

bodies, especially when the oxides of the heavy metals come in the room of the earths and alkalis, exerts a most essential influence on the external aspect of the species, particularly in regard to colour, specific gravity, and transparency. The varieties of hornblende, augite, garnet, epidote, and many other minerals are remarkable proofs of this influence. This intermixture of isomorphous elements confers many valuable properties on minerals, and to this department of nature owes much of its variety and beauty. Without the occasional presence of the colouring substances, especially the oxides of iron and manganese, the non-metallic combinations would have exhibited a very monotonous aspect. It is also remarkable that in some silicates the substitution of a certain portion of the metallic oxides for the earthy bases seems to be almost a regular occurrence; whilst in others, as the feldspars and zeolites, this rarely happens. This fact is also of great economic interest, as drawing attention to important elements often combined with others of less value. Thus iron oxide and chrome oxide, sulphuret of copper and sulphuret of silver, nickel and cobalt, may be looked for in connexion. The

DESCRIPTION OF MINERAL SPECIES.

The arrangement adopted in the following description of mineral species is chemical. Simple substances are considered first, in the order of their quantivalence, then binary compounds, and lastly those of more complex structure. Our limits permit of the briefest notice of the less important, in order that more space may be available for the delineation of the characteristic and transition forms of such as go to constitute the more important rock masses.

The following abbreviations are used:—H., hardness; G., specific gravity (distilled water at 60° Fahr. and barometer 30 inches = 1); cl., cleavage; sol., soluble; s. [h. or n.] acid, sulphuric [hydrochloric or nitric] acid; B.B., before blowpipe; ox., oxidizing; red., reducing; c.c., chemical composition; com., combination.

In the chemical formulae, barred letters express two equivalents, and the dots over the symbols indicate the combination with them of as many equivalents of oxygen as there are dots.

In the symbolic notation the several faces of crystals are separated by semicolons, and the constituent members of combinations by commas. The lettering on the faces of the figures is for the most part that adopted by Miller. In the enumeration of crystal forms, that which is typical of the mineral is placed first.

SIMPLE SUBSTANCES.

1. SULPHUR, S.

(a) Right prismatic. P (p) polar edges 106° 38', 84° 58', middle edge 143° 17'; ∞P 101° 58'; OP (c); ½P (s); ⅓∞ (∞). Crystals pyramidal, single or in druses; also stalactitic, disseminated, and pulverulent. Cl. basal and ∞P. H.—1.5 to 2.5; G.—1.9 to 2.1. Fracture conchoidal or splintery; brittle, sectile. Lustre resinous, streak and colour sulphur-yellow, passing into red, brown, or green. Sublimes in the closed tube. Fuses a little above the temperature of boiling water. Takes fire at 518° F., and burns with a pale blue flame with odour of sulphurous acid. C.c.: pure sulphur, occasionally mixed with traces of selenium, and when amorphous with clay or bitumen. Found chiefly in Tertiary strata. Localities: Girgenti in Sicily, with celestine; Comil in Spain; Bex in Switzerland; Cracow in Poland; deposited from hot springs in Solfatara near Naples; from hot springs in Iceland; from sulphur springs in New York; and in cavities of decomposing galena, cinnabar, and pyrites at several localities.

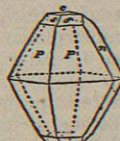


Fig. 257.

(b) Oblique prismatic. The crystals of volcanic sulphur are of this form; they occur in the neighbourhood both of extinct and of recent volcanoes. They are slender, needle-shaped, and interlacing, and have generally more or less of a red-brown tinge. Oxhaever and Cape Reykjanes in Iceland, Sicily, and the volcanoes of the Pacific, the Chilean Andes, and California yield this variety.

2. SELENIUM, Se.

Like sulphur, but reddish brown to orange-yellow. B.B. burns with fumes of selenious acid mixed with the sulphurous. Found in the crater of Volcano in the Lipari Islands, and Kilauea in Hawaii.

general chemical formula for such compounds is formed by writing R (= radical or basis) for the whole isomorphous elements; and in special instances their signs are placed one below the other, connected by a bracket, or, as is more convenient, are enclosed in brackets one after the other separated by a comma. Thus the general sign for the garnet is $R_2Si_2 + \frac{1}{2}Si$, which, when fully expressed, becomes $(Ca_2, Fe_2, Mg_2, Mn_2)Si_2 + (\frac{1}{2}Al, \frac{1}{2}Fe, \frac{1}{2}Cr)Si$; and this mineral forms many varieties as the one or other element preponderates.

Of the forms special to similar groups of atoms the more notable are—the cubic system, special to metals proper, and binary compounds as protoxides and haloid salts; the tetragonal to binoxides; the rhombohedral to carbonates; the hexagonal to sesquioxides and phosphates and their isomorphs; the prismatic to sulphates and their isomorphs.

The isomorphism of minerals goes as a whole to show that form depends on the number of molecules present, and is comparatively little influenced by the nature of the molecules themselves.

3. SELENIUM, Se.

H.—2; G.—4.3. Brownish black to lead-grey; thin splinters translucent and red. From Culebras in Mexico.

4. TELLURIUM, Te.

Rhombohedral; R 86° 50'. In minute hexagonal prisms, with basal edges replaced; usually massive and granular. Cl. lateral perfect, basal imperfect. H.—2 to 2.5; G.—6.1 to 6.3. Tin-white; sectile. C.c.: tellurium with a little gold and iron. Occurs at Facebaya near Zalathna (Transylvania), and in several mines in Boulder county, Colorado; masses 25 lb in weight have been obtained there.

5. ARSENIC, As.

Rhombohedral; R 85° 36' (fig. 258). Usually in botryoidal investing masses composed of numberless layers. The structure is fine granular, rarely columnar. H.—3.5; G.—5.7 to 5.93. Cl. basal. Colour black and dull, but when fresh broken very splendid and silver-white; fracture uneven. When rubbed or heated gives out a garlic-like odour. B.B. volatile, with formation of white fumes. C.c.: arsenic, with some antimony, and traces of iron, silver, and gold. Andreasberg in the Harz, Annaberg, Schneeberg, Freiberg, Joachimsthal, Allemont (Dauphiné), Kongsberg (Norway), the Altai, Chili, Pebble mine (Dumfriesshire), Tyndrum (Perthshire).



Fig. 258.

6. ANTIMONY, Sb.

Rhombohedral; R 87° 35'; but rarely crystallized, generally in foliated or granular masses. Cl. basal. H.—3; G.—6.6 to 6.8. Tin-white, with slight yellow tarnish. Brittle and sectile. B.B. easily fusible; volatilizes, and on charcoal leaves a white deposit, burning with a pale flame. Found at Andreasberg, Przibram (Bohemia), Sala (Sweden), Allemont, Southham in East Canada, and Borneo.

7. ALLEMONTITE, SbAs.

Hexagonal, spherical, reniform, and investing. H.—3.5; G.—6.1 to 6.2. Lustre, when fresh, metallic. Tin-white to lead-grey, but with a blue or brown tarnish. B.B. strong odour of garlic, with residuum of oxide of antimony. C.c.: antimony 87.85, arsenic 62.15. Almost always in curved foliated laminae. Occurs at Allemont, Przibram, Schladming in Styria, Andreasberg.

8. BISMUTH, Bi.

Rhombohedral; R 87° 40'. Crystals, R, OR, generally distorted; also reticulated, spear-head twins, or arborescent; also disseminated and granular. Cl. basal, perfect. H.—2.5; G.—9.6 to 9.8. Brittle and sectile. Reddish white, often tarnished grey, brown, or blue. B.B. easily fusible, even in candle flame. Volatilizes on charcoal, leaving a citron-yellow crust. Sol. in n. acid; solution precipitated when thrown into water. Occurs in gneiss and clay slate in veins and disseminated, along with ores of cobalt, silver, lead, and zinc. Alva in Stirlingshire, Cumberland, Devonshire and Cornwall, Schneeberg, Marienberg, Joachimsthal, Bieber, Modum (Norway), Falun (Sweden), Bolivia.

9. TELLURIC BISMUTH, BiTe.

Bismuth 52, tellurium 48. Virginia, Dahlonega in Georgia, Montana. A variety with 7 per cent. of selenium and H.—2 also occurs.

10. TETRADYMITTE, BiTeS.

Rhombohedral; 3R 68° 10'. Almost always twins of 6R and OR, with the faces of OR at 93°. Cl. basal, perfect. Sectile, and thin laminae flexible. H.—1 to 2; G.—7.2 to 7.5. Steel-grey. B.B. fuses, yielding a grain of metal which ultimately volatilizes. Sol. in n. acid. C.c.: 59.6 bismuth, 35.9 tellurium, and 4.5 sulphur Schemnitz.

11. WEHLITE, Bi(TeS).

Hexagonal. Cl. basal. H.—1 to 2; G.—8.44. High lustre. Steel-grey. C.c.: bismuth 61.15, tellurium 29.74, sulphur 2.33, silver 2.07. Deutsch-Pilsen in Hungary.

12. JOSEITE, BiTe(SSe).

Hexagonal. Cl. basal. G.—7.93. Colour grey-black to steel-grey. Brittle. C.c.: tellurium 15.93, sulphur 3.15, selenium 1.48, bismuth 79.15. San José (Brazil). A Cumberland variety yielded tellurium 6.73, sulphur 6.43, bismuth 84.33, corresponding to $Bi_4(TeS_4)$.

13. DIAMOND, C.

Var. 1. Crystallized.—Cubic; very frequently hemihedral. Crystals most generally with curved faces. Twins common on the octahedral face; hemitropes also common (see figs. 170, 204, 205, 207). Crystals vary remarkably in appearance (see figs. 259 to 262). Cl. octahedral. H.—10; G.—3.5 to 3.6. Transparent, or translucent when of dark colour. Refracts light strongly. The back planes of diamonds reflect all the light which strikes them at an angle exceeding 24° 13', and thence comes their peculiar brilliancy. High adamantine lustre. Colourless, but often tinged white, grey, and brown,—more rarely yellow, pink, blue, green, and black, those last named being the rarest. Disperses light highly, and hence emits brilliant flashes of all the colours of the spectrum. Becomes positively electric by friction. B.B. infusible, but burns into carbonic

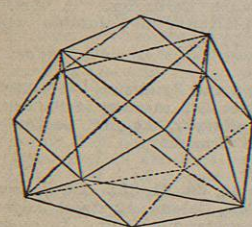


Fig. 259.

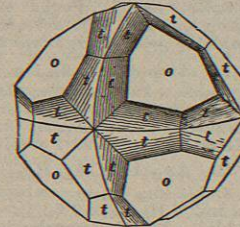


Fig. 260.

acid in oxygen gas. When air is excluded is unchanged at the temperature of melting cast iron, but at that of melting malleable iron is changed into a black coke, or, it is said, into graphite. Insoluble in all acids and alkalis. C.c.: carbon, with traces of silica and earths. Geologic formation apparently a laminated flexible quartz rock called itacolomite, which occurs in Brazil, the Urals, Georgia, and North Carolina, in the vicinity of places where diamonds have been found. Minute crystals have been found in xanthophyllite, and in talc slate and serpentine, in the Schischimskian hills, near Zlatoust (Russia). They have also been obtained in Brazil imbedded in a conglomerate composed of much-worn pebbles of quartz, chalcedony, and gold, cemented by limonite or

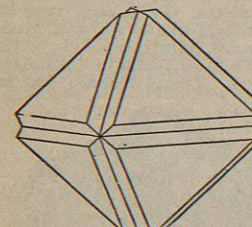


Fig. 261.

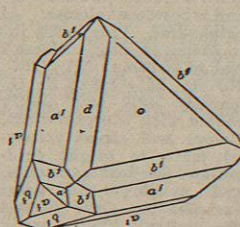


Fig. 262.

ferruginous clay. In South Africa they are imbedded in a steatitic clay. Diamonds were formerly obtained in India, at Panna, Raolconda, and Golconda. So few are now obtained here that the mines are let for £1 a year. From these mines were obtained not only the Kohinoor, which was possibly the same as the great diamond mentioned by Tavernier as having been seen by him in the possession of the Great Mogul, which weighed 280 carats, but the Regent, of 136 carats (which, not only from its size, but from the perfection of its form, is very much the finest diamond known), the Nizam, an uncut diamond of 340 carats, and the Carlow, rose-cut, 193 carats. More lately diamonds were found in great quantity in the neighbourhood of Rio Janeiro in Brazil; they occur in two different deposits: the one called "gurgulho" consists of broken quartz covered by a bed of sand; the other, "cascalho," consists of rolled quartz pebbles united by ferruginous clay; both rest on talcose clays, which are the debris from talcose rocks. The first deposit affords the finest diamonds, and both contain gold, platinum, magnetite, and rutile. A dodecahedral diamond of 257 carats was lately found at Bogagem in this district; this was

reduced by cutting to an oblong brilliant of 125 carats, and is the second most valuable diamond,—the Kohinoor, now reduced to an imperfectly circular brilliant of 102 carats, occupying the third place. The two coloured diamonds most worthy of note are a green diamond in the Dresden collection weighing 31 carats, which is a little deeper in tint than a beryl, and a blue diamond in the Hope collection, of 44 carats, as highly coloured as a sapphire, which it is by some considered to be. Diamonds have lately been found in very large quantities, and some of great size, north of the Cape of Good Hope; these for the most part are of yellow colour and of very inferior value. While a Brazilian cut brilliant of one carat is worth from £20 to £25, the value of the finest brilliants from the Cape is only from £3 to £4, and that of the yellow diamonds is from £2 to £2, 10s. Apart from its employment as an ornamental stone, the diamond has an intrinsic value from its being utilized for cutting glass and for grinding and polishing other gems. Of late years its usefulness has had a new application, it being employed for the drilling of rocks in tunnelling operations and in the boring of artesian wells. A singular observation has resulted from these last methods of utilizing it, namely, that the hardness of the African diamonds, as tested by the amount of their endurance, is markedly inferior to that of the Brazilian and Indian. So much is this recognized that, while the bort, or minute crystals, of the latter command a price of 15s. per carat, the African can be got for about 5s. The cleavage of certain of the African diamonds is so eminent that even the heat of the hand causes some of them to fall in pieces. Such diamonds, generally octahedra, may be recognized by a peculiar watery lustre; they are called plate diamonds. The above facts give some ground for the supposition that there may be a slight difference in their composition, possibly that both may contain small, but different, quantities of hydrogen. The circumstances under which diamonds have been formed are altogether unknown. The fact of their being changed into a kind of coke at a very high temperature is an argument against their having been produced through the operation of heat, and it has long been known that an excess of carbon dissolved by molten cast iron crystallizes on cooling in the form of graphite; yet the only attempts to form diamonds deserving of being mentioned as having been attended with any measure of success are those in which sugar charcoal was dissolved in molten silver at the temperature only of melting steel. There were thus obtained a few minute black and also colourless octahedral and cubo-octahedral crystals with curved faces, mingled with a much larger amount of graphitoid carbon.

Var. 2. Massive.—In black pebbles or masses called *carbonado*, sometimes 1000 carats in weight. H.—10; G.—3.012 to 3.42. C.c.: carbon except .27 to 2.07 per cent. of ash. Found in the mines of Baranco, &c., in Bahia.

Var. 3. Anthracitic.—Like anthracite, but scratches the diamond. In mammillar masses, partly in concentric layers, and globular. Brittle. G.—1.66. C.c.: carbon 97, hydrogen .5, oxygen 1.5. When cut and polished, refracts and disperses light, like the diamond. Supposed from Brazil.

14. GRAPHITE, C.

Hexagonal in flat crystals; p:p 85° 29'. Usually foliated, scaly, or compact. Cl. basal. H.—0.5 to 1; G.—1.9 to 2.2. Lustre metallic. Colour and streak black to dark steel-grey; flexible in thin laminae; very sectile; feels greasy; leaves a mark on paper of its own colour; conducts electricity. B.B. burns with difficulty; heated with nitre, deflagrates. C.c.: carbon, with small quantities of volatile matter, and ash from 5 to 40 per cent. Strathfarrer (Inverness-shire), Mull, Craigman (Ayrshire), Borrowdale in Cumberland, Ural Mountains Cevlon. Greenland Used for making pencils.

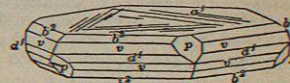


Fig. 263.

15. TIN, Sn.

Tetragonal in greyish white metallic grains. Reported as occurring with Siberian gold; with bismuthite from Guanajuato in Mexico.

16. IRON, Fe.

Cubic; in grains and plates or disseminated. H.—4.5; G.—7 to 7.8. Steel-grey or iron-black. Fracture hackly, very magnetic. B.B. infusible. Sol. in h. acid. Two varieties are to be distinguished. (a) *Telluric Iron*, in grains and plates. Almost pure iron, or contains graphite, carbon, lead, or copper, but no nickel. At Chotzen in Bohemia in limestone; in an argillaceous sandstone in the keuper at Mühlhausen; in Thuringia along with fossils; in an ironstone conglomerate in Brazil, and in lava in Auvergne; in the mine of Hackenburg; at Bexley, in Liberia, Africa, along with quartz, a zeolite, and magnetite; enclosed in magnetite in Unst (Shetland) and in Sutherlandshire; in basalt in Antrim, Ireland; in the gold sands of Brazil, the Urals, and Olahpian (Transylvania). (b) *Meteoric iron*, steel-grey to silver-white.

Almost always contains nickel, with cobalt, copper, and several minerals which are non-terrestrial. When polished and etched with nitric acid the surface is marked by lines of unaffected inter-lacing crystals called Widmannstätten's figures; most of the nickel is contained in these. Occurs in masses which vary in size from the smallest microscopic dust as dredged from the depths of the ocean to upwards of 32,000 lb. Many of these masses have been seen to fall. Several (suspected, however, to be terrestrial) have been found imbedded in a basaltic rock near Disco Bay in Greenland, one of which is 44,000 lb in weight. Several contain hydrogen in their pores, condensed to the extent of eight times the volume of the mass; and the pitted depressions frequently observable upon their surface give countenance to the view that, if not discharged from a volcanic throat, they were set at liberty by some sudden disrupting gaseous explosion.

17. ZINC, Zn.

Rhombohedral. Said to be found in large hexagonal pyramids. Cl. basal, perfect. H.—2; G.—7. Lustre metallic. Colour and streak bluish white. Found in a gneiss in basalt near Melbourne, Australia, coated with smithsonite, erythrine, and aragonite. Also in the gold sands of the Mittamitta river.

18. COPPER, Cu.

Cubic (figs. 28, 30, 26, 33, 37, 264). Twins, on an octahedral face. Crystals generally distorted. Often filiform and arborescent, or in plates and laminae. H.—2.5 to 3; G.—8.5 to 8.9. Lustre dull metallic. Colour and streak copper-red, with yellow or brown tarnish. B.B. easily fusible, colouring the outer flame green. Sol. in n. acid. Occurs in many rocks (generally igneous), and frequently associated with zeolites. In the Faroes, Unst (Shetland), Cornwall, Chessy near Lyons, the Banat (Hungary), Siberia, China, Mexico, Brazil, Chili, and Australia. Masses of great size are found, much the largest being from the Ontonagon river, on the south of Lake Superior. One mass found in February 1857 was 45 feet in length, 22 feet in width, and 8 feet in thickness; its weight was 420 tons. Another was found in 1869, 65 feet in length, 32 in width, and from 4 to 7 feet in thickness; this weighed upwards of 1000 tons, and had a value of 400,000 dollars.

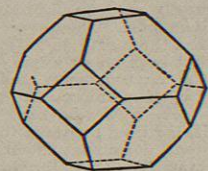


Fig. 264.

19. LEAD, Pb.

Cubic, but only in thin plates, capillary or filiform. Cl. none. H.—1.5; G.—11.36 to 11.4. Ductile, malleable, and sectile. Bluish grey, but with a blackish tarnish. Found in lava in Madeira, and at the mines near Cartagena in Spain; in amygdaloid near Weissig; in basaltic tuff at Rautenberg in Moravia; with gold near Mount Alatau in the Altai, at Velika in Slavonia, and at Olahpian in Transylvania; near Ekaterinburg in the Urals; in the district of Zomelahuacan in Vera Cruz, in foliated galena, in granules. Limestone; in the iron and manganese bed of Paisberg in Wermland (Sweden), with hematite, magnetite, and hausmannite; in white quartz, north-west, near the Dog Lake of the Kaministiquia, an affluent of Lake Superior; imbedded in hornstone in plates and grains, in the mine of Bogoslovskoi in the Kirghiz steppes; in greenstone porphyry at Stützerbach in Thuringia; with hematite in the islands of Nias on the west coast of Sumatra.

20. MERCURY, Hg.

Cubic. Occurs in small liquid globules in its gangue, but may be solidified at -39°, when it forms octahedral crystals. G.—13.596 when liquid, 15.612 when solid. Lustre brilliant metallic; tin-white. B.B. volatile, sometimes leaving a little silver. Readily sol. in n. acid. Occurs generally in clay shales or schists of different ages. The globules of mercury are usually found in rents in cinnabar, or accompanying calomel, at most of the localities for these minerals. Found at Idria in Carniola and Almaden in Spain. At Idria it is obtained by washing a soft clay slate. In Transylvania and Galicia springs issuing from the Carpathian sandstone bear along globules of mercury. At the Pioneer mine in California some of the quartz geodes contain several pounds of mercury. At Cividale in Lombardy it is found in an Eocene marl. It has also been observed occasionally in drift, and has even been stated to have been found in a peat bog.

21. SILVER, Ag.

Cubic (figs. 26, 30, 33, 40, 37). Crystals generally small, also and most frequently filiform, arborescent, and in plates or crusts. These either project into cavities, coat their surfaces, or ramify in a reticulated manner throughout the mass of the rock. Twins of octahedral and tetrahedral composition. No cl. H.—2.5 to 3; G.—10.1 to 11.1. Lustre metallic. Colour and streak silver-white, but generally tarnished yellow, brown, or black. Malleable, ductile, and sectile, but less so than gold. B.B. easily fusible. Sol. in n. acid; the solution colours the skin black. C.c.: silver, with varying

proportions of gold, platinum, mercury, copper, antimony, and bismuth. The auriferous from Norway contains silver 72, gold 28; from quartz reefs in Sutherland, silver 71.4, gold 28.6. The cupriferous from Courcy near Caen contains 10 per cent. of copper. The antimonial from Bohemia contains 1 per cent. of antimony. The mercurial from Kongsberg in Norway has 4 of mercury, found chiefly in veins in gneiss, clay slate, and limestone. Localities: Alva and elsewhere in Scotland, Ballycorus in Ireland, and Cornwall in England; at Freiberg, Andreasberg, and Kongsberg; along with native copper at Lake Superior; in Mexico, in Peru, and in the United States. The finest crystallized silver occurs at Lake Superior, and at Kongsberg. At the last locality the crystals are an inch in diameter, and are disposed on large filiform brushes. Silver occurs in large masses; three of 436, 560, 812 lb have been recorded from Kongsberg. A block which smelted 44,000 lb was for some years used as a table by Duke Albert on his annual visits of inspection to the Schneeberg mine in Saxony. A Mexican specimen was found of 400 lb; the mines of Huantaya in Peru have yielded masses of 444 and 960 lb. Britain produces annually about 760,000 oz. of silver, chiefly, however, from lead ores. The value of annual produce for the whole world from all sources is from 8 to 10 millions of pounds sterling.

22. SCHNEIDERITE (Gold Amalgam), Au₂Hg₃.

Tetragonal four-sided prisms, easily crumbling, yellowish white to white; sometimes in grains the size of a pea. C.c.: gold 41.63, mercury 58.37. Found at Mariposa in California. A variety (Au, Ag)₂Hg₃ is found along with platinum in Columbia; this contains gold 38.39, silver 5, mercury 57.40.

23. ARQUERITE, Ag₅Hg.

Cubic. In octahedra, also in grains and dendrites. G.—10.8. Like native silver, but softer. C.c.: silver 86.5, mercury 13.5. From Arqueros in Coquimbo, Chili. Kongsbergite, Ag₁₈Hg₃, occurs at Kongsberg, with 95.1 of silver and 4.9 of mercury.

24. AMALGAM, Ag₂Hg₃, and Ag₃Hg₅.

Cubic (fig. 33, in combination with 40, 30, 41, 38). Cl. dodecahedral. H.—3 to 3.5; G.—10.5 to 14. Colour and streak silver-white. Fracture conchoidal, brittle, grates when cut. In closed tube yields mercury and leaves silver. Sol. in n. acid. The first variety (silver 34.8, mercury 65.2) occurs at Moschellandsberg in the Palatinat, where the veins of mercury and silver intersect one another; the second (silver 26.25, mercury 73.75) there, and also at Allemont in Dauphiné, Almaden in Spain, and also at Allemont in Dauphiné, Almaden in Spain, and in Sweden. From Rosilla in Atacama (Chili) Hungary, and in Sweden. From Rosilla in Atacama (Chili) Doneyko reports the following other compounds: Ag₃Hg₄, silver 46.8, mercury 53.2, white and silvery; Ag₂Hg, silver 55.1, mercury 44.9, granular and dull; Ag₅Hg₃, silver 64.2, mercury 35.8; of the last there is a mass weighing 22 lb in the museum of Santiago.

25. GOLD, Au.

Cubic (figs. 30, 26, 33, 40, 36) and more complex forms. Crystals generally small and indistinct through elongation, assuming capillary and arborescent shapes. Also in thin plates. Twins rare; twin face octahedral. Frequently in rounded and apparently colloidal masses impacted in clay, or loose in small grains (pipettes) rolling in the bed of streams. Fig. 265 is of such a mass found in Sutherland. No cl. H.—2.5 to 3; G.—17 to 19.4. Lustre metallic, but frequently dull and partly coated with a brown crust. Colour and streak yellowish white to bright gold-yellow. Malleable, ductile, and sectile; the purer varieties the more so and the softer. B.B. easily fusible. Sol. in aqua regia, generally with precipitation of chloride of silver. Solution yellow, stains skin purple-red, with corrosion. C.c.: gold, with silver from 72 to 26 per cent.; sometimes iron and copper under 1 per cent. Found in beds and veins generally of quartz in metamorphic rocks of a schistose nature, rarely in diorite and porphyry, and very rarely in granite. Its general associate is limonite, formed from decomposition of pyrite; sometimes also hematite and magnetite. Occurs also in microscopic grains in quartz, from which it is extracted by crushing and amalgamation. The geologic range is from the Azoic to the Tertiary and Cretaceous, as in California; but even in these more recent rocks the original source must have been at least Palaeozoic. Of localities which yield gold the following may be noticed:—the Leadhills in Scotland, Wicklow in Ireland, Dolgelly in North Wales, Cornwall in England; Transylvania, Hungary, and Piedmont; the Urals, Ekaterinburg, and India; Kordofar, the coast opposite Madagascar, and the Gold Coast (the fame of which has been recently revived); Minas Geraes in Brazil, Bolivia, North Carolina, and



Fig. 265.

California; and more recently New South Wales and Queensland in Australia, Tasmania, and New Zealand.

Some of the largest single masses of gold found in recent times are the following:—one of 22 oz. in Transylvania, of 28 lb in North Carolina, of 20 lb in California, one of 96 lb troy near Miask in the Urals, and one of 184 lb 8 oz., which yielded £8376, 10s. 6d., at Ballarat, Australia.

The annual produce of gold from Australia is about 5 millions of pounds sterling, of the United States about 15 millions, and the whole earth about 23 millions.

The following sub-species may be noticed:—

1. *Electrum*. This name for the alloys of gold and silver was applied by Pliny, whenever the proportion of the latter metal was one-fifth. An alloy of 2 gold and 1 silver contains 21 per cent. of silver; this is found in Sutherland. One of 1 to 1 contains 33 per cent. of silver, this last being the most usual proportion. It occurs in Transylvania, in the Altai, and in Columbia. Its colour is brass-yellow to yellowish white. G.—12.5 to 15.5.

2. *Porpezite*, or *Palladium Gold* (*ovro-poudré*), from Porpez in Brazil, contains 9.85 per cent. of palladium and 4.17 of silver.

3. *Rhodium Gold*, from Mexico (G.—15.5 to 16.8), contains from 34 to 43 per cent. of rhodium.

26. PLATINUM, Pt.

Cubic; rarely in small cubes or octahedrons, usually in minute scaly grains, sometimes cohering, and also in rounded lumps. No cl. H.—4 to 4.5; G.—17 to 19. Lustre metallic. Colour and streak pale steel-grey. Malleable and ductile with difficulty, having a hackly fracture. When containing much iron, magnetipolar. B.B. infusible. Sol. in aqua regia, but only when heated; solution red; corrodes the skin. C.c.: platinum, but never to a greater extent than 86.5 per cent. The remainder consists of iron, iridium, rhodium, palladium, osmium, gold, copper, and a mechanical mixture of irid-osmine. The iron exists in quantities varying from 4.3 per cent. to double that amount. Occurs in Brazil in syenite; near Popayan (Columbia) in alluvium, associated with chromite, iridium, palladium, gold, and copper; in the Urals in alluvium derived from crystalline rocks; and at Nijni-Tagilsk in serpentine along with chromite. It is also found in Borneo, California, and Carolina, and is said to have been found in the county of Wicklow in Ireland. The sands of many rivers yield it in small amount. Platinum does not occur in large masses. A mass in the Madrid Museum from Condoto weighs 26½ oz.; masses have been found in the Urals from 11 to 21 lb.

Iron Platina is a sub-species. This, which has a composition FePt₂, and contains from 11 to 13 per cent. of iron, is found at Nijni-Tagilsk. G.—14.6 to 15.8; H.—6. It is magnetipolar, and attracts iron much more strongly than an ordinary magnet.

27. PLATINIRIDIUM.

In minute silver-white grains. H.—6 to 7; G.—16.94 to 22.8. Contains 55.44 platinum, 27.79 iridium, 6.86 rhodium, 4.14 iron, 3.3 copper, 4.9 palladium. Is found in Brazil.

28. IRIIDIUM, Ir.

Cubic (fig. 27). H.—6 to 7; G.—21.57 to 23.46. Cl. cubic, traces. Very slightly malleable. Silver-white to steel-grey. B.B. unchanged. Insoluble in all acids. C.c.: 76.8 iridium, 19.64 platinum, 0.89 palladium, 1.78 copper. Found at Nijni-Tagilsk, generally in minute grains. Is the heaviest known substance.

Avate, sub-species. From Ava in India. C.c.: 60 iridium, 20 platinum (according to Prins).

29. PALLADIUM, Pd.

Cubic; in minute octahedrons, and in grains. H.—4.5 to 5; G.—11.3 to 11.8. Malleable. Light steel-grey. B.B. infusible. Slowly dissolves in n. acid, forming a brown-red solution. C.c.: palladium, with a little platinum and iridium. From the gold sands of Brazil, often in small plumose crystalline lumps. Also from St Domingo, and the Urals. Does not tarnish with sulphurous fumes.

30. ALLOPALLADIUM, Pd₂.

Hexagonal; in small flat hexagons. Cl. basal, perfect. Lustre bright silvery. Colour pale steel-grey. From Tilkerode in the Harz, with gold.

31. NEWJANSKITE (*Osmiridium*), IrOs (iridium 49.78, osmium 50.22) and Ir₂O₃.

Hexagonal; P 124°. OP, P, ∞P. Generally in flat scales. Cl. basal perfect. H.—7; G.—18.8 to 19.47. Lustre metallic. Colour tin-white. B.B. unchanged. Insoluble in all acids. The analyses of this mineral give quantities of iridium varying from 44 to 77 per cent., and of osmium from 21 to 49. Ruthenium, rhodium, and platinum make up the 100 parts. The largest quantity of ruthenium is 8.49, and one variety from New Granada was found to contain no ruthenium, but 12.3 of rhodium, which is more than double its usual amount. Occurs with platinum in Choco (Columbia); at Newjansk and

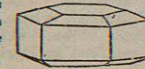


Fig. 266.

several localities in the Urals, in Australia, in northern California (somewhat abundantly in gold sands), also in Canada.

32. *SISSERSKITE* (*Iridosmium*), IrOs₄ (iridium 19.9, osmium 80.1) and IrOs₃ (iridium 24.8, osmium 75.2).

Rhombohedral; R—84° 28'. H.—7.5; G.—21.12. Colour lead-grey to bluish. B.B. becomes black, with strong odour of osmic acid; in flame of spirit-lamp shines strongly, and colours flame yellowish red. Occurs in small quantity with newjanskite at all its localities, and in proportionally larger quantity at Sissersk in the Urals. It is used for pointing gold pens, and in the United States sells at 50 dollars an ounce.

COMPOUNDS OF FLUORINE, CHLORINE, BROMINE, AND IODINE (HALOID SALTS).

33. FLUORITE (*Fluor-spar*), CaF₂.

Cubic (figs. 267 to 270, also figs. 31, 33, 36, 55, 56, 57, 58); also divergent crystalline, granular, and compact. Cl. octahedral; fracture conchoidal; brittle. H.—4; G.—3.1 to 3.2. Transparent to pellucid. Lustre vitreous. Colourless, but generally coloured purple, blue, green, yellow, white, black, and pink. Sometimes two or three colours disposed in layers in one crystal. Frequently

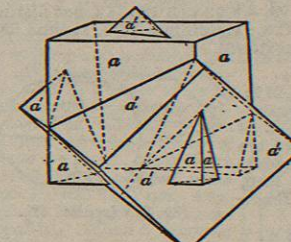


Fig. 267.

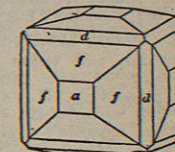


Fig. 268.

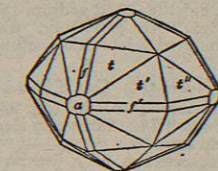


Fig. 269.

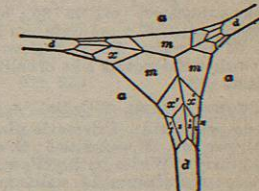


Fig. 270.

phosphoresces with different tints of light, when heated. B.B. decrepitates and fuses to an opaque bead. Sol. in s. acid with evolution of hydrofluoric acid. C.c.: 51.3 calcium, 48.7 fluorine. Common in veins, generally associated with metallic ores. Shetland, Sutherland, on the Avon, and Ballater in Scotland; Cumberland, Northumberland, Derbyshire, and Cornwall; Saxony, Bohemia, Freiberg. Used to be turned into vases and other ornaments ("blue John"); formerly employed as a flux, now for etching and obscuring glass.

34. YTROCERITE.

In crystalline crusts. H.—4 to 5; G.—3.4 to 3.5. Translucent, vitreous. Violet-blue to grey or white. B.B. infusible. Evolves fluorine when heated with sulphuric acid. C.c.: fluorides of cerium, yttrium, and calcium. Finbo and Broddbo near Falun (Sweden), Massachusetts and New York.

35. FLUOCERITE, CeF + Ce₂F₃.

Hexagonal. H.—4 to 5; G.—4.7. Opaque or translucent on the edges. Pale brick-red or yellowish; streak yellowish white. B.B. infusible. In closed tube gives out hydrofluoric acid. C.c.: 82.64 peroxide of cerium, 1.12 yttria, 16.24 hydrofluoric acid. Finbo and Broddbo.

36. FLUOCERINE, Ce₂F₃ + (Ce₂O₃ + H₂O).

Massive; fracture conchoidal. H.—4.5 to 5. Opaque; resinous. Bright yellow to reddish brown; streak brownish yellow. B.B. infusible, darkens with the heat; colour restored on cooling. C.c.: cerium 17.6, fluorine 10.9, sesquioxide of cerium 66.4, water 5.1. From Finbo.

37. BASTNAESITE, Ce₂F₃ + Ce₂O₃ + 4H₂O, and

38. HAMARTITE, 2(LaO, CeO)3CO₂ + CeF₃, are similar. The first is from Bastnaes in Sweden, the second from Pike's Peak in Colorado.

39. FLUELLITE, Al_2F_3 .
Right prismatic. In acute rhombic octahedrons with truncated apex. Polar edges $109^\circ 6'$ and $82^\circ 12'$, middle 144° . H.—3. Lustre vitreous. Colour white; transparent. Stenna-gwyn in Cornwall.

40. CRYOLITE, $3NaF + Al_2F_3$.
Anorthic; but mostly in cleavable masses. $M: T 91^\circ 57'$; $P: T 90^\circ 2'$; $P: M 90^\circ 40'$. Cl. P perfect, M and T imperfect; brittle. H.—2.5; G.—2.9 to 3.08. Vitreous, somewhat pearly on P. Translucent; after immersion in water transparent. Colourless and snow-white; but when deep-seated brown to black. Melts even in flame of candle to a white enamel. In open tube traces of hydrofluoric acid. Sol. in a. acid. C.c.: aluminium 13, sodium 32.8, fluorine 54.2. Arksutfoord, Greenland; Miask, Siberia. Used for manufacture of a white glass, and extraction of aluminium.

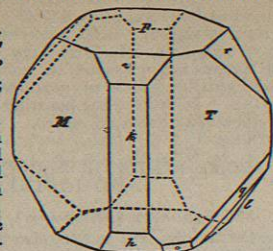


Fig. 271.

41. ARKSUTITE, $(CaNa)_2F + Al_2F_3$. Ca: Na=1:3.
Massive granular. H.—2.5; G.—3.03 to 3.18. Cl. one distinct. Vitreous; white; translucent. C.c.: aluminium 18.6, sodium 23.3, calcium 6.8, fluorine 51.3. Arksutfoord.

42. CHIOLITE, $3NaF + 2Al_2F_3$.
Pyramidal, and twins (fig. 272). Middle edge $111^\circ 14'$. Mostly granular. Cl. imperfect. H.—4; G.—2.84 to 2.9. Resinous; white. Fuses more easily than cryolite; evolves hydrofluoric acid. C.c.: aluminium 18.6, sodium 23.4, fluorine 58. Ilmen Mts. near Miask.

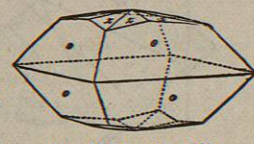


Fig. 272 (species 42).

43. CHODNEFFITE, $2NaF + Al_2F_3$.
G.—3. Other characters like chiolite, and from same locality.

44. PACHNOLITE, $3(CaNa)F + Al_2F_3 + 2H_2O$. Ca: Na=3:2.
Oblique prismatic. $\infty P 98^\circ 34'$; always twins. Vitreous; white; semitransparent. C.c.: aluminium 12.3, calcium 16.1, sodium 12.4, fluorine 51.1, water 8.1. Evolves water with crackling, when heated; other characters like cryolite along with which it occurs in Greenland.

45. THOMSENOLITE, $2(CaNa)F + Al_2F_3 + 2H_2O$. Ca: Na=7:3.
Oblique prismatic. Prismatic planes striated; $\infty P 89^\circ$ (fig. 273). Cl. basal, perfect. H.—2.5 to 4; G.—2.74 to 2.76. Vitreous; cleavage face pearly. White with yellow crust; translucent. C.c.: aluminium 15, calcium 15.4, sodium 7.6, fluorine 52.2, water 9.8. B.B. fuses more easily than cryolite to clear glass, decrepitating violently. Along with cryolite in Greenland.

46. GEARKSUTITE, $Ca_2F + Al_2F_3 + 4H_2O$.
Earthy. H.—2. White; dull; opaque. C.c.: aluminium 15.5, calcium 19.3, sodium 2.5, fluorine 41.2, water 20.3. Along with cryolite.

47. EYVJORITE, $2CaF_2 + Al_2F_3 + 2H_2O$.
Crystalline. Soft; brittle; like kaolin. C.c.: calcium 22.39, aluminium 16.23, sodium 4.3, fluorine 55.24, water 5.71. Arksutfoord, Greenland.

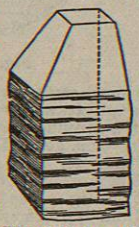
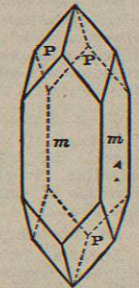


Fig. 273 (sp. 45).

48. PROSOPITE.
Oblique prismatic. A hydrated silico-fluoride of aluminium and calcium. H.—4; G.—2.89. Colourless imbedded crystals. From the tinmines of Altenberg.

49. CALOMEL, Hg_2Cl .
Pyramidal; $P 135^\circ 50'$ (fig. 274). H.—1 to 2; G.—6.4 to 6.5. Translucent; adamantine. Yellowish white to grey. Sublimes unchanged in closed tube; with soda yields mercury. Insol. in n. acid. C.c.: mercury 85, chlorine 15. Moschellandsberg, Idria, Almaden.



50. SYLVITE, KCl .
Cubic (figs. 26, 30); also massive. Cl. cubic. H.—2; G.—1.9 to 2. White or colourless. Vitreous; soluble; taste like common salt. Fig. 274 (sp. 49). C.c.: potassium 52.5, chlorine 47.5. B.B. fuses, and colours flame violet. Crater of Vesuvius, and salt beds of Stassfurt.

51. HALITE (Common Salt, Rock-salt), $NaCl$.
Cubic (fig. 21); generally granular, sometimes fibrous. Cl. cubic.

H.—2; G.—2.1 to 2.2. Transparent to translucent; vitreous. Colourless or white; but often coloured red, yellow, or blue. Taste saline. B.B. fuses and partly evaporates; colours flame yellow. C.c.: sodium 39.3, chlorine 60.7. In great beds at Wieliczka, Salzburg, Bex, &c., on the Continent; Cheshire in England. As an efflorescence in Brazil, Abyssinia, the Caspian and Aral Seas. As a sublimation among lavas at Vesuvius and other volcanoes.

52. SALMIAC, NH_4Cl .
Cubic (figs. 30, 40, and 41 with 26, 33, 40). Cl. octahedral; also stalactitic, globular, and as an efflorescence. H.—1.5 to 2; G.—1.5 to 1.6. Pellucid; vitreous. Colourless, but sometimes stained. Taste pungent. B.B. directly volatile; in copper colours flame blue-green. C.c.: 32 ammonia, 66.4 chlorine. A sublimate on active volcanoes. Vesuvius, island of Volcano, Iceland. Near coal-seams which have taken fire, in Scotland and at Newcastle.

53. CHLORO-CALCITE, $CaCl + (KCl, NaCl)$.
Cubic. Vesuvian bombs.

54. CERARGYRITE, $AgCl$.
Cubic (fig. 26). Twins on octahedral face. No cl.; chiefly massive in crusts. H.—1 to 1.5; G.—5.5 to 5.6. Fracture conchoidal. Malleable. Translucent; adamantine to resinous. Grey, yellowish, and greenish. B.B. fuses easily to a dark bead, reduced in inner flame. Soluble in ammonia. C.c.: silver 75, chlorine 25. Johann-Georgenstadt, Mexico, Peru.

55. ENBOLITE, $2AgBr + 3AgCl$.
Cubic (fig. 29); also massive or concretionary. H.—1 to 1.5; G.—5.8. Adamantine to resinous. Green and yellowish green. C.c.: silver 67, chlorine 13, bromine 20. Chili, Mexico, Honduras.

56. BROMITE, $AgBr$.
Cubic (figs. 26, 30). H.—1 to 2; G.—5.8 to 6. Splendent. Yellow to olive-green; streak siskin-green. B.B. fusible easily. C.c.: silver 57.5, bromine 42.5. San Onofre and Plateros (Mexico).

57. IODITE, AgI .
Hexagonal. Cl. basal; also massive, and in crystalline plates some inches in width; these are flexible. H.—1 to 1.5; G.—5.5 to 5.7. Translucent; adamantine. Citron and sulphur-yellow; streak yellow. B.B. fusible, colours the flame purple-red, and leaves button of silver. C.c.: silver 46, iodine 54. Zacatecas in Mexico, Algodones in Chili, Arizona, rarely in Spain.

58. COCCINITE, HgI_2 .
In grains of an adamantine lustre, from Casas-Viejas in Mexico. Colour red to yellow; in acute rhombic prisms. Also from Zimapan and Culebras.

59. TOCORNALITE, $AgI + Hg_2I$.
Amorphous, yellow, soft. Chafarillo in Chili.

60. COTUNNITE, $PbCl$.
Right prismatic. H.—2; G.—5.238. Transparent; high adamantine to pearly. White. C.c.: lead 74, chlorine 26. Crater of Vesuvius.

61. MOLYSITE, Fe_2Cl_2 .
Incrusting. Brownish red and yellow. On lavas of Vesuvius. C.c.: iron 34.5, chlorine 65.5.

62. CARNALLITE, $KCl + 2MgCl + 12H_2O$.
Right prismatic. No cl. Conchoidal fracture. H.—2 to 2.5; G.—1.6. Colourless, generally red from iron. C.c.: 34.2 chloride of magnesium, 26.9 chloride of potassium, 38.9, water. Stassfurt, Galicia, Persia.

63. TACHYDRITE, $CaCl + 2MgCl + 12H_2O$.
Massive. Yellow, translucent, very deliquescent. In anhydrite. C.c.: calcium 7.46, magnesium 9.51, chlorine 40.34, water 42.63. Stassfurt.

64. KREMERSITE, $KCl + NH_4Cl + Fe_2Cl_2 + 3H_2O$.
Cubic; in octahedra. Ruby-red. Soluble. Fumaroles of Vesuvius.

65. ERITHROSIDERITE, $2KCl + Fe_2Cl_2 + 2H_2O$.
Right prismatic. Vesuvian lava.

66. MATLOCKITE, $PbCl + PbO$.
Pyramidal; $P 136^\circ 17'$. Crystals tabular. Cl. basal; fracture conchoidal. H.—2.5; G.—7.21. Translucent; adamantine. Yellowish white. B.B. fuses easily with decrepitation; colours flame blue. C.c.: chloride of lead 55.5, oxide of lead 44.5. Cromford in Derbyshire.

67. MENDIPITE, $PbCl + 2PbO$.
Right prismatic; chiefly massive. Cl. ∞P perfect $102^\circ 36'$. H.—2.5 to 3; G.—7 to 7.1. Fracture conchoidal. Translucent; adamantine to pearly. Yellowish or greyish white. BB. decrepitates, fuses

easily. Sol. in n. acid. C.c.: chloride of lead 40, protoxide of lead 60. Mendip Hills, and Brilon in Westphalia.

68. SCHWARTZEMBERGITE, $PbI + 2PbO$.
Rhomboidal; in thin crusts. H.—2 to 2.5; G.—5.7 to 6.3. Adamantine. Honey-yellow. Desert of Atacama.

69. ATACAMITE, $CuCl + 3CuO, H_2O$.
Right prismatic; $\infty P (M) 112^\circ 25'$, $\tilde{P} \infty (P) 106^\circ 10'$, $\infty \tilde{P} \infty (h)$ (fig. 275); also reniform. Cl. h perfect. Semitransparent; vitreous. Emerald-green; streak apple-green. B.B. fuses, leaving copper. Easily soluble in acids. C.c.: copper protoxide 55.85, water 14.86, chlorine 16.61, Tarapaca, Peru; Bolivia; Burra-Burra, Australia; Serra de Bombe, Ambriz, Africa; Vesuvius and (?) Etna.

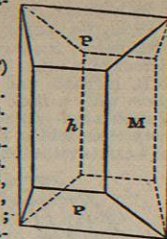


Fig. 275 (sp. 69).

70. TALLINGITE, $CuCl, H_2O + 4CuO, H_2O$.
In crusts. H.—3; G.—3.5. Bright blue to greenish blue. Translucent; brittle. Botallack in Cornwall.

71. PERCYLITE, $(PbCl + PbO) + (CuCl + CuO)$.
Cubic (com. of figs. 26, 30, 33, 36). H.—2. Vitreous. Sky-blue. Sonora in Mexico.

72. CONNELLITE.
Hexagonal (fig. 276). $b: r 143^\circ 10'$; $r: r 132^\circ 50'$. Crystals acicular. Vitreous; translucent. Vitriol-blue. A chloride and sulphide of copper. Wheal Unity and Wheal Damsel (Cornwall).

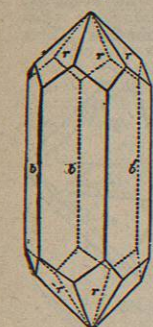


Fig. 276 (sp. 72).

OXIDES OF METALS.

1. SUBOXIDES AND PROTOXIDES.

73. COPRITE, Cu_2O .
Cubic (figs. 22, 30, 33, 26, with 39, 40). Compact and granular. Cl. octahedral; brittle. H.—3.5 to 4; G.—5.7 to 6. Transparent and opaque; adamantine. When transparent, crimson; when opaque, cochineal or brick-red. Often tarnished grey. B.B. becomes black, fuses, and is reduced on charcoal. Soluble in acids and in ammonia. C.c.: 88.9 copper, 11.1 oxygen. Cornwall, Siberia, Banat, Chessy near Lyons, Linares in Spain, Urals, South Africa, Burra-Burra. Valuable copper ore. Chalcocrite consists of cubes elongated so as to become fibrous. Tile-ore is a ferruginous variety. Hepatic copper, liver ore, or pitchy copper ore seems to be a product of the decomposition of chalcocopyrite. Delafossite, $Cu_2O + Fe_2O_3$, from Bohemia and Siberia.

74. WATER, H_2O .
Hexagonal, when solid, in complex twins in snow crystals; rhombohedral by cleavage, in ice. H.—1.5; G.—.918. Hence 1000 of water=1089.5 of ice, or water expands $\frac{1}{11}$ th in freezing. Transparent; vitreous. Colourless, but in bulk pale emerald-green. R $117^\circ 28'$. Cl. basal. Water when pure colourless, in mass bluish green. Occurs in centre of geodes of chalcidony in China; of druses of quartz in California and many other countries; in zeolitic cavities to the amount of several gallons in the Faroes, also in the Hebrides, &c. Water of the ocean, from holding saline matters in solution, has G.—1.027 to 1.0285. Waters of saline lakes contain sometimes 26 per cent. of salts, and have G. 1.212. Besides its vast bulk in the ocean, water occurs in enormous amount in the solid form, often as water of crystallization in rocks and minerals, e.g., zeolites. Igneous rocks in some districts are converted largely into saponite, which contains 25 per cent. of water. Water is the standard for specific gravities of solids and liquids; 1 cubic inch at $60^\circ F$. and 80 inches of the barometer weighs 252.453 grains: 1 litre weighs 1000 grammes.

75. PERICLASE, MgO .
Cubic; in cubes and octahedrons. Cl. do. H.—6; G.—3.6 to 3.75. Transparent; vitreous. Grey to dark green. B.B. infusible. Sol. in acids. C.c.: magnesia, with 6 to 8 of iron oxide. Somma.

76. BUNSENITE, NiO .
Cubic; in octahedrons. H.—5.5; G.—6.4. Vitreous. Pistachio-green. Johann-Georgenstadt.

77. ZINCITE, ZnO .
Hexagonal and granular. Cl. basal. H.—4 to 4.5; G.—5.4 to 5.6. Adamantine; translucent. Blood- or hyacinth-red; streak orange-yellow. B.B. infusible, but phosphoresces. C.c.: zinc

80.26, oxygen 19.74; sometimes with manganese peroxide. Valuable ore of zinc. Franklin and Sterling in New Jersey.

78. MASSICOT, PbO .
Massive; scaly crystalline. H.—2; G.—7.3 to 8. Sulphur- or lemon-yellow; often contains iron. Ropocatepetl in Mexico.

79. MELACONITE, CuO .
Cubic; compact. H.—3 to 4; G.—6 to 6.3. Black. B.B. infusible; soluble in acids. Cornwall, Leadhills, Lake Superior, Burra-Burra.

80. TENORITE, CuO .
Oblique prismatic; occurs in thin scales of metallic lustre on lava of Vesuvius. Colour black and dark-red.

2. SESQUIOXIDES.

81. CORUNDUM, Al_2O_3 .
Hexagonal; R $86^\circ 4'$. Twins common. Cl. rhombohedral, and basal. Excessively tough, and difficultly frangible. H.—9; G.—3.9 to 4.2. Transparent or translucent; vitreous, but pearly to metallic on basal face. B.B. unchanged. As *Corundum*, white, grey, and greenish, frequently with bronzy lustre on basal face. C.c.: alumina, with a little peroxide of iron. China, Ceylon, Bohemia, Malabar, Macon in North Carolina (one crystal 300 lb weight). *Emerald* is compact, crystalline, granular; grey; to indigo-blue. Asia Minor, Naxos, Spain, Greenland, America. Corundum is used when crushed for cutting and polishing gems in China and India, emery in powder

occurs also in a purer state in transparent crystals of various tints of colour. When red and of the colour of pigeon's blood they are termed *Rubies*; these come from Syriam in Pegu, Ava, Ceylon, Bohemia, and near Exally, when 5 carats in weight a ruby is twice the value of a diamond of the same size, when 10 carats three times the value. When blue the crystal is the *Sapphire*, found chiefly in Ceylon and Pegu; when green it is the *Oriental Emerald*, when yellow the *Oriental Topaz*, when purple the *Oriental Amethyst*,—the adjective here distinguishing them from the true or occidental stones of the same name. Other tints of colour also occur, but with the exception of the red and blue they are seldom pure or deep. The prism when cut with a hemispherical dome sometimes displays a six-rayed star, either of a bright gold or a silvery white colour, upon a greyish blue ground. These receive the name of *Asteria Sapphires*. The same crystal frequently shows portions of even three different tints. When perfectly devoid of colour, they are called *Water Sapphires*; such are little inferior to the diamond in brilliancy, but do not disperse rays of light to the same extent.

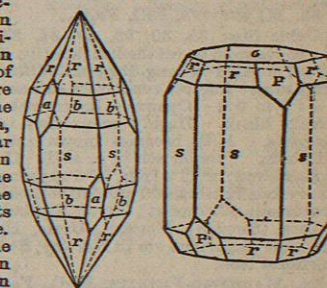


Fig. 277.

Fig. 278.

82. HEMATITE, Fe_2O_3 .
Hexagonal and rhombohedral; R 86° . Crystals rhombohedral, prismatic, and tabular. Twins with axes parallel. Cl. R, and basal; fracture conchoidal; brittle. H.—5.5 to 6.5; G.—5.1 to 5.3. Opaque, but in thin laminae transparent and blood-red. Brilliant metallic lustre, iron-black to steel-grey, often brilliantly tarnished of red, yellow, green, and blue tints; streak cherry-red. B.B. in the inner flame becomes black and magnetic. Sol. in acids. C.c.: iron 70, oxygen 30. The following are varieties or subdivisions:—

Elba Iron Ore, highly modified rhombohedral crystals, often brilliantly tarnished. *Specular Iron Ore*, in thin flat crystals, often from volcanoes, as on the island of Ascension; this variety includes *Micaeous Iron*, thin, lamellar, and curved, and *Red Iron Froth*, scaly. *Red Hematite*, in botryoidal and stalactitic forms, which are internally composed of radiating fibres, and often have a concentric structure; the external surface has a dark red to a brownish red hue. *Compact* and *Ochrey* varieties, with more or less aluminous impurity, pass into *Reddle* or red chalk, and when still more earthy into jaspery and columnar ores. This ore is very commonly distributed:—micaeous iron at Pitfichie in Aberdeen and Birnam in Perthshire; red hematite at Leadhills and at

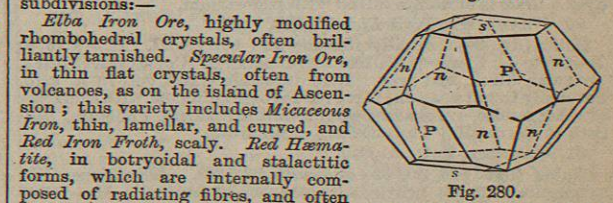


Fig. 279.

Fig. 280.