Pyr., etc. — B.B. infusible, or only slightly rounded on the edges, sometimes coloring the outer flame green (copper). With borax and salt of phosphorus gives a yellow bead in O.F., becoming green in R.F. (uranium). With soda on charcoal gives a coating of lead oxide, and frequently the odor of arsenic. Many specimens give reactions for sulphur and arsenic in the open tube. Soluble in nitric and sulphuric acids; the solubility differs widely in different varieties, being greater in those kinds containing the rare earths. Not attractable by the magnet. Strongly radioactive.

Obs. — As noted above, uraninite occurs either as a primary constituent of granitic rocks or as a secondary mineral with ores of silver, lead, copper, etc. Under the latter condition it is found in Germany at Johanngeorgenstadt, Marienberg, and Schneeberg in Saxony; in Bohemia at Joachimstal and Příbram; in Hungary at Rezbánya. Occurs in Norway in pegmatitic veins at several points near Moss, viz.: Anneröd (*bröggerite*), Elvestad, etc., also near Arendal at the Garta feldspar quarry (*cleveite*), associated with orthite, fergusonite, thorite, etc.

In the United States, at the Middletown feldspar quarry, Conn., in large octahedrons, rare; at Hale's quarry in Glastonbury, a few miles N.E. of Middletown. At Branchville, Conn., in a pegmatite vein, as small octahedral crystals, embedded in albite. In N. C., at the Flat Rock mine and other mica mines in Mitchell Co., rather abundant, but usually altered, in part or entirely, to gummite and uranophane; the crystals are sometimes an inch or more across and cubic in habit. In S. C., at Marietta. In Texas, at the gadolinite locality in Llano Co. (*nivenite*). In large quantities at Black Hawk, near Central City, Col. Rather abundant in the Bald Mountain district, Black Hills, S. D. Also with monazite, etc., at the Villeneuve mica veins, Ottawa Co., Quebec, Canada.

Use. — As a source of uranium and of radium salts.

Gummite. An alteration-product of uraninite of doubtful composition. In rounded or flattened pieces, looking much like gum. G. = 3·9–4·20. Luster greasy. Color reddish yellow to orange-red, reddish brown. n = 1·61. From Johanngeorgenstadt, Germany, also Mitchell Co., N. C.

YTTROGUMMITE. Occurs with cleveite as a decomposition-product.

THOROGUMMITE. Occurs with fergusonite, cyrtolite, and other species at the gadolinite locality in Llano Co., Texas.

Thorianite. Chiefly thorium and uranium oxides. Isometric, cubic habit. G. = 9·3. Color black: Radioactive. Obtained from gem gravels of Balangoda, Ceylon. Also noted from Province of Betroka, Madagascar.

Uranosphærite. $(BiO)_2U_2O_7.3H_2O$. In half-globular aggregated forms. Color orange-yellow, brick-red. From near Schneeberg, Saxony.

Oxygen Salts

6. SULPHATES, CHROMATES, TELLURATES

A. Anhydrous Sulphates, etc.

The important BARITE GROUP is the only one among the anhydrous sulphates and chromates.

Mascagnite. Ammonium sulphate, $(NH_4)_2SO_4$. Orthorhombic. Usually in crusts and stalactitic forms. β = 1·523. Occurs about volcanoes, as at Etna, Vesuvius, etc.

Taylorite. $5K_2SO_4.(NH_4)_2SO_4$. In small compact lumps or concretions. From the guano of the Chincha Islands.

Thenardite. Anhydrous sodium sulphate, Na_2SO_4. In orthorhombic crystals, pyramidal, short prismatic or tabular; also as twins (Fig. 384, p. 160). White to brownish. Optically +. β = 1·477. Soluble in water. Often observed in connection with salt lakes, as on the shores of Lake Balkhash, Central Asia; similarly elsewhere; also in South America in Tarapaca, Chile. In the United States, forms extensive deposits on the Rio Verde, Ariz. In Cal., at Borax Lake, San Bernardino Co.

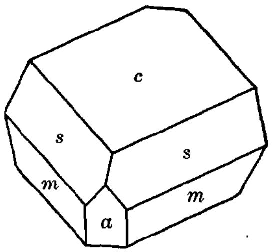
Aphthitalite. Arcanite. Glaserite. $(K,Na)_2SO_4$. Rhombohedral; also massive, in crusts. Color white. From Vesuvius, upon lava; at Douglashall near Westeregeln, Germany, in blödite; Stassfurt, Germany; Rocalmuto, Sicily.

GLAUBERITE.

Monoclinic. Axes $a : b \cdot c = 1{\cdot}2200 : 1 : 1{\cdot}0275$; $\beta = 67° 49'$.

ca, 001 ∧ 100 = 67° 49'. *cs*, 001 ∧ 111 = 43° 2'.
mm''', 110 ∧ $1\bar{1}0$ = 96° 58'. *cm*, 001 ∧ 110 = 75° 30½'.

995



In crystals tabular || *c* (001); also prismatic.

Cleavage: *c* perfect. Fracture conchoidal. Brittle. H. = 2·5–3. G. = 2·7–2·85. Luster vitreous. Color pale yellow or gray; sometimes brick-red. Streak white. Taste slightly saline. Optically –. 2V = 7°. $\alpha = 1{\cdot}515$. $\beta = 1{\cdot}532$. $\gamma = 1{\cdot}536$. Optical characters change on heating, see p. 297.

Comp. — $Na_2SO_4.CaSO_4$ = Sulphur trioxide 57·6, lime 20·1, soda 22·3 = 100; or, Sodium sulphate 51·1, calcium sulphate 48·9 = 100.

Pyr., etc. — B.B. decrepitates, turns white, and fuses at 1·5 to a white enamel, coloring the flame intensely yellow. On charcoal fuses in O.F. to a clear bead; in R.F. a portion is absorbed by the charcoal, leaving an infusible hepatic residue. Soluble in hydrochloric acid. In water it loses its transparency, is partially dissolved, leaving a residue of calcium sulphate, and in a large excess this is completely dissolved.

Obs. — In crystals in rock salt at Villa Rubia, in New Castile, Spain; also at Aussee and Hallstatt, Upper Austria; in Germany at Berchtesgaden, Bavaria; Westeregeln; Stassfurt. In crystals in the Rio Verde Valley, Ariz., with thenardite, mirabilite, etc.; Borax lake, San Bernardino Co., Cal.

Langbeinite. $K_2Mg_2(SO_4)_3$. Isometric-tetartohedral. In highly modified colorless crystals. G. = 2·83. $n = 1{\cdot}533$. From Westeregeln and Stassfurt, Germany; Hall, Tyrol; Punjab, India.

Vanthoffite. $3Na_2SO_4.MgSO_4$. Almost colorless crystalline material found at Wilhelmshall, near Stassfurt, Prussia.

Barite Group. RSO_4. Orthorhombic

		m ∧ *m'''*	*dd'*	*oo'*	
		110 ∧ $1\bar{1}0$	102 ∧ $\bar{1}02$	011 ∧ $0\bar{1}1$	*a* : *b* : *c*
Barite	$BaSO_4$	78° 22½'	77° 43'	105° 26'	0·8152 : 1 : 1·3136
Celestite	$SrSO_4$	75° 50'	78° 49'	104° 0'	0·7790 : 1 : 1·2801
Anglesite	$PbSO_4$	76° 16½'	78° 47'	104° 24½'	0·7852 : 1 : 1·2894
Anhydrite	$CaSO_4$	(83° 33')	(58° 31')	(90° 3')	0·8933 : 1 : 1·0008

The BARITE GROUP includes the sulphates of barium, strontium, and lead, three species which are closely isomorphous, agreeing not only in axial ratio but also in crystalline habit and cleavage. With these is also included calcium sulphate, anhydrite, which has a related but not closely similar form; it differs from the others conspicuously in cleavage. It is to be noted that the carbonates of the same metals form the isomorphous ARAGONITE GROUP, p. 437.

BARITE. Heavy Spar. Barytes.

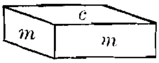
Orthorhombic. Axes $a : b : c = 0{\cdot}8152 : 1 : 1{\cdot}3136$.

mm''', 110 ∧ $1\bar{1}0$ = 78° 22½'. *dd'''*, 102 ∧ $10\bar{2}$ = 102° 17'.
cd, 001 ∧ 102 = 38° 51½'. *oo'''*, 011 ∧ $01\bar{1}$ = 74° 34'.
co, 001 ∧ 011 = 52° 43'. *cz*, 001 ∧ 111 = 64° 19'.

Crystals commonly tabular || *c* (001), and united in diverging groups having the axis *b* in common; also prismatic, most frequently || axis *b*, *d* (102) predominating; also || axis *c*, *m* (110) prominent; again || axis *a*, with *o* (011) prominent. Also in globular forms, fibrous or lamellar, crested; coarsely laminated, laminæ convergent and often curved; granular, resembling white marble, and earthy; colors sometimes banded as in stalagmite.

Cleavage: *c* (001) perfect; *m* (110) also perfect, Fig. 996 the form yielded by cleavage; also *b* (010) imperfect. Fracture uneven. Brittle. H. = 2·5–3·5. G. = 4·3–4·6. Luster vitreous, inclining to resinous; sometimes pearly on *c* (001), less often on *m* (110). Streak white. Color white; also inclining to yellow, gray, blue, red, or brown, dark brown. Transparent to translucent to opaque. Sometimes fetid, when rubbed. Optically +. Ax. pl. || *b* (010). Bx ⊥ *a* (100). 2V = 37° 30′. $\alpha = 1.636$. $\beta = 1{\cdot}637$. $\gamma = 1{\cdot}648$.

996



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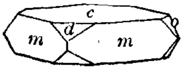

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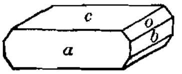

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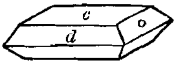

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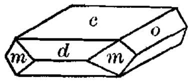

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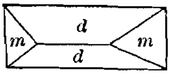

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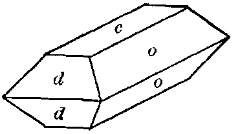

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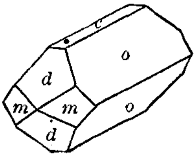

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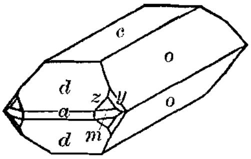


Var. — *Ordinary.* (*a*) Crystals usually broad or stout; sometimes very large; again in slender needles. (*b*) *Crested;* massive aggregations of tabular crystals, the crystals projecting at surface into crest-like forms. (*c*) *Columnar;* the columns often coarse and loosely aggregated, and either radiated or parallel; rarely fine fibrous. (*d*) In globular or nodular concretions, subfibrous or columnar within. *Bologna Stone* (from near Bologna) is here included; it was early a source of wonder because of the phosphorescence it exhibited after heating with charcoal. "Bologna phosphorus" was made from it. (*e*) Lamellar, either straight or curved; the latter sometimes as aggregations of curved scale-like plates. (*f*) Granular. (*g*) Compact or cryptocrystalline. (*h*) Earthy. (*i*) Stalactitic and stalagmitic; similar in structure and origin to calcareous stalactites and stalagmites and of much beauty when polished. (*h*) *Fetid;* so called from the odor given off when struck or when two pieces are rubbed together, which odor may be due to carbonaceous matters present.

The barite of Muzsaj and of Betler, near Rosenau, Hungary, was early called *Wolnyn. Cawk* is the ordinary barite of the Derbyshire lead mines. *Dreelite,* supposed to be rhombohedral, is simply barite. *Michel-lévyte* from Perkin's Mill, Templeton, Quebec (described as monoclinic), is peculiar in its pearly luster on *m*, twinning striations, etc.

Comp. — Barium sulphate, $BaSO_4$ = Sulphur trioxide 34·3, baryta 65·7 = 100.

Strontium sulphate is often present, also calcium sulphate; further, as impurities, silica, clay, bituminous or carbonaceous substances.

Pyr, etc. — B.B. decrepitates and fuses at 3, coloring the flame yellowish green; the fused mass reacts alkaline with test paper. On charcoal reduced to a sulphide. With soda gives at first a clear pearl, but on continued blowing yields a hepatic mass, which spreads out and soaks into the coal. This reacts for sulphur (p. 340). Insoluble in acids.

Diff. — Characterized by high specific gravity (higher than celestite, aragonite, albite, calcite, gypsum, etc.); cleavage; insolubility; *green* coloration of the blowpipe flame. Albite is harder and calcite effervesces with acid.

Obs. — Occurs commonly in connection with beds or veins of metallic ores, especially of lead, also copper, silver, cobalt, manganese, as part of the gangue of the ore; also often accompanies stibnite. Sometimes present in massive forms with hematite deposits. It is met with in secondary limestones and sandstones, sometimes forming distinct veins, and in the former often in crystals along with calcite and celestite; in the latter often with copper ores. Sometimes occupies the cavities of amygdaloidal basalt, porphyry, etc.; forms earthy masses in beds of marl. Occurs as the petrifying material of fossils and occupying cavities in them.

Fine crystals are obtained in England at the Dufton lead mines, Westmoreland; also in Cumberland and Lancashire; in Derbyshire, Staffordshire, etc.; Cleator Moor; Alston Moor. In Scotland, in Argyleshire, at Strontian. Some of the most important of the many European localities are Felsöbánya, Nagybánya. Schemnitz, and Kremnitz, in Hungary, and Ilefeld, often with stibnite; Hüttenberg, Carinthia; Freiberg, Marienberg, in Saxony; Claustal in the Harz Mts.; Přibram, Bohemia; Auvergne, France.

In the United States, formerly in Conn., at Cheshire, intersecting the red sandstone in veins with chalcocite and malachite. In N. Y., at Pillar Point, opposite Sackett's Harbor, massive; at Scoharie, fibrous; in St. Lawrence Co., crystals at De Kalb; the crested variety at Hammond. In Pa., in crystals at Perkiomen lead mine. In Va., at Eldridge's gold mine in Buckingham Co. In N. C., white massive at Crowders Mt., Gaston Co., etc. In Tenn., on Brown's Creek; at Haysboro', near Nashville; in large veins in sandstone on the west end of Isle Royale, Lake Superior, and on Spar Island, north shore. In Mo. not uncommon with the lead ores; in concretionary forms at Salina, Saline Co., Kan. In Col., at Sterling, Weld Co.; Apishapa Creek; also in El Paso and Fremont Cos. In fine crystals, near Fort Wallace, N. M. Crystals enclosing quartz sand, "sand barite," from Norman, Oklahoma. In distorted crystals from the Bad Islands, S. D.

In Ontario, in Bathurst, and North Burgess, Lanark Co.; Malway, Peterborough Co.; as large veins on Jarvis, McKellars, and Pie islands, in Lake Superior, and near Fort William, Thunder Bay. In Nova Scotia, in veins in the slates of East River of the Five Islands, Colchester Co.

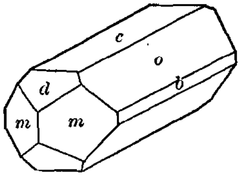
Named from *βαρυς, heavy.*

Use. — Source of barium hydroxide used in the refining of sugar; ground and used as a pigment, to give weight to paper, cloth, etc.

CELESTITE. Cœlestine.

Orthorhombic. Axes $a : b : c = 0·7790 : 1 : 1·2800$.

1005



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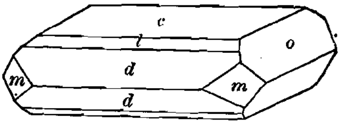


mm''', 110 ∧ $1\bar{1}0$ = 75° 50'.
cl, 001 ∧ 104 = 22° 20'.
cd, 001 ∧ 102 = 39° 24½'.
co, 001 ∧ 011 = 52° 0'.

Crystals resembling those of barite in habit; commonly tabular || *c* (001) or prismatic || axis *a* or *b*; also more rarely pyramidal by the prominence of the forms *ψ* (133) or *χ* (144). Also fibrous and radiated; sometimes globular; occasionally granular.

Cleavage: *c* (001) perfect; *m* (110) nearly perfect; *b* (010) less distinct. Fracture uneven. H. = 3–3·5. G. = 3·95–3·97. Luster vitreous, sometimes inclining to pearly. Streak white. Color white, often faint bluish, and sometimes reddish. Transparent to subtranslucent. Optically +. Ax. pl. || *b* (010). Bx ⊥ *a* (100). 2V = 51°. $\alpha = 1·622$. $\beta = 1·624$. $\gamma = 1·631$.

Var. — 1. *Ordinary.* (*a*) In crystals of varied habit as noted above; a tinge of a delicate blue is very common and sometimes belongs to only a part of a crystal. The variety from Montmartre, near Paris, France, called *apotome*, is prismatic by extension of *o* (011) and doubly terminated by the pyramid *ψ* (133). (*b*) Fibrous, either parallel or radiated. (*c*) Lamellar; of rare occurrence. (*d*) Granular. (*e*) Concretionary. (*f*) Earthy; impure usually with carbonate of lime or clay.

Comp. — Strontium sulphate, $SrSO_4$ = Sulphur trioxide 43·6, strontia 56·4 = 100. Calcium and barium are sometimes present.

Pyr., etc. — B.B. frequently decrepitates, fuses at 3 to a white pearl, coloring the flame strontia-red; the fused mass reacts alkaline. On charcoal fuses, and in R.F. is converted into a difficultly fusible hepatic mass; this treated with hydrochloric acid and alcohol gives an intensely red flame. With soda on charcoal reacts like barite. Insoluble in acids.

Diff. —Characterized by form, cleavage, high specific gravity, *red* coloration of the blowpipe flame. Does not effervesce with acids like the carbonates (e.g., strontianite); specific gravity lower than that of barite.

Obs.—Usually associated with limestone, or sandstone of various ages; occasionally with metalliferous ores, as with galena and sphalerite at Condorcet, France; at Rezbánya, Hungary; also in beds of gypsum, rock salt, as at Bex, Switzerland; Ischl, Austria; Lüneberg, Hannover; sometimes fills cavities in fossils, e.g., ammonites; with sulphur in some volcanic regions as at Girgenti, Sicily. From Yate, Gloucester, England.

Specimens, finely crystallized, of a bluish tint, are found in limestone about Lake Huron, particularly on Drummond Island, also on Strontian Island, Put-in-Bay, Lake Erie, and at Kingston in Ontario, Canada; Chaumont Bay, Lake Ontario, Schoharie, and Lockport, N. Y. From near Syracuse, N. Y. A blue fibrous celestite occurs at Bell's Mills, Blair Co., Pa. From near Cumberland, Md. In Mineral Co., W. Va., a few miles south of Cumberland, Md., in pyramidal blue crystals. At Tifflin, Ohio. In Texas, at Lampasas, large crystals. With colemanite at Death Valley, San Bernardino Co., Cal. In Canada, in crystalline masses at Kingston, Frontenac Co.; Lansdowne, Leeds Co.; in radiating fibrous masses in the Laurentian of Renfrew Co.

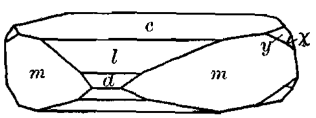
Named from *cœlestis, celestial,* in allusion to the faint shades of blue often present.

Use. — Used in the preparation of strontium nitrate for fireworks; other salts used in the refining of sugar.

ANGLESITE.

Orthorhombic. Axes $a : b : c = 0·7852 : 1 : 1·2894$.

1007



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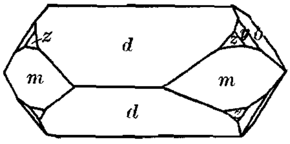

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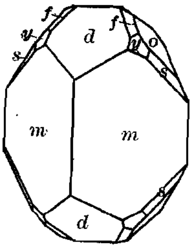


mm''', 110 ∧ 1$\bar{1}$0 = 76° 16½'.
cl, 001 ∧ 104 = 22° 19'.
cd, 001 ∧ 102 = 39° 23'.
co, 001 ∧ 011 = 52° 12'.

Crystals sometimes tabular || *c* (001); more often prismatic in habit, and in all the three axial directions, *m* (110), *d* (102), *o* (011), predominating in the different cases; pyramidal of varied types. Also massive, granular to compact; stalactitic; nodular.

Cleavage: *c* (001), *m* (110) distinct, but interrupted. Fracture conchoidal. Very brittle. H. = 2·75–3. G. = 6·3–6·39. Luster highly adamantine in some specimens, in others inclining to resinous and vitreous. Color white, tinged yellow, gray, green, and sometimes blue. Streak uncolored. Transparent to opaque. Optically +. Ax. pl. || *b* (010). Bx ⊥ *a* (100). Dispersion strong, $\rho < v$. 2V = 60°–75°. α = 1·877. β = 1·882. γ = 1·894.

Comp. — Lead sulphate, $PbSO_4$ = Sulphur trioxide 26·4, lead oxide 73·6 = 100.

Pyr., etc. — B.B. decrepitates, fuses in the flame of a candle (F. = 1·5). On charcoal in O.F. fuses to a clear pearl, which on cooling becomes milk-white; in R.F. is reduced with effervescence to metallic lead. With soda on charcoal in R.F. gives metallic lead, and the soda is absorbed by the coal. Difficultly soluble in nitric acid.

Diff.— Characterized by high specific gravity; adamantine luster; cleavage; and by yielding lead B.B. Cerussite effervesces in nitric acid.

Obs. — A result of the decomposition of galena, and often found in its cavities; also surrounds a nucleus of galena in concentric layers. First found in England at Pary's mine in Anglesea; in Derbyshire and in Cumberland in crystals; at Leadhill, Scotland; in Germany at Claustal, in the Harz Mts.; near Siegen in Prussia; Schapbach and Badenweiler in Baden; in Hungary at Felsöbánya and elsewhere; Nerchinsk, Siberia; and at Monte Poni, Sardinia; Granada and Andalusia, Spain; massive in Siberia; in Australia, whence it is exported to England. At Broken Hill, New South Wales. In the Sierra Mojada, Mexico, in immense quantities, mostly massive.

In the United States in crystals at Wheatley's mine, Phenixville, Pa.; in Missouri lead mines; in crystals of varied habit at the Mountain View mine, Carroll Co., Md. In Col. at various points, but less common than cerussite. At the Cerro Gordo mines of Cal. (argentiferous galena), with other lead minerals. In Ariz., in the mines of the Castle Dome district, Yuma Co., and elsewhere. In fine crystals from Kingston and Wardner, Idaho; Eureka, Utah.

Named from the locality, Anglesea, where it was first found.

Use. — An ore of lead.

ANHYDRITE.

Orthorhombic. Axes $a : b : c$ = 0·8933 : 1 : 1·0008.

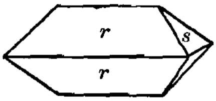
mm''', $110 \wedge 1\bar{1}0 = 83° 33'$ ss', $011 \wedge 0\bar{1}1 = 90° 3'$

rr', $101 \wedge \bar{1}01 = 96° 30'$ bo, $010 \wedge 111 = 56° 19'$

Twins: 1, tw. pl. *d* (012); 2, *r* (101) occasionally as tw. lamellæ. Crystals not common, thick tabular, also prismatic || axis *b*. Usually massive, cleavable, fibrous, lamellar, granular, and sometimes impalpable.

Cleavage: in the three pinacoidal directions yielding rectangular fragments but with varying ease, thus, *c* (001) very perfect; *b* (010) also perfect; *a* (100) somewhat less so. Fracture uneven, sometimes splintery. Brittle. H. = 3–3·5. G. = 2·899–2·985. Luster: *c* pearly, especially after heating in a closed tube; *a* somewhat greasy; *b* vitreous; in massive varieties, vitreous inclining to pearly. Color white, sometimes a grayish, bluish, or reddish tinge; also brick-red. Streak grayish white. Optically +. Ax. pl. || *b* (010). Bx ⊥ *a* (100). 2V = 42°. α = 1·571. β = 1·576. γ = 1·614.

1010



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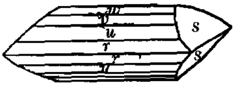

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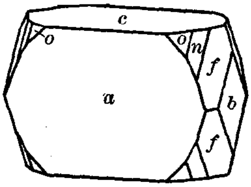


1010, 1011, Stassfurt 1012, Aussee

Var. — 1. *Ordinary.* (*a*) Crystallized; crystals rare, more commonly massive and cleavable in its three rectangular directions. (*b*) Fibrous; either parallel, radiated or plumose. (*c*) Fine granular. (*d*) Scaly granular. *Vulpinite* is a scaly granular kind from Vulpino in Lombardy, Italy; it is cut and polished for ornamental purposes. A kind in contorted concretionary forms is the *tripestone.*

2. *Pseudomorphous;* in cubes after rock-salt.

Comp. — Anhydrous calcium sulphate, $CaSO_4$ = Sulphur trioxide, 58·8, lime 41·2 = 100.

Pyr., etc. — B.B. fuses at 3, coloring the flame reddish yellow, and yielding an enamel-like bead which reacts alkaline. On charcoal in R.F. reduced to a sulphide; with soda does not fuse to a clear globule, and is not absorbed by the coal like barite; is, however, decomposed, and yields a mass which blackens silver. Soluble in hydrochloric acid.

Diff. — Characterized by its cleavage in three rectangular directions (pseudo-cubic in aspect); harder than gypsum; does not effervesce with acids like the carbonates.

Obs. — Occurs in rocks of various ages, especially in limestone strata, and often the same that contain ordinary gypsum, and also very commonly in beds of rock-salt; at the salt mine near Hall in Tyrol, Austria; of Bex, Switzerland; at Aussee, upper Austria, crystallized and massive; Lüneburg, Hannover, Germany; Kapnik in Hungary; Wieliczka in Poland; Ischl in Upper Austria; Berchtesgaden in Bavaria; Stassfurt, Germany, in fine crystals, embedded in kieserite; in cavities in lava at Santorin Island.

In the United States, at Meriden, Conn.; at Lockport, N. Y., fine blue, in geodes of black limestone, with calcite and gypsum; at West Paterson, N. J.; in limestone at Nashville, Tenn., etc. In the salt beds of central Kansas. In Nova Scotia it forms extensive beds.

Anhydrite by absorption of moisture changes to gypsum. Extensive beds are sometimes thus altered in part or throughout, as at Bex, in Switzerland, where, by digging down 60 to 100 ft., the unaltered anhydrite may be found. Sometimes specimens of anhydrite are altered between the folia or over the exterior.

Bassanite. $CaSO_4$. In white opaque crystals having form of gypsum but composed of slender needles in parallel arrangement. These show parallel extinction and positive elongation. G. = 2·69–2·76. Transformed into anhydrite at red heat. Found in blocks ejected from Vesuvius.

Zinkosite. $ZnSO_4$. Reported as occurring at a mine in the Sierra Almagrera, Spain.

Hydrocyanite. $CuSO_4$. Found at Vesuvius as a pale green to blue incrustation after the eruption of 1868.

HOKUTOLITE. A mixture in variable proportions of lead and barium sulphates. A radioactive crystalline crust deposited by hot springs at Hokuto, Formosa.

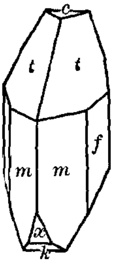
Millosevichite. Normal ferric and aluminium sulphate. As a violet incrustation, Alum Grotto, Island of Vulcano, Lipari Islands.

CROCOITE.

Monoclinic. Axes $a : b : c = 0·9603 : 1 : 0·9159$; $\beta = 77° 33'$.

mm''', $110 \wedge 1\bar{1}0 = 86° 19'$. tt', $111 \wedge 1\bar{1}1 = 60° 50'$.
ck, $001 \wedge \bar{1}01 = 49° 32'$. ct, $001 \wedge 111 = 46° 58'$.

1013



Crystals usually prismatic, habit varied. Also imperfectly columnar and granular.

Cleavage: *m* (110) rather distinct; *c* (001), *a* (100) less so. Fracture small conchoidal to uneven. Sectile. H. = 2·5–3. G. = 5·9–6·1. Luster adamantine to vitreous. Color various shades of bright hyacinth-red. Streak orange-yellow. Translucent. $\beta = 2·42$.

Comp. — Lead chromate, $PbCrO_4$ = Chromium trioxide 31·1, lead protoxide 68·9 = 100.

Pyr., etc. — In the closed tube decrepitates, blackens, but recovers its original color on cooling. B.B. fuses at 1·5, and on charcoal is reduced to metallic lead with deflagration, leaving a residue of chromium oxide, and giving a lead coating. With salt of phosphorus gives an emerald-green bead in both flames.

Obs. — First found at Berezov, Ural Mts., in crystals in quartz veins; also at Mursinka and near Nizhni Tagilsk in the Ural Mts.; in Brazil, at Congonhas do Campo; at Rezbánya in Hungary, Moldawa in Hungary; on Luzon, one of the Phillippines; in fine crystals from Mt. Dundas, Tasmania; in the Vulture district, Maricopa Co., Ariz.

The name *crocoite* is from *κρόκος*, *saffron*.

Phœnicochroite. Phœnicite. A basic lead chromate, $3PbO.2CrO_3$. In crystals and massive. Color between cochineal- and hyacinth-red. From Berezov in the Ural Mts.

Vauquelinite. A phospho-chromate of lead, perhaps $2(Pb,Cu)CrO_4.(Pb,Cu)_3P_2O_8$. In crystals; also mammillary and reniform. Color green to brown. Index, 1·93. From Berezov in the Ural Mts.

Bellite. Lead chromate containing arsenious oxide. Hexagonal. In aggregates of delicate tuffs. H. = 2·5. G. = 5·5. Color crimson red, yellow to orange. Fusible. From Magnet, Tasmania.

Sulphates with Chlorides, Carbonates, etc. — In part hydrous

LEADHILLITE.

Monoclinic. Axes $a : b : c = 1{\cdot}7476 : 1 : 2{\cdot}2154$; $\beta = 89° 48'$.

mm''', $110 \wedge 1\bar{1}0 = 120° 27'$. cx, $001 \wedge 111 = 68° 31'$.
cw, $001 \wedge 101 = 51° 36'$. cm, $001 \wedge 110 = 89° 54'$.

Twins: tw. pl. *m* (110), analogous to aragonite. Crystals commonly tabular || *c* (001).

Cleavage: *c* (001) very perfect; *a* (100) in traces. Fracture conchoidal, scarcely observable. Rather sectile. H. = 2·5. G. = 6·26–6·44. Luster of *c* pearly, other parts resinous, somewhat adamantine. Color white, passing into yellow, green, or gray. Streak uncolored. Transparent to translucent. Optically −. $\beta = 1{\cdot}93$.

Comp. — Sulphato-carbonate of lead, $4PbO.SO_3.2CO_2.H_2O$ or $PbSO_4.2PbCO_3.Pb(OH)_2$ = Sulphur trioxide 7·4, carbon dioxide 8·2, lead oxide 82·7, water 1·7 = 100.

Pyr., etc. — B.B. intumesces, fuses at 1·5, and turns yellow; but becomes white on cooling. Easily reduced on charcoal. With soda affords the reaction for sulphuric acid. Effervesces briskly in nitric acid, and leaves white lead sulphate undissolved. Yields water in the closed tube.

Obs. — Found at Leadhill, Scotland, with other ores of lead; in England at Red Gill, Cumberland, and at Matlock, Derbyshire. From the Mala-Calzetta lead mine near Iglesias, Sardinia (*maxite*). Observed from Arizona, at the Schulz gold mine with wulfenite, vanadinite, cerussite; partly altered to cerussite. From Tintic district, Utah; from Searchlight, Nev., from Granby, Mo.

SUSANNITE. Regarded at one time as rhombohedral and dimorphous with leadhillite, but probably only a modification of that species. From the Susanna mine, Leadhill, in Scotland.

Sulphohalite. $3Na_2SO_4NaCl.NaF$. In pale greenish yellow octahedrons and dodecahedrons. $n = 1{\cdot}455$. From Borax lake, and Searles lake, San Bernardino Co., Cal.

Caracolite. Perhaps $Pb(OH)Cl.Na_2SO_4$. As a crystalline incrustation. Colorless. From Atacama, Chile.

Kainite. $MgSO_4.KCl.3H_2O$. Usually granular massive and in crusts. Color white to dark flesh-red. Optically −. $\beta = 1{\cdot}506$. From Stassfurt, Germany, and Wolfenbrittel, Brunswick; Kalusz, Galicia.

Connellite. Probably $CuSO_4.2CuCl_2.19Cu(OH)_2.H_2O$. Crystals slender, hexagonal prisms. Color fine blue. Optically +. $\omega = 1{\cdot}724$. From Cornwall, England; from Eureka, Utah; Bisbee, Ariz. *Footeite,* originally described as a hydrous oxychloride of copper from Bisbee, Ariz., is identical with connellite.

Spangolite. A highly basic sulphate of aluminium and copper, $Cu_6AlClSO_{10}.9H_2O$. In dark green hexagonal crystals (hemimorphic), tabular or short prismatic. Usually in very small crystals. From the neighborhood of Tombstone, Ariz.; Clifton and Bisbee, Ariz.; Tintic district, Utah; from Cornwall, England; Sardinia.

Hanksite. $9Na_2SO_4.2Na_2CO_3.KCl$. In hexagonal prisms, short prismatic to tabular; also in quartzoids. Color white to yellow. Optically −. $\omega = 1{\cdot}481$. From Borax Lake, San Bernardino Co., Cal.; also from Death Valley, Inyo Co

B. Acid and Basic Sulphates

Misenite. Probably acid potassium sulphate, $HKSO_4$. In silky fibers of a white color. From Cape Misene, near Naples, Italy.

BROCHANTITE.

Orthorhombic. Axes *a* : *b* : *c* = 0·7739 : 1 : 0·4871.

In groups of prismatic acicular crystals (mm''' 110 ∧ $1\bar{1}0$ = 75° 28′) and drusy crusts; massive with reniform structure.

Cleavage: *b* (010) very perfect; *m* (110) in traces. Fracture uneven. H. = 3·5–4. G. = 3·907. Luster vitreous; a little pearly on the cleavage-face *b* (101). Color emerald-green, blackish green. Streak paler green. Transparent to translucent.

Comp. — A basic sulphate of copper, $CuSO_4.3Cu(OH)_2$ or $4CuO.SO_3.3H_2O$ = Sulphur trioxide 17·7, cupric oxide 70·3, water 12·0 = 100.

Pyr., etc. — Yields water, and at a higher temperature sulphuric acid, in the closed tube, and becomes black. B.B. fuses, and on charcoal affords metallic copper. With soda gives the reaction for sulphuric acid.

Obs. — Occurs in the Ural Mts.; the königine (or *königite*) was from Gumeshevsk, Ural Mts.; in England near Roughten Gill, in Cumberland and in Cornwall (in part *waringtonite*); at Rezbánya, Hungary; in small beds at Krisuvig in Iceland (*krisuvigite*); in Mexico (*brongnartine*); Atacama and Tarapacá, Chile. In the United States, at Monarch mine, Chaffee Co., Col.; in Utah, at Frisco, in Tintic district, at the Mammoth mine; in Clifton-Morenci district, and Bisbee, Ariz.

Lanarkite. Basic lead sulphate, Pb_2SO_5. In monoclinic crystals. Color greenish white, pale yellow or gray. From Leadhill, Scotland; Siberia; the Harz Mts., Germany.

Dolerophanite. A basic cupric sulphate, Cu_2SO_5(?). In small brown monoclinic crystals. From Vesuvius (eruption of 1868).

Caledonite. A basic sulphate of lead and copper, perhaps $2(Pb,Cu)O.SO_3.H_2O$. Said at times to contain CO_2. In small prismatic orthorhombic crystals. Color deep verdigris-green or bluish green. Index, 1·85. From Leadhill, Scotland; Red Gill, Cumberland, etc., England; Inyo Co., Cal.; Organ Mts., N. M.; Butte, Mon.; Atacama, Chile; New Caledonia.

Linarite. A basic sulphate of lead and copper, $(Pb,Cu)SO_4.(Pb,Cu)(OH)_2$. In deep blue monoclinic crystals. Optically −. β = 1·838. From Leadhill, Scotland; Cumberland, England; the Ural Mts.; Broken Hill, New South Wales; Sardinia. Also Inyo Co., Cal.; Eureka, Utah; Schulz, Ariz.; Slocan, British Columbia.

Antlerite. Perhaps $CuSO_4.2Cu(OH)_2$. In light green soft lumps. From the Antler mine, Mohave Co., Ariz. *Stelznerite* from Remolinos, Vallinar, Chile, is probably the same as antlerite. In prismatic crystals. G. = 3·9.

Alumian. Perhaps $Al_2O_3.2SO_3$. White crystalline or massive. Sierra Almagrera, Spain.

C. Normal Hydrous Sulphates

Three well-characterized groups are included here. Two of these, the EPSOMITE GROUP and the MELANTERITE GROUP, have the same general formula, $RSO_4.7H_2O$, but in the first the crystallization is orthorhombic, in the second monoclinic. The species are best known from the artificial crystals of the laboratory; the native minerals are rarely crystallized. There is also the isometric ALUM GROUP, to which the same remark is applicable.

Lecontite. $(Na,NH_4,K)_2SO_4.2H_2O$. From bat guano in the cave of Las Piedras, near Comayagua, Central America.

MIRABILITE. Glauber Salt.

Monoclinic. Crystals like pyroxene in habit and angle. Usually in efflorescent crusts.

Cleavage: *a* (100), perfect; *c* (001), *b* (010) in traces. H. = 1·5–2. G. = 1·481. Luster vitreous. Color white. Transparent to opaque. Taste cool, then feebly saline and bitter. Optically −. 2V = 76°. $\alpha = 1{\cdot}396$. $\beta = 1{\cdot}410$. $\gamma = 1{\cdot}419$.

Comp. — Hydrous sodium sulphate, $Na_2SO_4.10H_2O$ = Sulphur trioxide 24·8, soda 19·3, water 55·9 = 100.

Pyr., etc. — In the closed tube much water; gives an intense yellow to the flame. Very soluble in water. Loses its water on exposure to dry air and falls to powder.

Obs. — Occurs at Ischl, Hallstadt, and Aussee in Upper Austria; also in Hungary, Switzerland, Italy; at the hot springs at Carlsbad, Bohemia, etc. Large quantities of this sodium sulphate are obtained from the waters of Great Salt Lake, Utah.

Kieserite. $MgSO_4.H_2O$. Monoclinic. Usually massive, granular to compact. Color white, grayish, yellowish. Optically +. $\beta = 1{\cdot}535$. From Stassfurt, Germany; Hallstadt, Austria; India.

Szomolnokite. $FeSO_4.H_2O$. Monoclinic. Isomorphous with *kieserite*. In pyramids. G. = 3·08. Color yellow or brown. Found with other iron sulphates from Szomolnok, Hungary. Apparently identical with *ferropallidite* from near Copiapo, Chile.

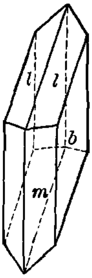
Szmikite. $MnSO_4.H_2O$. Stalactitic. Whitish, reddish. From Felsöbánya, Hungary.

GYPSUM.

Monoclinic. Axes $a : b : c = 0{\cdot}6899 : 1 : 0{\cdot}4124$; $\beta = 80° 42'$.

mm''', 110 ∧ 1$\bar{1}$0 = 68° 30'.
cd, 001 ∧ 101 = 28° 17'.
ct, 001 ∧ $\bar{1}$01 = 33° 8½'.
ce, 001 ∧ $\bar{1}$03 = 11° 29'.
vv', 011 ∧ 0$\bar{1}$1 = 44° 17½'.
ll', 111 ∧ 1$\bar{1}$1 = 36° 12'.
nn', $\bar{1}$11 ∧ $\bar{1}\bar{1}$1 = 41° 20'.
ml, 110 ∧ 111 = 49° 9'.
mn, 110 ∧ $\bar{1}$11 = 59° 15'.

1014



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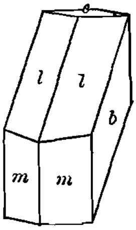
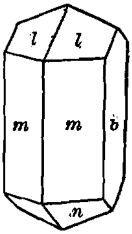


1016



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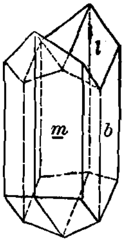
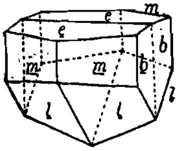


1018

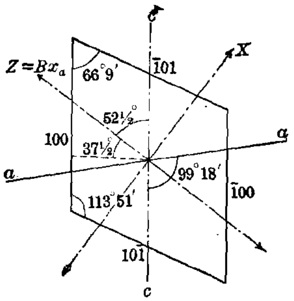


Crystals usually simple in habit, common form flattened || *b* (010) or prismatic to acicular || *c* axis; again prismatic by extension of *l* (111). Also lenticular by rounding of *l* (111) and *e* ($\bar{1}$03). The form *e* ($\bar{1}$03), whose faces are usually rough and convex, is nearly at right angles to the vertical axis (edge *m* (110)/*m'''* (1$\bar{1}$0), hence the apparent hemimorphic character of the twin (Fig. 1018). Simple crystals often with warped as well as curved surfaces. Also foliated massive; lamellar-stellate; often granular massive; and sometimes nearly impalpable. Twins: tw. pl. *a* (100), very common, often the familiar swallow-tail twins.

Cleavage: *b* (010) eminent, yielding easily thin polished folia; *a* (100), giving a surface with conchoidal fracture; *n* ($\bar{1}$11), with a fibrous fracture || *t*($\bar{1}$01); a cleavage fragment has the rhombic form of Fig. 1019, with plane angles of 66° and 114°. H. = 1·5–2. G. = 2·314–2·328, when in pure crystals. Luster of *b* (010) pearly and shining, other faces subvitreous. Massive varieties often glistening, sometimes dull earthy. Color usually white; sometimes gray, flesh-red, honey-yellow, ocher-yellow, blue; impure varieties often black, brown, red, or reddish brown. Streak white. Transparent to opaque.

Optically +. Ax. pl. || *b* (010), and Bx ∧ *c* axis = + $52\frac{1}{2}°$ (at 9·4° C.), (cf. Fig. 1019). Dispersion $\rho > v$; also inclined strong. $Bx_r \wedge Bx_{bl}$ = 0° 30′. 2V = 58°. α = 1·520. β = 1·523. γ = 1·530. On the effect of heat on the optical properties, see p. 297.

1019



Var. — 1. *Crystallized*, or *Selenite;* colorless, transparent; in distinct crystals, or broad folia, often large. Usually flexible and yielding a fibrous fracture || *t* (1̄01), but the variety from Montmartre near Paris, France, rather brittle.

2. *Fibrous;* coarse or fine. Called *Satin spar*, when fine-fibrous, with pearly opalescence.

3. *Massive; Alabaster*, a fine-grained variety, white or delicately shaded; *earthy* or *rock-gypsum*, a dull-colored rock, often impure with clay, calcium carbonate or silica.

Also, in caves, curious curved forms, often grouped in rosettes and other shapes.

Comp. — Hydrous calcium sulphate, $CaSO_4.2H_2O$ = Sulphur trioxide 46·6, lime 32·5, water 20·9 = 100.

Pyr., etc. — In the closed tube gives off water and becomes opaque. Fuses at 2·5–3, coloring the flame reddish yellow. For other reactions see ANHYDRITE, p. 629. Ignited at a temperature not exceeding 260° C., it again combines with water when moistened, and becomes firmly solid. Soluble in hydrochloric acid, and also in 400 to 500 parts of water.

Diff. — Characterized by its softness in all varieties, and by cleavages in crystallized kinds;. it does not effervesce with acids like calcite, nor gelatinize like the zeolites; harder than talc and yields much water in the closed tube.

Obs. — Gypsum often forms extensive beds in connection with various stratified rocks, especially limestones, and marlites or clay beds. It occurs occasionally in crystalline rocks. It is also a product of volcanoes, occurring about fumaroles, or where sulphur gases are escaping, being formed from the sulphuric acid generated, and the lime afforded by the decomposing lavas. It is also produced by the decomposition of pyrite when lime is present. Gypsum is also deposited on the evaporation of sea-water and brines, in which it exists in solution.

Fine specimens are found in the salt mines of Bex in Switzerland; Hall in Tyrol, Austria; the sulphur mines of Sicily; in the clay of Shotover Hill, near Oxford, England; and large lenticular crystals at Montmartre, near Paris, France. A noted locality of alabaster occurs at Castelino, 35 m. from Leghorn, Italy, whence it is taken to Florence for the manufacture of vases, figures, etc.

Occurs in extensive beds in several of the United States, and more particularly N. Y., Iowa, Mich., Okla., Texas, Ohio, and Ark., and is usually associated with salt springs, also with rock salt. Also on a large scale in Nova Scotia, etc.

Handsome selenite and snowy gypsum occur in N. Y., near Lockport in limestone. In Md., large grouped crystals on the St. Mary's in clay. In Ohio, large transparent crystals have been found at Ellsworth and Canfield, Trumbull Co. In Tenn., selenite and alabaster in Davidson Co. In Ky., in Mammoth Cave, it has the forms of rosettes, or flowers, vines, and shrubbery. Also common in isolated crystals and masses, in the Cretaceous clays in the western United States. In enormous crystals, several feet in length, in Wayne Co., Utah. In Nova Scotia, in Sussex, Kings Co., large single and grouped crystals, which mostly contain much symmetrically disseminated sand.

Named from γύψος, the Greek for the mineral, but more especially for the *calcined* mineral. The derivation ordinarily suggested, from γῆ, *earth*, and ἕψειν, *to cook*, corresponds with this, the most common use of the word among the Greeks.

Burnt gypsum is called *Plaster-of-Paris*, because the Montmartre gypsum quarries, near Paris, are, and have long been, famous for affording it.

Use. — In the manufacture of plaster-of-Paris used for molds and casts and as "staff" in erection of temporary buildings; in making adamant plaster for interior use; as land plaster for fertilizer; as alabaster for ornamental purposes.

Ilesite. $(Mn,Zn,Fe)SO_4.4H_2O$. In loosely adherent aggregates. Color clear green. From Colorado.

Epsomite Group. $RSO_4.7H_2O$. Orthorhombic

Epsomite	$MgSO_4.7H_2O$	$a : b : c = 0{\cdot}9902 : 1 : 0{\cdot}5709$
	$(Fe,Mg)SO_4.7H_2O$	
Goslarite	$ZnSO_4.7H_2O$	$0{\cdot}9807 : 1 : 0{\cdot}5631$
Ferro-goslarite	$(Zn,Fe)SO_4.7H_2O$	
Morenosite	$NiSO_4.7H_2O$	$0{\cdot}9816 : 1 : 0{\cdot}5655$

EPSOMITE. Epsom Salt.

Orthorhombic. Usually in botryoidal masses and delicately fibrous crusts. Cleavage: *b* (010) very perfect. Fracture conchoidal. H. = 2·0–2·5. G. = = 1·751. Luster vitreous to earthy. Streak and color white. Transparent to translucent. Taste bitter and saline. Optically −. 2V = 52°. α = 1·433. β = 1·455. γ = 1·461.

Comp. — Hydrous magnesium sulphate, $MgSO_4.7H_2O$ = Sulphur trioxide 32·5, magnesia 16·3, water 51·2 = 100.

Obs. — Common in mineral waters, and as a delicate fibrous or capillary efflorescence on rocks, in the galleries of mines, and elsewhere. In the former state it exists at Epsom, England, and at Sedlitz and Saidschitz (or Saidschütz) in Bohemia. At Idria in Carniola, Austria, it occurs in silky fibers, and is hence called *hairsalt* by the workmen. Also obtained at the gypsum quarries of Montmartre, near Paris. Also found at Vesuvius, at the eruptions of 1850 and 1855.

The floors of the limestone caves of Kentucky, Tennessee, and Indiana, are in many instances covered with epsomite, in minute crystals, mingled with the earth. In the Mammoth Cave, Ky., it adheres to the roof in loose masses like snowballs. From Laramie Basin, Wy.; near Leona Heights, Alameda Co., Cal.; Cripple Creek, Col.

Goslarite. $ZnSO_4.7H_2O$. Commonly massive. Color white, reddish, yellowish. Optically −. β = 1·480. Formed by the decomposition of sphalerite, and found in the passages of mines, as at the Rammelsberg mine near Goslar, in the Harz Mts., Germany, etc. In Mon. at the Gagnon mine, Butte. *Ferro-goslarite* (4·9 p. c. $FeSO_4$) occurs with sphalerite at Webb City, Jasper Co., Mo. *Cuprogoslarite* (13·4 p. c. $CuSO_4$) occurs as a light greenish blue incrustation on the wall of an abandoned zinc mine at Galena, Kan.

Morenosite. $NiSO_4.7H_2O$. In acicular crystals; also fibrous, as an efflorescence. Color apple-green to greenish white. β = 1·489. A result of the alteration of nickel ores, as near Cape Hortegal, in Galicia; Riechelsdorf, in Hesse, Germany; Zermatt, Switzerland, containing magnesium.

Melanterite Group. $RSO_4.7H_2O$. Monoclinic

		$a : b : c$	
Melanterite	$FeSO_4.7H_2O$	$1{\cdot}1828 : 1 : 1{\cdot}5427$	$\beta = 75° 44'$
Luckite	$(Fe,Mn)SO_4.7H_2O$		
Mallardite	$MnSO_4.7H_2O$		
Pisanite	$(Fe,Cu)SO_4.7H_2O$	$1{\cdot}1609 : 1 : 1{\cdot}5110$	74° 38′
Bieberite	$CoSO_4.7H_2O$	$1{\cdot}1815 : 1 : 1{\cdot}5325$	75° 20′
Cupromagnesite	$(Cu,Mg)SO_4.7H_2O$		
Boothite	$CuSO_4.7H_2O$	$1{\cdot}1622 : 1 : 1{\cdot}500$	74° 24′
Chalcanthite	$CuSO_4.5H_2O$	Triclinic	

$a : b : c = 0{\cdot}5656 : 1 : 0{\cdot}5507$; $\alpha = 82° 21'$, $\beta = 73° 11'$, $\gamma = 77° 37'$.

The species here included are the ordinary vitriols. They are identical in general formula with the species of the Epsomite group, and are regarded as the same compound essentially under oblique crystallization. The copper sulphate, chalcanthite, diverges from the others in crystallization, and contains but 5 molecules of water.

MELANTERITE. Copperas.

Monoclinic. Usually capillary, fibrous, stalactitic, and concretionary; also massive, pulverulent. Cleavage: *c* (001) perfect; *m* (110) less so. Fracture conchoidal. Brittle. H. = 2. G. = 1·89–1·90. Luster vitreous. Color, various shades of green, passing into white; becoming yellowish on exposure. Streak uncolored. Subtransparent to translucent. Taste sweetish, astringent, and metallic. Optically +. 2V = 86°. $\alpha = 1{\cdot}471$. $\beta = 1{\cdot}478$. $\gamma = 1{\cdot}486$.

Comp. — Hydrous ferrous sulphate, $FeSO_4.7H_2O$ = Sulphur trioxide 28·8, iron protoxide 25·9, water 45·3 = 100. Manganese and magnesium sometimes replace part of the iron.

Obs. Proceeds from the decomposition of pyrite or marcasite; thus near Goslar in the Harz Mts., Germany; Bodenmais in Bavaria; Falun, Sweden, and elsewhere. Usually accompanies pyrite in the United States, as an efflorescence. In crystals from near Leona Heights, Alameda Co., Cal. *Luckite* (1·9 p. c. MnO) is from the "Lucky Boy" mine, Butterfield Cañon, Utah.

Mallardite. $MnSO_4.7H_2O$. Fibrous, massive; colorless. From the mine "Lucky Boy," south of Salt Lake, Utah.

Pisanite. $(Fe,Cu)SO_4.7H_2O$. CuO 10 to 15 p. c. In concretionary and stalactitic forms. Color blue. From Turkey. From Bingham, Utah; Ducktown, Tenn.; near Leona Heights, Cal.

SALVADORITE. A copper-iron vitriol near pisanite. From the Salvador mine Quetena, Chile.

Bieberite. $CoSO_4.7H_2O$. Usually in stalactites and crusts. Color flesh- and rose-red. From Bieber, in Hesse, Germany, etc.

Boothite. $CuSO_4.7H_2O$. Usually massive. H. = 2–2·5. G. = 1·94. Color blue, paler than chalcanthite. Found at Alma pyrite mine, near Leona Heights, Alameda Co., and at a copper mine near Campo Seco, Calaveras Co., Cal.

CUPROMAGNESITE. $(Cu,Mg)SO_4.7H_2O$. From Vesuvius.

CHALCANTHITE. Blue Vitriol.

Triclinic. Crystals commonly flattened || *p* (111). Occurs also massive, stalactitic, reniform, sometimes with fibrous structure.

Cleavage: *M* $(1\bar{1}0)$, *m* (110), *p* (111) imperfect. Fracture conchoidal. Brittle. H. = 2·5. G. = 2·12–2·30. Luster vitreous. Color Berlin-blue to sky-blue, of different shades; sometimes a little greenish. Streak uncolored. Subtransparent to translucent. Taste metallic and nauseous. Optically −. 2V = 56°. $\alpha = 1{\cdot}516$. $\beta = 1{\cdot}539$. $\gamma = 1{\cdot}546$.

Comp. — Hydrous cupric sulphate, $CuSO_4.5H_2O$ = Sulphur trioxide 32·1, cupric oxide 31·8, water 36·1 = 100.

Pyr., etc. — In the closed tube yields water, and at a higher temperature sulphur trioxide. B.B. with soda on charcoal yields metallic copper. With the fluxes reacts for copper. Soluble in water; a drop of the solution placed on a surface of iron coats it with metallic copper.

Obs. — Found in waters issuing from mines and in connection with rocks containing chalcopyrite, by the alteration of which it is formed; thus at the Rammelsberg mine near Goslar in the Harz Mts., Germany; Falun in Sweden; Parys mine, Anglesea, England; at various mines in County Wicklow, Ireland; Rio Tinto mine, Spain; Zaječar, Servia. From the Hiwassee copper mine, also in large quantities at other mines, in Polk Co., Tenn. In Ariz., near Clifton, Graham Co., and Jerome, Yavapai Co.; in Cal. near Leona Heights, Alameda Co.; from Ely and Reno, Nev.

Syngenite. Kaluszite. $CaSO_4.K_2SO_4.H_2O$. In prismatic (monoclinic) crystals. Colorless or milky-white. $\beta = 1{\cdot}517$. From Kalusz, Galicia.

Löweite. $MgSO_4.Na_2SO_4.2\frac{1}{2}H_2O$. Tetragonal. Massive, cleavable. Color pale yellow. Index, 1·49. From Ischl, Austria.

Blödite. $MgSO_4.Na_2SO_4.4H_2O$. Crystals short prismatic, monoclinic; also massive granular or compact. Colorless to greenish, yellowish, red. Optically —. β = 1·488. From the salt mines of Ischl and at Hallstadt (*simonyite*), Austria; at Stassfurt, Germany; the salt lakes of Astrakhan (*astrakanite*), Asia; India; Chile, etc. From Soda Lake, San Luis Obispo Co., Cal.

Leonite. $MgSO_4.K_2SO_4.4H_2O$. In monoclinic crystals from Westeregeln and Leopoldshall, Germany. β = 1·487.

Boussingaultite. $(NH_4)_2SO_4.MgSO_4.6H_2O$. From the boric acid lagoons, Tuscany, Italy. Index, 1·474.

Picromerite. $MgSO_4.K_2SO_4.6H_2.O$. As a white crystalline incrustation. Monoclinic. Optically +. β = 1·463. From Vesuvius with *cyanochroite*, an isomorphous species in which copper replaces the magnesium. Also at Stassfurt (*schoenite*) and Aschersleben, Germany; Galusz in East Galicia.

Polyhalite. $2CaSO_4.MgSO_4.K_2SO_4.2H_2O$. Triclinic. Usually in compact fibrous or lamellar masses. Color flesh- or brick-red. Optically —. β = 1·562. Occurs at the mines of Ischl, Hallstadt, etc., in Austria; in Germany at Berchtesgaden, Bavaria; Stassfurt, Prussia.

Hexahydrite. $MgSO_4.6H_2O$. Columnar to fibrous structure. Cleavage prismatic. G. = 1·76. Color, white with light green tone. Pearly luster. Opaque. Salty, bitter taste. B.B. exfoliates and yields water but does not fuse. Found in Lillooet district, British Columbia.

Alum Group. Isometric

$$\overset{\text{I}}{R}Al(SO_4)_2.12H_2O \text{ or } \overset{\text{I}}{R}_2SO_4.Al_2(SO_4)_3.24H_2O.$$

Kalinite	Potash Alum	$KAl(SO_4)_2.12H_2O$
Tschermigite	Ammonia Alum	$(NH_4)Al(SO_4)_2.12H_2O$
Mendozite	Soda Alum	$NaAl(SO_4)_2.12H_2O$

The ALUMS proper are isometric in crystallization and, chemically, are hydrous sulphates of aluminium with an alkali metal and 12 (i.e., if the formula is doubled, 24) molecules of water. The species listed above occur very sparingly in nature, and are best known in artificial form in the laboratory.

The HALOTRICHITES are oblique in crystallization, very commonly fibrous in structure, and are hydrous sulphates of aluminium with magnesium, manganese, etc.; the amount of water in some cases is given as 22 molecules, and in others 24, but it is not always easy to decide between the two. Here belong:

Pickeringite. Magnesia Alum. $MgSO_4.Al_2(SO_4)_3.22H_2O$. In long fibrous masses; and in efflorescences.

Halotrichite. Iron Alum. $FeSO_4.Al_2(SO_4)_3.24H_2O$. In yellowish silky fibrous forms. Index, 1.48.

Bilinite. $FeSO_4.Fe_2(SO_4)_3.24H_2O$. Radiating fibrous. Color white to yellow. From Schwaz, near Bilin, Bohemia.

Apjohnite. Manganese Alum. $MnSO_4.Al_2(SO_4)_3.24H_2O$. *Bushmanite* contains MgO. In fibrous or asbestiform masses; also as crusts and efflorescences.

Dietrichite. $(Zn,Fe,Mn)SO_4.Al_2(SO_4)_3.22H_2O$.

Coquimbite. $Fe_2(SO_4)_3.9H_2O$. Rhombohedral. Granular massive. Color white, yellowish, brownish. Optically +. ω = 1·550. From the Tierra Amarilla near Copiapo, Chile (not from Coquimbo).

Quenstedtite. $Fe_2(SO_4)_3.10H_2O$. In reddish tabular crystals. With coquimbite, Chile.

Ihlëite. $Fe_2(SO_4)_3.12H_2O$? An orange yellow efflorescence on graphite. From Mugrau, Bohemia. Perhaps identical with *copiapite.*

Alunogen. $Al_2(SO_4)_3.18H_2O$. Usually in delicate fibrous masses or crusts; massive. Color white, or tinged with yellow or red. From near Bilin, Bohemia; Bodenmais, Germany; Pusterthal, Tyrol, Austria; from Vesuvius; Elba. From Cripple Creek, Doughty Springs, and Alum Gulch, Col.

DOUGHTYITE. A hydrated aluminium sulphate deposited by the alkaline waters of the Doughty Springs in Col.

Kröhnkite. $CuSO_4.Na_2SO_4.2H_2O$. Monoclinic crystalline; massive, coarsely fibrous. Color azure-blue. Optically −. $\beta = 1{\cdot}577$. From Calama, Atacama, Chuquicamata, Autofagasta, and Collahurasi, Tarapacá, Chile.

Natrochalcite. $Cu_4(OH)_2(SO_4)_2.Na_2SO_4.2H_2O$. Monoclinic. Habit pyramidal. Perfect basal cleavage. H. = 4·5. G. = 2·3. Color bright emerald-green. $\beta = 1{\cdot}65$. Found at Chuquicamata, Autofagasta, Chile.

PHILLIPITE. Perhaps $CuSO_4.Fe_2(SO_4)_3.nH_2O$. In blue fibrous masses. Found at the copper mines in the Cordilleras of Condes, province of Santiago, Chile.

Ferronatrite. $3Na_2SO_4.Fe_2(SO_4)_3.6H_2O$. Rhombohedral. Rarely in acicular crystals; usually in spherical forms. Color greenish or gray to white. Optically +. $\omega = 1{\cdot}558$. From Sierra Gorda near Caracoles, Chile.

Römerite. $FeSO_4.Fe_2(SO_4)_3.14H_2O$. In tabular triclinic crystals; granular, massive. Color chesnut-brown. From Goslar in the Harz Mts., Germany; Persia; Chile.

Basic Hydrous Sulphates

Langite. Near brochantite. $CuSO_4.3Cu(OH)_2.H_2O$. Usually in fibro-lamellar, concretionary crusts. Color blue to greenish blue. From Cornwall.

Herrengrundite. $2(CuOH)_2SO_4.Cu(OH)_2.3H_2O$ with one-fifth of the copper replaced by calcium. In thin tabular monoclinic crystals; usually in spherical groups. Color emerald-green, bluish green. From Herrengrund, Hungary.

Vernadskite. $3CuSO_4.Cu(OH)_2.4H_2O$. In aggregates of minute crystals. H. = 3·5. Occurs as an alteration of *dolerophanite* at Vesuvius.

Kamarezite. A hydrous basic copper sulphate from Laurion, Greece.

Cyanotrichite. Lettsomite. Perhaps $4CuO.Al_2O_3.SO_3.8H_2O$. In velvet-like druses; in spherical forms. Color bright blue. From Moldawa in the Banat, Hungary; Cap Garonne, France. In Utah and Arizona.

Serpierite. A basic sulphate of copper and zinc. In minute crystals, tabular, in tufts. Color bluish green. From Laurion, Greece.

Beaverite. $CuO.PbO.Fe_2O_3.2SO_3.4H_2O$. Hexagonal? In microscopic plates. Color, canary-yellow. Refractive index > 1·74. From Horn Silver mine, Frisco, Beaver Co., Utah.

Vegasite. $PbO.3Fe_2O_3.3SO_3.6H_2O$. Hexagonal. In microscopic fibrous crystals, sometimes showing hexagonal plates. Optically −. Indices, 1·75–1·82. Found in Yellow Pine district, near Las Vegas, Nev.

COPIAPITE.

Monoclinic. Usually in loose aggregations of crystalline scales, or granular massive; incrusting.

Cleavage: *b* (010). H. = 2·5. G. = 2·103. Luster pearly. Color sulphur-yellow, citron-yellow. Translucent. Optically −. $\alpha = 1{\cdot}527$. $\beta = 1{\cdot}547$. $\gamma = 1{\cdot}572$.

Comp. — A basic ferric sulphate, perhaps $2Fe_2O_3.5SO_3.18H_2O$ = Sulphur trioxide 38·3, iron sesquioxide 30·6, water 31·1 = 100.

Misy is an old term, which has been somewhat vaguely applied. It seems to belong in part here and in part also to other related species. *Janosite* is identical with copiapite.

Pyr., etc. — Yields water, and at a higher temperature sulphuric acid. On charcoal becomes magnetic, and with soda affords the reaction for sulphuric acid. With the fluxes reacts for iron. Soluble in water, and decomposed by boiling water.

Obs. — The original copiapite was from Copiapo, Chile. Also from Elba and from near Leona Heights, Alameda Co., Cal.

Other hydrated ferric sulphates:

Castanite. $Fe_2O_3.2SO_3.8H_2O$. Color chestnut-brown. From Sierra Gorda, Chile.

Utahite. $3Fe_2O_3.2SO_3.7H_2O$. In aggregates of fine scales. Color orange-yellow. From the Tintic district, Utah; Guanaco, Taltal, Chile. Perhaps identical with *carphosiderite.*

Amarantite. $Fe_2O_3.2SO_3.7H_2O$. Triclinic. Usually in columnar or bladed masses, also radiated. Color amaranth-red. From near Caracoles, Chile. *Hohmannite* is the same partially altered; this is probably also true of *paposite.*

Fibroferrite. $Fe_2O_3.2SO_3.10H_2O$. Orthorhombic. In delicately fibrous aggregates. Color pale yellow, nearly white. From the Tierra Amarilla near Copiapo, Chile.

Raimondite. $2Fe_2O_3.3SO_3.7H_2O$. In thin six-sided tables. Color between honey- and ocher-yellow. From the tin mines of Ehrenfriedersdorf; mines of Bolivia. Perhaps identical with *carphosiderite.*

Carphosiderite. $3Fe_2O_3.4SO_3.7H_2O$. In reniform masses, and incrustations; also in micaceous lamellæ. Color straw-yellow. From Greenland. *Utahite, apatelite, raimondite* and *cyprusite* are probably identical with *carphosiderite.*

Planoferrite. $Fe_2O_3.SO_3.15H_2O$. Orthorhombic? In rhombic or hexagonal plates. Yellowish green to brown. From near Morro Moreno, Autofagasta, Chile.

Glockerite. $2Fe_2O_3.SO_3.6H_2O$. Massive, sparry or earthy; stalactitic. Color brown to ocher-yellow to pitch-black; dull green. From Goslar, Harz Mts., Germany.

Knoxvillite. A hydrous basic sulphate of chromium, ferric iron, and aluminium. In rhombic plates. Color greenish yellow. From the Redington mercury mine, Knoxville, Cal.

REDINGTONITE. A hydrous chromium sulphate, in finely fibrous masses of a pale purple color. From Redington mercury mine, Knoxville, Cal.

Cyprusite. Perhaps $7Fe_2O_3.Al_2O_3.10SO_3.14H_2O$. An aggregation of microscopic crystals. Color yellowish. From the island of Cyprus. Perhaps identical with *carphosiderite.*

Aluminite (Websterite). $Al_2O_3.SO_3.9H_2O$. Usually in white earthy reniform masses, compact. Index, 1·48. From near Halle, Germany, in clay; also at Newhaven, Sussex, England, and elsewhere.

Paraluminite. Near aluminite, but supposed to be $2Al_2O_3.SO_3.15H_2O$.

Felsöbányite. $2Al_2O_3.SO_3.10H_2O$. Massive; in scaly concretions. Color snow-white. From near Felsöbánya, Hungary.

Botryogen. Perhaps $MgO.FeO.Fe_2O_3.4SO_3.18H_2O$. Monoclinic. Usually in reniform and botryoidal shapes. Color deep hyacinth-red, ocher-yellow. $\beta = 1{\cdot}548$. From Falun, Sweden; also from Persia; from Lake and Napa Cos., Cal.

Sideronatrite. $2Na_2O.Fe_2O_3.4SO_3.7H_2O$. Fibrous, massive. Color yellow. From the province of Tarapacá, Chile. Also on the Urus plateau, near Sarakaya, on the island, Cheleken, in the Caspian Sea (*urusite*).

Voltaite. Perhaps $3(K_2,Fe)O.2(Al,Fe)_2O_3.6SO_3.9H_2O$. In octahedrons, etc. Color dull oil-green to brown or black. From the solfatara near Naples; Schmölnitz, Hungary; also Persia.

Metavoltine. Perhaps $5(K_2,Na_2,Fe)O.3Fe_2O_3.12SO_3.18H_2O$. In aggregates of minute yellow scales. Occurs with voltaite in Persia. From Vesuvius; found in fumeroles on islands of Milo and Vulcano; from Miseno, Italy.

ALUNITE. Alumstone.

Rhombohedral. Axis $c = 1{\cdot}2520$. In rhombohedrons, resembling cubes (rr' $10\bar{1}1 \wedge \bar{1}101 = 90^\circ\ 50'$). Also massive, having a fibrous, granular, or impalpable texture.

Cleavage: *c* (0001) distinct; *r* $(10\bar{1}1)$ in traces. Fracture flat conchoidal, uneven; of massive varieties splintery; and sometimes earthy. Brittle. H. = 3·5–4. G. = 2·58–2·752. Luster of *r* vitreous, basal plane somewhat pearly. Color white, sometimes grayish or reddish. Streak white. Transparent to subtranslucent. Optically +. $\omega = 1{\cdot}572$. $\epsilon = 1{\cdot}592$.

Comp. — Basic hydrous sulphate of aluminium and potassium, $K_2Al_6(OH)_{12}(SO_4)_4$ = Sulphur trioxide 38·6, alumina 37·0, potash 11·4, water 13·0 = 100. Sometimes contains considerable soda, *natroalunite*.

Pyr., etc. — B.B. decrepitates, and is infusible. In the closed tube yields water, sometimes also ammonium sulphate, and at a higher temperature sulphurous and sulphuric oxides. Heated with cobalt solution affords a fine blue color. With soda and charcoal infusible, but yields a hepatic mass. Soluble in sulphuric acid.

Obs. — Forms seams in trachytic and allied rocks, where it has been formed as a result of the alteration of the rock by means of sulphurous vapors; as at Tolfa, near Civitavecchia, Italy; in Hungary; on Milo, Grecian Archipelago; at Mt. Dore, France; Kinkwaseki, Formosa. In the United States, associated with diaspore, in rhombohedral crystals, tabular through the presence of *c* (0001) at the Rosita Hills, Custer Co., and from Red Mt., Col.; Marysvale, Utah; Goldfield and near Sulphur, Nev.

JAROSITE.

Rhombohedral. Axis $c = 1{\cdot}2492$; rr' $10\bar{1}1 \wedge \bar{1}101 = 90°\ 45'$, cr $0001 \wedge 10\bar{1}1 = 55°\ 16'$. Often in druses of minute crystals; also fibrous, granular massive; in nodules, or as an incrustation.

Cleavage: *c* (0001) distinct. Fracture uneven. Brittle. H. = 2·5–3·5. G. = 3·15–3·26. Luster vitreous to subadamantine: brilliant, also dull. Color ocher-yellow, yellowish brown, clove-brown. Streak yellow, shining. Optically +. $\omega = 1{\cdot}74$. $\epsilon = 1{\cdot}77$.

Comp. — $K_2Fe_6(OH)_{12}(SO_4)_4$ = Sulphur trioxide 31·9, iron sesquixoide 47·9, potash 9·4, water 10·8 = 100.

Obs. — The original Gelbeisenerz was from Luschitz, between Kolosoruk and Bilin, Bohemia, in brown coal; and later from Modum, Norway, in alum slate. The jarosite was from Barranco Jaroso, in the Sierra Almagrera, Spain; Schlaggenwald, Bohemia; Elba; Chocaya, Potosi, Bolivia. In the United States on quartz in the Vulture mine, Ariz.; in Chaffee County, Col.; Tintic district, Utah; Lawrence Co., S. D.; Dona Ana Co., N. M.; Bisbee, Ariz.; Brewster Co., Texas.

Natrojarosite. $Na_2Fe_6(OH)_{12}(SO_4)_4$. Rhombohedral. In minute tabular crystals. Color yellow-brown. From Soda Springs Valley, Esmeralda Co., Nev.

Plumbojarosite. $PbFe_6(OH)_{12}(SO_4)_4$. Rhombohedral. In minute tabular crystals. Color dark brown. From Cook's Peak, N. M., and in Beaver County, Utah.

Palmierite. $3(K,Na)_2SO_4.4PbSO_4$? In microscopic plates, often hexagonal in outline. Colorless. Fusible. Found in fumerole deposits at Vesuvius.

Löwigite. Perhaps $K_2O.3Al_2O_3.4SO_3.9H_2O$. In rounded masses, similar to compact alunite. Found in a coal bed at Tabrze in Upper Silesia; Mt. Kinjal, Northern Caucasia; also with alunite at Tolfa, Italy.

ALMERIITE. $Na_2SO_4.Al_2(SO_4)_3.5Al(OH)_3.H_2O$. Compact. White. From Almeria, Spain.

Ettringite. Perhaps $6CaO.Al_2O_3.3SO_3.33H_2O$. In minute colorless acicular crystals. From limestone-inclusions in lava, near Mayen, Rhenish Prussia; Tombstone, Ariz.

Quetenite. $MgO.Fe_2O_3.3SO_3.13H_2O$. Massive, in indistinct crystals. Color reddish brown. From Quetena, Chile.

Zincaluminite. $2ZnSO_4.4Zn(OH)_2.6Al(OH)_3.5H_2O$. In minute hexagonal plates. Color white, bluish. From Laurion, Greece.

Johannite. A hydrous sulphate of uranium and copper. In druses or reniform masses of a green color. From Joachimstal, Bohemia.

Gilpinite. A hydrous sulphate of uranium and copper, $(Cu,Fe,Na_2)O.UO_3.SO_3.4H_2O$. Probably monoclinic. In minute lath-shaped crystals. Color pale greenish yellow to canary-yellow. H. = 2. G. > 3·3. Indices, 1·57–1·61. Infusible. Readily soluble in acids. From Gilpin Co., Col.

Uranopilite. Perhaps $CaU_8S_2O_{31}.25H_2O$. In velvety incrustations; yellow. From Johanngeorgenstadt, Germany.

Zippeite, voglianite, uraconite are uncertain uranium sulphates, from Joachimstal, Bohemia.

Minasragrite. An acid hydrous vanadyl sulphate $(V_2O_2)H_2(SO_4)_3.15H_2O$. Probably monoclinic. In granular aggregates, small mammillary masses, or in spherulites. Two cleavages. Color blue. Indices 1·51–1·54. Strongly pleochroic, deep blue to colorless. Easily fusible. Soluble in cold water. Found as an efflorescence on *patronite* from Minasragra, Peru.

Rhomboclase. A hydrated acid ferric sulphate, $Fe_2O_3.4SO_3.9H_2O$. In rhombic plates. Basal cleavage. Colorless. Occurs at Szomolnok, Hungary.

Tellurates; also Tellurites, Selenites

Montanite. $Bi_2O_3.TeO_3.2H_2O$. In earthy incrustations; yellowish to white. From Highland, Mon., with tetradymite.

Emmonsite. Probably a hydrated ferric tellurite. In thin yellow-green scales. From near Tombstone, Ariz.

Durdenite. Hydrous ferric tellurite, $Fe_2(TeO_3)_3.4H_2O$. In small mammillary forms; greenish yellow. Honduras.

Chalcomenite. Hydrous cupric selenite, $CuSeO_3.2H_2O$. In small blue monoclinic crystals. From the Cerro de Cacheuta, Argentina, with silver, copper selenides.

MOLYBDOMENITE is lead selenite and COBALTOMENITE probably cobalt selenite, from the same locality as chalcomenite.

Oxygen Salts

7. TUNGSTATES, MOLYBDATES

The monoclinic Wolframite Group and the tetragonal Scheelite Group are included here.

Wolframite Group

Wolframite	$(Fe,Mn)WO_4$	$a : b : c$ = 0·8300 : 1 : 0·8678	β = 89° 22′
Hübnerite	$MnWO_4$	0·8362 : 1 : 0·8668	89° 7½′

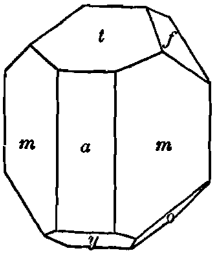
WOLFRAMITE.

Monoclinic. Axes $a : b : c = 0·8300 : 1 : 0·8678$; $\beta = 89° \ 22'$.

mm‴, 110 ∧ 1$\bar{1}$0 = 79° 23′. *ay′*, 100 ∧ 10$\bar{2}$ = 62° 54′

at, 100 ∧ 102 = 61° 54′. *ff′*, 011 ∧ 011 = 81° 54′.

1020



Twins: (1) tw. axis *c* with *a* (100) as comp.-face; (2) tw. pl. *k* (023), Fig. 449, p. 171. Crystals commonly tabular || *a* (100); also prismatic. Faces in prismatic zone vertically striated. Often bladed, lamellar, coarse divergent columnar, granular.

Cleavage: *b* (010) very perfect; also parting || *a* (100), and || *t* (102). Fracture uneven. Brittle. H. = 5–5·5. G. = 7·2–7·5. Luster submetallic. Color dark grayish or brownish black. Streak nearly black. Opaque. Sometimes weakly magnetic. $\beta = 1·93$.