f Reniform clay iron-stone
g Pea-ore, or pisiform ironstone.
228 Bog iron-ore
a Morass-ore
b Swamp-ore
c Medow-ore
229 Blue iron-earth
230 Pitchy iron-ore
231 Green iron-earth
232 Cube-ore
233 Gadolinite

7. LEAD GENUS.

234 Galena or lead-glance
a Common
b *Disintegrated*
c Compact
235 Blue lead-ore
236 Brown lead-ore
237 Black lead-ore
238 White lead-ore
239 Green lead-ore
240 Red lead-ore
241 Yellow lead-ore
242 Lead-vitriol
243 Earthy lead-ore or Lead-earth
a Coherent
b Friable

8. TIN GENUS.

244 Tin pyrites
245 Tinstone
246 Cornish tin-ore

9. BISMUTH GENUS.

247 Native bismuth
248 Bismuth-glance
249 Bismuth-ochre
250 *Arsenical bismuth-ore*

10. ZINC GENUS.

251 Blende
a Yellow
b Brown
Foliated
Fibrous
Radiated
c Black
252 Calamine

11. ANTIMONY GENUS.

253 Native antimony
254 Grey antimony-ore
a Compact
b Foliated
c Radiated
d Plumose
255 Black antimony-ore
256 Red antimony-ore
257 White antimony ore
258 Antimony-ochre

12. SYLVAN GENUS.

259 Native sylvan
260 Graphic-ore
261 White sylvan-ore
262 Nagyag-ore

13. MANGANESE GENUS.

263 Grey manganese-ore
a Radiated
b Foliated
c Compact
d Earthy
264 Black manganese-ore
265 *Piedmontese manganese ore*
266 Red manganese-ore
267 *Manganese-spar*

14. NICKEL GENUS.

268 Copper-nickel
269 *Capillary-pyrites*
270 Nickel-ochre

15. COBALT GENUS.

Family of Speiss-Cobalt.

271 White cobalt-ore
272 Grey cobalt-ore
273 Glance-cobalt

Family of Cobalt-Ochre.

274 Black cobalt-ochre
a Earthy
b Indurated
275 Brown cobalt-ochre
276 Yellow cobalt-ochre
277 Red cobalt-ochre
a Cobalt-crust
b Cobalt-bloom

16. ARSENIC GENUS.

278 Native arsenic
279 Arsenic pyrites
a Common
b Argentiferous
280 Orpiment
a Yellow
b Red
281 Arsenic bloom

17. MOLYBDENA GENUS.

282. Molybdena.

18. SHEELE GENUS.

283 Tungsten
284 Wolfram

19. MENACHINE GENUS.

285 Menachan
286 Octahedrite
287 Rutile
288 Nigrine
289 Iserine
290 Brown menachine ore
291 Yellow menachine-ore

20. URAN GENUS.

292 Pitch-ore
293 Uran-mica
294 Uran-ochre

21. CHROME GENUS.

295 Acicular-ore
296 Chrome-ochre

22. CERIUM GENUS.

297. Cerium-stone.

TABULAR VIEW

OF THE

PELLUCID GEMS,

ARRANGED ACCORDING TO COLOUR, WITH SOME OF THEIR MORE DISTINCTIVE CHARACTERS.

	Specific Gravities.	Hardness.	Refractions.
1. WHITE & GREY GEMS.			
a. Diamond	3 · 5	Scratches all other minerals	Simple.
b. Sapphire	4 · 0	Scratches topaz	Feeble double.
c. Topaz of Brazil	3·55	Scratches rock crystal	Double, and stronger than that of sapphire.
d. Rock crystal	6·65	Scratches felspar	Same as the preceding.

	Specific Gravities.	Hardness.	Refractions.
2.			
RED GEMS.			
a. Oriental ruby	4 · 2	Scratches topaz	Feeble double.
b. Spinel ruby	3 · 7	Scratches topaz, but in a lower degree than oriental ruby	Simple.
c. Brazilian ruby or red topaz	3 · 5	Scratches rock crystal, but does not affect spinel	Double in a moderate degree.
d. Precious garnet columbine of a red colour	4 ·0	Scratches rock crystal in a moderate degree	Simple.
e. Pyrope of a blood red colour	3 · 7	Scratches rock crystal more readily than precious garnet	Simple.
f. Tourmaline	3 · 0	Scratches rock crystal but feebly	Double in a moderate degree.

	Specific Gravities.	Hardness.	Refractions.
3.			
BLUE GEMS.			
a. Oriental sapphire	4 · 2	Scratches topaz	Feeble double.
b. Beryl or aquamarine	2 · 7	Scratches rock crystal feebly	Feeble double.
c. North American tourmaline	3 · 0	Scratches rock crystal freely	Double.
d. Water sapphire or dichroite; when viewed in one direction shews a violet blue colour, and in another a brownish yellow	2 · 7	Same as preceding	Feeble double.
4.			
GREEN GEMS.			
a. Oriental emerald or green sapphire	4 · 2	Scratches topaz and spinel ruby	Feeble double.

	Specific Gravities.	Hardness.	Refractions.
b. Peruvian emerald or true emerald	2 · 8	Scratches rock crystal, but not topaz	Feeble double.
c. Brazilian or Columbian emerald; a variety of tourmaline	3 · 0	Scratches rock crystal feebly	Double.
d. Chrysoprase	2 · 6	Scratches glass and felspar	
5. BLUISH GREEN GEMS.			
a. Oriental aquamarine; a variety of sapphire	4 · 0	Scratches topaz	Feeble double.
b. Siberian beryl	2 · 6	Scratches rock crystal	Feeble double.

	Specific Gravities.	Hardness.	Refraction.
6.			
YELLOW GEMS.			
a. Oriental topaz; a variety of sapphire	4 · 0	Scratches topaz	Feeble double.
b. Brazilian topaz	3 · 5	Scratches rock crystal, but not so deeply as spinel	Feeble double.
c. Yellow zircon or jargoon	4 · 4	Scratches rock crystal, but not topaz	Strong double.
7.			
YELLOWISH GREEN, AND GREENISH YELLOW GEMS.			
a. Oriental peridote; a variety of sapphire	4 · 0	Scratches topaz	Feeble double.
b. Chrysoberyl, or oriental chrysolite	3 · 8	Nearly as hard as sapphire	Double in a middling degree.

	Specific Gravities.	Hardness.	Refraction.
c. Beryl, or aquamarine	2 · 6	Scratches quartz but feebly	Feeble double.
d. Jargoon of Ceylon, or yellowish green zircon	4 · 4	Scratches rock crystal more easily than it does beryl	Very perfect double.
e. Chrysolite	3 · 4	Scratches felspar but not rock crystal	Double in a high degree, but not so powerful as that of zircon.
f. Yellowish green tourmaline, or peridote of Ceylon	3 · 0	Scratches rock crystal feebly	Double.
8.			
a. Oriental amethyst; a variety of sapphire	4 · 0	Scratches topaz	Feeble double.
b. Amethyst	2 · 7	Scratches felspar	Double in a middling degree.

	Specific Gravities.	Hardness.	Refraction.
9. HYACINTH-RED GEMS.			
a. Cinnamon-stone	3 · 6	Scratches rock crystal feebly	Simple.
b. Hyacinth garnet, or vermeille	4 · 0	Scratches rock crystal in a middling degree	Simple.
c. Hyacinth	4 · 4	Scratches rock crystal in a middling degree	Perfect double.
d. Hyacinthine tourmaline	3· 0	Scratches rock crystal feebly	Double.
10. GEMS WHICH ARE OPALESCENT, OR WHICH DISPLAY A VARIETY OF COLOUR.			
a. Asterias, or star-stone; a variety of sapphire	4 · 0	Scratches topaz.	

	Specific Gravities.	Hardness.	Refraction.
1. Ruby asterias — red ground			
2. Sapphire asterias—blue ground			
3. Topaz asterias — yellow ground	3 · 5	Scratches rock crystal.	
b. Opal	2 · 1	Scratches white glass feebly.	
c. Oriental girasol, or girasol corundum, with a milky ground, from which there shoot bluish and yellowish pencils of light	4 · 0	Scratches topaz.	
d. Moonstone, argentine, or fish-eye stone, is a variety of felspar	2 · 6	Scratches felspar, but not rock crystal.	

	Specific Gravities.	Hardness.	Refraction.
e. Sunstone, or oriental aventurine.	2 · 6		
f. Labrador-stone.	3 · 0		

As this small volume is intended to be an introductory work, it is necessary to enumerate and give some account of the apparatus, with which every person, who would become experimentally acquainted with the science of mineralogy, ought to be furnished.

The blowpipe, (a description of which is given in a following page); a cast-steel hammer, of about six or eight ounces weight, having a square face and a sharp pane, (its handle, made of either whalebone or tough-wood, is thirteen inches long); a pocket knife; a small file; a magnet; and a powerful lens.

These articles, with the exception of

the blow-pipe, ought to be the pocket companions of the mineralogist, when walking for pleasure.

In order to try experiments, it is necessary to have the fluxes, acids, and tests, a small iron pestle and mortar, test tubes, watch glasses, and a pair of small scales.

The use of each instrument:—

The blow-pipe is for melting the specimen.

The hammer is for breaking it, in order to discover its fracture, &c.

The knife and file are for ascertaining its hardness and colours.

The magnet is for detecting the presence of iron in it. This instrument has not any effect, if the specimen contain much sulphur, nor if the iron be oxidized.

The fluxes are for mixing with the ore, to make it fuse easily, &c.

The acids are for dissolving the minerals.

The tests are for detecting the presence of metals, &c.

The pestle and mortar are for the pulverizing of the ores.

The test tubes are for either the dissolving or the testing of the ores.

The watch-glasses are for evaporating the different solutions. They are called evaporating dishes.

The scales are for weighing the ores and metals.

To make nitro-muriatic acid:—mix two parts of nitric acid, one of muriatic acid, and two of distilled water. This mixture will dissolve gold.

ACIDS AND TESTS USED FOR ANALYZING THE DIFFERENT MINERALS.

Acids.

Nitric acid	Sulphuric acid
Muriatic acid	Fluoric acid.

Tests.

Ammonia.
Bright pieces of copper, of iron, of tin, and of zinc.
Carbonated potassa.

Caustic potassa.
Ferro-cyanate of potassa.
Ferro-prussiate of potassa.
Hydro-sulphuret of ammonia.
Muriate of ammonia.
Muriate of gold.
Muriate of soda.
Nitrate of lead.
Oxalate of ammonia.
Proto-sulphuret of iron
Prussiate of mercury.
Sulphurate of soda.
Tincture of galls.

A FAMILIAR DESCRIPTION OF THE BLOW-PIPE, AND SOME INSTRUCTIONS RESPECTING THE MANNER OF USING IT.

As the blow-pipe is an instrument used in the analysis of minerals, which requires a more minute description than the rest of the apparatus, I will here give that description, and some instructions respecting the manner of using it.

The blow-pipe is a brass tube, about ten inches long, and bent at one end; it has an ivory mouth-piece attached to the

other end, and a small cistern about the middle of the tube, for the purpose of condensing the moisture which passes with the breath. The bore of the mouth-piece is about a quarter of an inch in diameter, and that at the other extremity of the tube is so small that it will scarcely admit a pin; the blow-pipe is furnished with two or three loose pieces also, to fit the end of the tube, each having an aperture of different dimensions, for the purpose of varying the size of the *jet*, according to the flame required for melting the particular metal or ore which is to be analyzed. In analyzing, it is requisite to maintain, for several minutes together, a continual stream of air, the art of doing which is soon acquired with a little practice. In order to do this, it is necessary to breathe through the nostrils at the same time that you supply the tube with breath from your mouth,—to do which, let the tongue press against the roof of the mouth, so as to prevent, while breathing, any communication between the

mouth and the passage to the nostrils. The candle used with the blow-pipe must have a thick wick, which must be bent in the direction of the breath, and the current of air passing through the tube will give the flame a neat conical shape of a blue colour, the heat of which is strongest at the extremity. The size of the specimen acted upon must not exceed the size of a pepper-corn or a small pea. There are some minerals which cannot be melted by this blow-pipe.

Monsieur Benzelius has written a very able account of the blow-pipe, which has been translated by Mr. Children. Mr. Gurney has invented a useful and powerful blow-pipe, and has published on the same.

DESCRIPTION OF THE PLATES.

Plate 1, contains a sketch taken at Cape D'or, of part of the Cape, where copper of the purest quality has been found; and, a draft of a *Transverse Section* of a tin and copper mine.

Explanation of the Draft.

The buildings which are represented are the houses in which the steam-engines are fixed, for working the pumps and drawing up the ores from the different levels; the two perpendicular lines represent the shafts through which the ore is brought to the surface; the horizontal lines represent the passages by which the miners pass to the different veins of the ore, and convey it to the shafts; the broad diagonal lines represent veins of copper; and the narrow diagonal lines represent veins of tin.

Plate 2, contains a draft of a *Longitudinal Section* of the same mine.

The buildings which are represented are the engine-houses; the shafts are where the pumps are fixed for drawing the water from different parts of the mine, and also where perpendicular ladders are fixed, by which the men descend and ascend; attached to the horizontal lines are shewn the excavations which have been made by the removal of the ores. As a scale is given with the draft, the dimension of the mine, its excavations, &c. may be ascertained.

AN

ALPHABETICAL INDEX.

THE END.

Preparing for Publication,

A SECOND VOLUME of this Work, which will comprise a description of the great variety of Rocks, and also the forms, &c. of the differently crystallized minerals.

LONDON:
PRINTED BY R. GILBERT, ST. JOHN'S SQUARE.

bound by J. Sinkankas