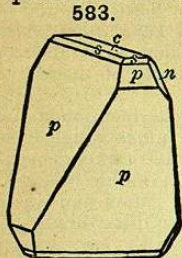


Crystals commonly acute pyramidal; sometimes thick tabular  $\parallel c$ , also sphenoidal in habit (Fig. 583). See also Figs. 66, p. 30, and 302, p. 94. Also



$mm''$ ,	$110 \wedge \bar{1}\bar{1}0 = 78^\circ 14'$ .
$ce$ ,	$001 \wedge 101 = 66^\circ 52'$ .
$cn$ ,	$001 \wedge 011 = 62^\circ 17'$ .
$cs$ ,	$001 \wedge 113 = 45^\circ 10'$ .
$cp$ ,	$001 \wedge 111 = 71^\circ 40'$ .
$pp'$ ,	$111 \wedge \bar{1}\bar{1}1 = 94^\circ 52'$ .
$pp''$ ,	$111 \wedge \bar{1}\bar{1}1 = 73^\circ 34'$ .

massive, in reniform shapes, incrusting, stalactitic and stalagmitic; in powder.

Cleavage:  $c, m, p$  imperfect. Fracture conchoidal to uneven. Rather brittle to imperfectly sectile.  $H. = 1.5-2.5$ .  $G. = 2.05-2.09$ . Luster resinous. Color sulphur-yellow, straw- and honey-yellow, yellowish brown,

greenish, reddish to yellowish gray. Streak white. Transparent to translucent. A non-conductor of electricity; by friction negatively electrified. Optically  $+$ . Double refraction strong. Ax. plane  $\parallel b$ .  $Bx \perp c$ . Dispersion  $\rho < v$ .  $2H_{ar} = 103^\circ 18'$  Dx. Refractive indices, see p. 208.

**Comp., Var.**—Pure sulphur; often contaminated with clay, bitumen, and other impurities.

Sulphur may also be obtained in the laboratory in other allotropic forms; a monoclinic form is common.

**Pyr., etc.**—Melts at  $108^\circ C.$ , and at  $270^\circ$  burns with a bluish flame yielding sulphur dioxide. Insoluble in water, and not acted on by the acids, but soluble in carbon disulphide.

**Diff.**—Readily distinguished by the color, fusibility and combustibility.

**Obs.**—The great repositories of sulphur are either beds of gypsum and the associate rocks, or the regions of active and extinct volcanoes. In the valley of Noto and Mazzaro, in Sicily; at Conil, in Spain; Bex, Switzerland; Cracow, Poland, it occurs in the former situation; near Bologna, Italy, in fine crystals, embedded in bitumen. Sicily and the neighboring volcanic isles; the Solfatara, near Naples; the volcanoes of the Pacific ocean, etc., are localities of the latter kind. It is also deposited from hot springs in Iceland; and is met with in certain metallic veins, thus with lead ores near Müsen and at Monte Ponì, Sardinia. The Sicilian mines at Girgenti yield large quantities for commerce, including beautifully crystallized specimens.

Sulphur is found near the sulphur springs of New York, Virginia, etc., sparingly; in many coal deposits and elsewhere, where pyrites is undergoing decomposition; in minute crystals on cleavage surfaces of galena, Phenixville, Pa. Some important deposits occur in the western U. S., as in Wyoming, in the Uintah Mts., 30 miles s.e. of Evanston; in Nevada, Humboldt county; Steamboat Springs, Washoe Co.; Columbus, Esmeralda Co. In southern Utah in large deposits, at Cove Creek, Millard county. In California, at the geysers of Napa valley, Sonoma Co.; in Santa Barbara in good crystals; near Clear Lake, Lake Co., a large deposit. In the Yellowstone Park, in deposits and about the fumaroles.

**Selensulphur.** Contains sulphur and selenium, orange-red or reddish brown; from the islands Vulcano and Lipari.

#### ARSENIC.

Rhombohedral. Generally granular massive; sometimes reticulated, reniform, stalactitic.

Cleavage:  $c$  highly perfect. Fracture uneven and fine granular. Brittle.  $H. = 3.5$ .  $G. = 5.63-5.73$ . Luster nearly metallic. Color and streak tin-white, tarnishing to dark gray.

**Comp.**—Arsenic, often with some antimony, and traces of iron, silver, gold, or bismuth.

**Pyr.**—B.B. on charcoal volatilizes without fusing, coats the coal with white arsenic trioxide, and affords a garlic odor; the coating treated in R. F. volatilizes, tingeing the flame blue.

**Obs.**—Occurs in veins in crystalline rocks and the older schists, often accompanied by ores of antimony, ruby silver, realgar, sphalerite, and other metallic minerals. Thus in the

silver mines of Saxony; also Andreasberg; Joachimsthal, Bohemia; in Hungary; Norway, etc. Abundant at Chañarcillo, Chili. In the U. S. sparingly at Haverhill and Jackson, N. H.; near Leadville, Colorado; Watson Creek, British Columbia.

**Allemontite.** Arsenical Antimony, SbAs. In reniform masses.  $G. = 6.203$ . Luster metallic. Color tin-white or reddish gray. From Allemont; Příbram, Bohemia, etc.

**Tellurium.** In prismatic crystals (Fig. 14, p. 10); commonly columnar to fine-granular massive.  $G. = 6.2$ . Color tin-white. From Transylvania and Colorado.

#### ANTIMONY.

Rhombohedral. Generally massive, lamellar and distinctly cleavable; also radiated; granular.

Cleavage:  $c$  highly perfect; also other cleavages. Fracture uneven; brittle.  $H. = 3-3.5$ .  $G. = 6.65-6.72$ . Luster metallic. Color and streak tin-white.

**Comp.**—Antimony, containing sometimes silver, iron, or arsenic.

**Pyr.**—B.B. on charcoal fuses, gives a white coating in both O. F. and R. F.; if the blowing be intermitted, the globule continues to glow, giving off white fumes, until it is finally crusted over with prismatic crystals of antimony trioxide. The white coating tinges the R. F. bluish green. Crystallizes readily from fusion.

**Obs.**—Occurs near Sala in Sweden; Andreasberg in the Harz; Allemont, Dauphiné; Příbram, Bohemia; Mexico; Chili; Borneo. In the U. S., at Warren, N. J., rare; in Kern Co., Cal. At Prince William parish, York Co., N. Brunswick.

#### BISMUTH.

Rhombohedral. Usually reticulated, arborescent; foliated or granular.

Cleavage:  $c$  perfect. Sectile. Brittle, but when heated somewhat malleable.  $H. = 2-2.5$ .  $G. = 9.70-9.83$ . Luster metallic. Streak and color silver-white, with a reddish hue; subject to tarnish. Opaque.

**Comp., Var.**—Bismuth, with traces of arsenic, sulphur, tellurium, etc.

**Pyr., etc.**—B.B. on charcoal fuses and entirely volatilizes, giving a coating orange-yellow while hot, lemon-yellow on cooling. Fuses at  $265^\circ C.$  Dissolves in nitric acid; subsequent dilution causes a white precipitate. Crystallizes readily from fusion.

**Obs.**—Occurs in veins in gneiss and other crystalline rocks and clay slate, accompanying various ores of silver, cobalt, lead and zinc. Thus at the mines of Saxony and Bohemia, etc.; Meymac, Corrèze, France. Also at Modum, Norway; at Falun, Sweden. In Cornwall and Devonshire; near Copiapo, Chili; Bolivia.

Occurs at Monroe, Conn.; Brewer's mine, Chesterfield district, S. Car.; near Cummins City, and elsewhere in Colorado.

**Zinc.** Probably does not occur in the native state. In the laboratory it is obtained in hexagonal prisms with tapering pyramids; also in complex crystalline aggregates. It also appears to crystallize in the isometric system, at least in various alloys.

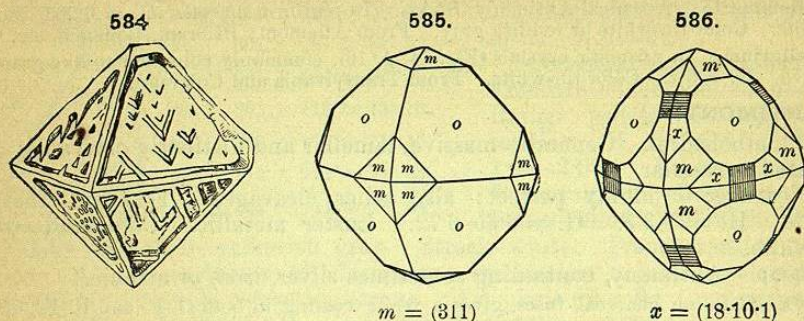
#### Gold Group.

##### GOLD.

Isometric. Distinct crystals rare,  $o$  most common, also  $d$  (110),  $m$  (331), and  $x$  (18:10:1); crystals often elongated in direction of an octahedral axis, giving rise to rhombohedral forms (Figs. 452, 453, p. 135), and arborescent shapes; also in plates flattened  $\parallel o$ , and branching at  $60^\circ$  parallel either to the edges or diagonals of an  $o$  face (see pp. 131, 132). Twins: tw. plane  $o$ . Skeleton crystals common; edges salient or rounded; in filiform, reticulated, dendritic shapes. Also massive and in thin laminae; often in flattened grains or scales.

Cleavage none. Fracture hackly. Very malleable and ductile.  $H. = 2.5-3$ .  $G. = 15.6-19.3$ ,  $19.33$  when pure. Luster metallic. Color and streak gold-yellow, sometimes inclining to silver-white and rarely to orange-red. Opaque.

**Comp., Var.**—Gold, but usually alloyed with silver in varying amounts and sometimes containing also traces of copper or iron.



**Var.**—1. *Ordinary*. Containing up to 16 p. c. of silver. Color varying accordingly from deep gold-yellow to pale yellow, and specific gravity from 19·3 to 15·5. The ratio of gold to silver of 3:1 corresponds to 15·1 p. c. silver. For  $G = 17·6$ ,  $Ag = 9$  p. c.;  $G = 16·9$ ,  $Ag = 13·2$ ;  $G = 14·6$ ,  $Ag = 38·4$ , Rose. The purest gold which has been described is that from Mount Morgan, in Queensland, which has yielded 99·7 to 99·8 of gold, the remainder being copper with a little iron; silver is present only as a minute trace.

2. *Argentiferous; Electrum*. Color pale yellow to yellowish white;  $G = 15·5-12·5$ . Ratio for the gold and silver of 1:1 corresponds to 36 p. c. of silver;  $1\frac{1}{2}:1$ , to 26 p. c.; 2:1, to 21 p. c.;  $2\frac{1}{2}:1$ , to 18 p. c. The word in Greek means also *amber*; and its use for this alloy probably arose from the pale yellow color it has as compared with gold.

Varieties have also been described containing palladium to 10 p. c. (*porpezite*), from Porpez, Brazil; bismuth, including the black gold of Australia (*maldonite*, Ulrich); also rhodium(?).

**Fyr., etc.**—B.B. fuses easily (at 1100° C.). Not acted on by fluxes. Insoluble in any single acid; soluble in nitro-hydrochloric acid (aqua regia), the separation not complete if more than 20 p. c. Ag is present.

**Diff.**—Readily recognized (*e.g.*, from other metallic minerals, also from scales of yellow mica) by its malleability and high specific gravity, which last makes it possible to separate it from the gangue by washing; distinguished from chalcopyrite and pyrite by insolubility in nitric acid, both of which are brittle.

**Observations.**—Native gold is found, when *in situ*, with comparatively small exceptions, in the quartz veins that intersect metamorphic rocks, and to some extent in the wall rock of these veins. The metamorphic rocks thus intersected are mostly chloritic, talcose, and argillaceous schist of dull green, dark gray, and other colors; also, much less commonly, mica and hornblende schist, gneiss, diorite, porphyry; and still more rarely, granite. A laminated quartzite, called itacolomite, is common in many gold regions, as those of Brazil and North Carolina, and sometimes specular schists, or slaty rocks containing much foliated specular iron (hematite), or magnetite in grains. A quartzose conglomerate is sometimes richly auriferous as in Transvaal. Less frequently calcite is the vein material.

The gold occurs in the quartz, irregularly distributed, in strings, scales, plates, and in masses which are sometimes an agglomeration of crystals; and the scales are often invisible to the naked eye. The associated minerals are: pyrite, which far exceeds in quantity all others, and is generally *auriferous*; next, chalcopyrite, galena, sphalerite, arsenopyrite, each frequently auriferous; often tetradymite and other tellurium ores, native bismuth, native arsenic, stibnite, cinnabar, magnetite, hematite; sometimes barite, scheelite, apatite, fluorite, siderite, chrysocolla. The quartz at the surface, or in the upper part of a vein, is usually cellular and rusted from the more or less complete disappearance of the pyrite and other sulphides by decomposition; but below, it is commonly solid.

The gold of the world was early gathered, not directly from the quartz veins (the "quartz reefs" of Australia and Africa), but from the gravel or sands of rivers or valleys in auriferous regions, or the slopes of mountains or hills, whose rocks contain in some part, and generally not far distant, auriferous veins; in California this method of hydraulic mining (*placer diggings*) has been carried on on a stupendous scale. Most of the gold of

the Urals, Brazil, Australia, and all other gold regions has come from such alluvial washings. At the present time, however, the alluvial washings are much less depended upon, in many regions all the gold being obtained direct from the rock.

The alluvial gold is usually in flattened scales of different degrees of fineness, the size depending partly on the original condition in the quartz veins, and partly on the distance to which it has been transported and assorted by running water. The rolled masses when of some size are called *nuggets*; in rare cases these occur very large and of great value. The Australian gold region has yielded many large nuggets; one of these found in 1858 weighed 184 pounds, and another (1869) weighed 190 pounds. In the auriferous sands, crystals of topaz are very common; also garnet and cyanite in grains; often also monazite, diamond, zircon, corundum, iridosmine, platinum. The zircons are sometimes mistaken for diamonds.

Besides the free gold of the quartz veins and gravels, much gold is also obtained from auriferous sulphides or the oxides produced by their alteration, especially pyrite, also arsenopyrite, chalcopyrite, sphalerite, marcasite, etc. The only minerals containing gold in combination are the rare tellurides (sylvanite, etc.).

Gold exists more or less abundantly over all the continents in most of the regions of crystalline rocks, especially those of the semi-crystalline schists; and also in some of the large islands of the world where such rocks exist. In Europe, it occurs with silver ores in Hungary; in Transylvania at Verespatak and Nagyág; in the sands of the Rhine, the Danube, and other rivers; on the southern slope of the Pennine Alps; in Piedmont; in many of the streams of Cornwall; in North Wales; in Scotland, near Leadhills; in the county of Wicklow, Ireland; in Sweden, at Edelfors; in Norway, at Kongsberg.

In Asia, gold occurs along the eastern flanks of the Urals for 500 miles, and is especially abundant at the Berezov mines near Ekaterinburg; also at Petropavlovski; Nizhni Tagilsk; Miask, near Zlatoust and Mt. Ilmen, etc. Ekaterinburg is the capital of the mining district. Siberian mines less extensive occur in the lesser Altai; at Nerchinsk, east of L. Baikal, including the Kara mines. Asiatic mines occur also in Little Tibet, Ceylon, and Malacca, China especially in the Amur district, Corea, Japan, Formosa, Sumatra, Java, Borneo, the Philippines, and other East India Islands; at numerous points in British India.

In Africa, gold occurs at Kordofan, between Darfur and Abyssinia; also, south of the Sahara in western Africa, from the Senegal to Cape Palmas. Also in Transvaal in southern Africa, at Lydenburg, both quartz veins and alluvial washings, and at Eersteling; recently the Kaap gold fields in southeastern Transvaal have become very productive: the chief town of the region is Barberton. The quartz reefs of Witwatersrand in the immediate vicinity of Johannesburg, farther west, are also very productive; here the gold occurs largely in a quartzose conglomerate.

In South America, gold is found in Brazil; in the U. S. of Colombia; Chili; Bolivia; sparingly in Peru. Also in Central America, especially in Honduras; also San Salvador, Guatemala, Costa Rica.

In Australia, the principal gold mines occur along the streams in the mountains of New South Wales and along the continuation of the same range in Victoria. Also obtained largely in Queensland, N. Australia, particularly at Mt. Morgan, Rockhampton district. Also occurs in Tasmania, New Zealand, and New Caledonia.

In North America, there are numberless mines along the mountains of western America, and others along the eastern range of the Appalachians from Alabama and Georgia to Labrador, besides some in portions of the intermediate Archean region about Lake Superior. They occur at many points along the higher regions of the Rocky Mountains, in Mexico; in New Mexico, near Santa Fé, Cerillos, Avo, etc.; in Arizona, in the San Francisco, Waaba, Yuma, and other districts; in Colorado, abundant, the gold largely in auriferous pyrites, also in connection with tellurium minerals; the Cripple Creek region in Colorado affords at present large quantities of gold; also in Montana; the Black Hills of Dakota; Idaho especially the Coeur d'Alène district, also Utah. Along ranges between the summit and the Sierra Nevada, in the Humboldt region and elsewhere. Also in the Sierra Nevada, mostly on its western slope (the mines of the eastern being principally silver mines). The auriferous belt may be said to begin in the Californian peninsula. Near the Tejon pass it enters California, and beyond for 180 miles it is sparingly auriferous, the slate rocks being of small breadth; but beyond this, northward, the slates increase in extent, and the mines in number and productiveness, and they continue thus for 200 miles or more. Gold occurs also in the Coast ranges in many localities, but mostly in too small quantities to be profitably worked. The regions to the north in Oregon and in Washington and Alaska, with British Columbia, are at many points auriferous, and productively so, though to a less extent than California. The Cariboo region on the Fraser river, and the Cassiar district on the Stickeen, have yielded considerable amounts. The Alaska quartz mines have

been worked to some advantage, as also the gravels of the Yukon river and its tributaries; of the latter, the Klondike is now (1898) reputed to be fabulously rich.

In eastern North America, the chief mines are mostly confined to the States of Virginia, North and South Carolina, and Georgia, or along a line from the Rappahannock to the Coosa in Alabama. In Canada, gold occurs to the south of the St. Lawrence, in the soil on the Chaudière and elsewhere; in Nova Scotia, at Deloro, near Hastings, Ontario (in arsenopyrite); also in the Port Arthur region, north of Lake Superior, and in the river-gravels of the Pacific slope, as before noted.

The world's production of gold was in 1897 about \$250,000,000, having considerably more than doubled since 1890. Of this amount the United States afforded about \$61,500,000, Africa about \$58,000,000, Australia nearly \$56,000,000, Russia about \$28,700,000, and other countries (China, Canada, India, So. America, etc.) the remainder. It is also interesting to note that in 1897 the production was nearly the same for the States of California and Colorado, the former \$17,000,000, the latter a little in excess of this amount. In 1890 Colorado produced only a little more than \$4,000,000.

#### SILVER.

Isometric. Crystals commonly distorted, in acicular forms, reticulated or arborescent shapes; coarse to fine filiform; also massive, in plates or flattened scales.

Cleavage none. Ductile and malleable. Fracture hackly.  $H. = 2.5-3$ .  $G. = 10.1-11.1$ , pure 10.5. Luster metallic. Color and streak silver-white, often gray to black by tarnish.

Comp., Var.—Silver, with some gold (up to 10 p. c.), copper, and sometimes platinum, antimony, bismuth, mercury.

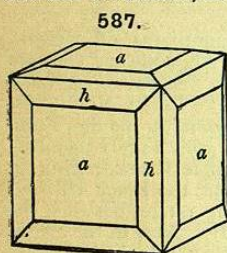
Pyr., etc.—B.B. on charcoal fuses easily to a silver-white globule, which in O.F. gives a faint dark-red coating of silver oxide; crystallizes on cooling; fusibility about  $1050^{\circ} C$ . Soluble in nitric acid, and deposited again by a plate of copper. Precipitated from its solutions by hydrochloric acid in white curdy forms of silver chloride.

Diff.—Distinguished by its malleability, color (on the fresh surface), and specific gravity.

Obs.—Native silver occurs in masses, or in arborescent and filiform shapes, in veins traversing gneiss, schist, porphyry, and other rocks. Also occurs disseminated, but usually invisibly, in native copper, galena, chalcocite, etc.; rarely in volcanic ashes (Mallet).

The mines of Kongsberg, in Norway, have afforded magnificent specimens; also the Saxon mines; occurs in Bohemia at Příbram and Joachimsthal; at Andreasberg; Hungary; Allemont, Dauphiné; in the Ural near Berezov; in the Altai, at Zmeov; and in some of the Cornish mines. In Durango, Sinaloa, and Sonora, in Mexico, are noted mines affording native silver; abundant in Peru.

In the United States disseminated through much of the copper of Michigan; at Silver Islet and at Port Arthur, Lake Superior. Occurs in Idaho, at the "Poor Man's lode"; in Nevada, rare; in California, sparingly; in Silver Mountain district, Alpine Co.; in the Maris vein, in Los Angeles Co. In Colorado, at many localities, especially with argentiferous ores; in Montana, near Butte, Silver Bow Co., with manganese ores. In Arizona, at the Silver King mine, and with argentiferous ores elsewhere.



587.  
 $h = (410)$

#### COPPER.

Isometric. The tetrahexahedron the most common form (Fig. 587); also in octahedral plates. Crystals often irregularly distorted and passing into twisted and wire-like forms; filiform and arborescent. Massive; as sand. Twins: tw. pl.  $o$ , very common, often flattened or elongated to spear-shaped forms. Cf. pp. 131, 132.

Cleavage none. Fracture hackly. Highly ductile and malleable.  $H. = 2.5-3$ .  $G. = 8.8-8.9$ . Luster metallic. Color copper-red. Streak metallic shining. Opaque. An excellent conductor for heat and electricity.

Comp.—Pure copper; often containing some silver, bismuth, mercury, etc.

Pyr., etc.—B.B. fuses readily; on cooling becomes covered with a coating of black

oxide. Dissolves readily in nitric acid, giving off red nitrous fumes, and produces a deep azure-blue solution with ammonia. Fusibility  $780^{\circ} C$ .

Obs.—Copper occurs in beds and veins accompanying its various ores, especially cuprite, malachite, and azurite; also with the sulphides, chalcopyrite, chalcocite, etc.; often abundant in the vicinity of dikes of igneous rocks; also in clay slate and sandstone.

Occurs at Turinsk, in the Ural, in fine crystals; at Nizhni Tagilsk and elsewhere; Siberia. In Germany, at the Friedrichsseggen mine, Nassau. Common in Cornwall, Brazil, Chili, Bolivia, and Peru afford native copper. In South Australia abundant at Wallaroo; in New South Wales.

Occurs native throughout the red sandstone region of the eastern United States, sparingly in Massachusetts, Connecticut, and more abundantly in New Jersey. Near New Haven, Conn., a mass was found in the drift weighing nearly 200 pounds; smaller isolated masses have also been found. The Lake Superior copper region, near Keweenaw Point, in northern Michigan, is the most important locality in the world. The copper is obtained practically all in the native state, sometimes in immense masses, and is obtained over an area 200 miles in length. It occurs in both amygdaloidal dolerite and sandstone, near the junction of these two rocks; associated with calcite, prehnite, datolite, analcite, etc.; also distributed widely in grains through the sandstone. Occurs sparingly in California. In Arizona, common at the Copper Queen mine, Cochise Co.; also in Grant Co., N. Mexico, at the Santa Rita and other mines.

#### MERCURY. Quicksilver. Gediegen Quecksilber Germ.

In small fluid globules scattered through its gangue.  $G. = 13.596$ . Luster metallic, brilliant. Color tin-white. Opaque.

Comp.—Pure mercury (Hg); with sometimes a little silver.

Pyr., etc.—B.B. entirely volatile, vaporizing at  $350^{\circ} C$ . Becomes solid at  $-40^{\circ} C$ , crystallizing in regular octahedrons with cubic cleavage;  $G. = 14.4$ . Dissolves in nitric acid.

Obs.—Mercury in the metallic state is a rare mineral, and is usually associated with the sulphide cinnabar, from which the supply of commerce is obtained. The rocks affording the metal and its ores are chiefly clay shales or schists of different geological ages. Also found in connection with hot springs. See cinnabar.

#### LEAD.

Isometric. Crystals rare. Usually in thin plates and small globular masses. Very malleable, and somewhat ductile.  $H. = 1.5$ .  $G. = 11.37$ , Harstig mine. Luster metallic. Color lead-gray. Opaque.

Comp.—Nearly pure lead; sometimes contains a little silver, also antimony.

Pyr.—B.B. fuses easily, coating the charcoal with a yellow oxide which, treated in R.F., volatilizes, giving an azure-blue tinge to the flame. Fusibility  $330^{\circ} C$ . Dissolves easily in dilute nitric acid.

Obs.—Of rare occurrence. Found at Pajsberg, Harstig, and Långban in Sweden; similarly at Nordmark; also in the gold washings of the Ural; reported elsewhere, but localities often doubtful. In the U. S., occurs at Breckinridge and Gunnison, Colorado; Wood River district, Idaho.

#### AMALGAM.

Isometric. Common habit dodecahedral. Crystals often highly modified (Fig. 100, p. 39). Also massive in plates, coatings, and embedded grains.

Cleavage:  $d$  in traces. Fracture conchoidal, uneven. Rather brittle to malleable.  $H. = 3-3.5$ .  $G. = 13.75-14.1$ . Luster metallic, brilliant. Color and streak silver-white. Opaque.

Comp.—(Ag,Hg), silver and mercury, varying from  $Ag_2Hg_3$  to  $Ag_3Hg$ .

Var.—Ordinary amalgam,  $Ag_2Hg_3$  (silver 26.4 p. c.) or  $AgHg$  (silver 35.0); also  $Ag_3Hg_5$ , etc. Arquerite,  $Ag_2Hg$  (silver 86.6);  $G. = 10.8$ ; malleable and soft. Kongsbergite,  $Ag_{32}Hg$  or  $Ag_{36}Hg$ .

Pyr., etc.—B.B. on charcoal the mercury volatilizes and a globule of silver is left. In the closed tube the mercury sublimes and condenses on the cold part of the tube in minute globules. Dissolves in nitric acid. Rubbed on copper it gives a silvery luster.

Obs.—From the Palatinate at Moschellandsberg; at Friedrichsseggen, Nassau; from

Sala, Sweden; Kongsberg, Norway; Allemont, Dauphiné; Almaden, Spain; Chili; Vitale Creek, Br. Columbia (*arquerite*).

**Tin.** Native tin has been reported from several localities. The only occurrence fairly above doubt is that from the washings at the headwaters of the Clarence river, near Oban, New South Wales. It has been found here in grayish-white rounded grains, with platinum, iridosmine, gold, cassiterite, and corundum.

### Platinum-Iron Group.

#### PLATINUM.

Isometric. Crystals rare; usually in grains and scales.

Cleavage none. Fracture hackly. Malleable and ductile.  $H. = 4-4.5$ .  $G. = 14-19$  native; 21-22 chem. pure. Luster metallic. Color and streak whitish steel-gray; shining. Sometimes magnetipolar.

**Comp.**—Platinum alloyed with iron, iridium, osmium, and other metals.

Most platinum yields from 8 to 15 or even 18 per cent of iron, 0.5 to 2 p. c. palladium, 1 to 3 p. c. rhodium and iridium, a trace of osmium and finally 0.5 to 2 p. c. or more of copper.

**Var.**—1. *Ordinary.* *Non-magnetic* or only slightly magnetic.  $G. = 16.5-18.0$  mostly. 2. *Magnetic.*  $G.$  about 14. Much platinum is magnetic, and occasionally it has polarity. The magnetic property seems to be connected with high percentage of iron (iron-platinum, Eisenplatin *Germ.*), although this distinction does not hold without exception.

**Pyr., etc.**—B.B. infusible. Not affected by borax or salt of phosphorus, except in the state of fine dust, when reactions for iron and copper may be obtained. Soluble only in heated nitro-hydrochloric acid.

**Diff.**—Distinguished by its color, malleability, high specific gravity, infusibility and insolubility in ordinary acids.

**Obs.**—Platinum was first found in pebbles and small grains, associated with iridium, gold, chromite, etc., in the alluvial deposits of the river Pinto, in the district of Choco, Colombia, S. America, where it received its name *platina* (platina del Pinto) from *plata*, silver. In Russia (discovered in 1822) occurs in alluvial material in the Ural at Nizhni Tagilsk, and with chromite in a serpentine probably derived from a peridotite; also in the Goroblagodatsk district. Also found on Borneo; in New Zealand, from a region characterized by a chrysolite rock with serpentine; in New South Wales, in the Broken Hill district, and in gold washings at various points.

In California, in the Klamath region, at Cape Blanco, etc., not abundant; in the gold washings of Cherokee, Butte Co.; at St. François, Beauce Co., Quebec; at several points in British Columbia.

**Iridium.** Platin-iridium. Iridium with platinum and other allied metals. Occurs usually in angular grains of a silver-white color.  $H. = 6-7$ .  $G. = 22.6-22.8$ . With the platinum of the Urals and Brazil.

#### IRIDOSMINE. Osmiridium.

Rhombohedral. Usually in irregular flattened grains.

Cleavage:  $c$  perfect. Slightly malleable to nearly brittle.  $H. = 6-7$ .  $G. = 19.3-21.12$ . Luster metallic. Color tin-white to light steel-gray. Opaque.

**Comp., Var.**—Iridium and osmium in different proportions. Some rhodium, platinum, ruthenium, and other metals are usually present.

**Var.**—1. *Neoyanskite.*  $H. = 7$ ;  $G. = 18.8-19.5$ . In flat scales; color tin-white. Over 40 p. c. of iridium. 2. *Siserskite.* In flat scales, often six-sided, color grayish white, steel-gray.  $G. = 20-21.2$ . Not over 30 p. c. of iridium. Less common than the light-colored variety.

**Diff.**—Distinguished from platinum by greater hardness and by its lighter color.

**Obs.**—Occurs with platinum in South America; in the Ural mountains; in auriferous drift in New South Wales. Rather abundant in the auriferous beach-sands of northern California.

**Palladium.**—Palladium, alloyed with a little platinum and iridium. Mostly in grains.  $H. = 4.5-5$ .  $G. = 11.3-11.8$ . Color whitish steel-gray. Occurs with platinum in Brazil; also from the Urals.

**Allopladium.** Palladium under the rhombohedral system (?). From Tilkerode in the Harz, in small hexagonal tables with gold.

#### IRON.

Isometric. Usually massive, rarely in crystals.

Cleavage:  $a$  perfect; also a lamellar structure  $\parallel o$  and  $\parallel d$ . Fracture hackly. Malleable.  $H. = 4-5$ .  $G. = 7.3-7.8$ . Luster metallic. Color steel-gray to iron-black. Strongly magnetic.

**Var.**—1. **Terrestrial Iron.** Found in masses, occasionally of great size, as well as in small embedded particles, in basalt at Blaafjeld, Ovfak (or Uifak), Disko Island, West Greenland; also elsewhere on the same coast. This iron contains 1 to 2 p. c. of Ni. Some other occurrences, usually classed as meteoric, may be in fact terrestrial; e.g., the Santa Catharina iron of Brazil discovered in 1875.

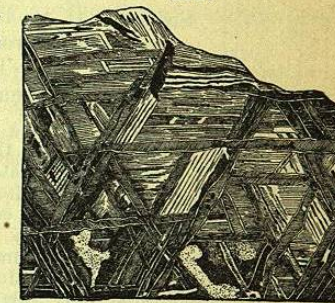
A nickeliferous metallic iron ( $FeNi_2$ ) called *awaruite* occurs in the drift of the Gorge river, which empties into Awarua Bay on the west coast of the south island of New Zealand; associated with gold, platinum, cassiterite, chromite; probably derived from a partially serpentinized peridotite. *Josephinite* is a nickel-iron ( $Fe_2Ni_3$ ) from Oregon, occurring in stream gravel. Native iron also occurs sparingly in some basalts; reported from gold or platinum washings at various points.

2. **Meteoric Iron.** Native iron also occurs in some meteorites, forming in some cases (a) the entire mass (*iron meteorites*); also (b) as a spongy, cellular matrix in which are embedded grains of chrysolite or other silicates (*siderolites*); (c) in grains or scales disseminated more or less freely throughout a stony matrix (*meteoric stones*). Rarely a meteorite consists of a single crystalline individual (Braunau) with numerous twinning lamellæ  $\parallel o$ . Cubic cleavage sometimes observed; also an octahedral, less often dodecahedral lamellar structure. Etching with dilute nitric acid (or iodine) commonly develops a crystalline structure (called *Widmanstätten figures*) (Fig. 588); usually consisting of lines or bands crossing at various angles according to the direction of the section, at  $60^\circ$  if  $\parallel o$ ,  $90^\circ$   $\parallel a$ , etc. They are formed by the edges of crystalline plates, usually  $\parallel o$ , of the nickeliferous iron of different composition (*kamacite*, *tenite*, *plessite*), as shown by the fact that they are differently attacked by the acid. Irons with cubic structure and with twinning lamellæ (e.g., Braunau) have a series of fine lines corresponding to those developed by etching (*Neumann lines*). A damascene luster is also produced in some cases, due to quadrilateral depressions. Some irons show no distinct crystalline structure upon etching.

The exterior of masses of meteoric iron is usually more or less deeply pitted with rounded thumblike depressions, and the surface at the time of fall is covered with a film of iron oxide in fine ridges showing lines of flow due to the melting caused by the heat developed by the resistance of the air; this film disappears when the iron is exposed to the weather.

Meteoric iron is always alloyed with nickel, which is usually present in amounts varying from 5 to 10 p. c., sometimes much more; small amounts of other metals, as cobalt, manganese, tin, copper, chromium, are also often present. Occluded gases can usually be detected. Graphite, in seams or nodules, also troilite (iron sulphide), schreibersite (iron-nickel phosphide) are common in masses of meteoric iron; diamond, daubreeelite, etc., are rare. *Cohenite*, sometimes identified, is  $(Fe, Ni, Co)_3C$  in tin-white crystals.

588.



Glorieta Mt., New Mexico