

Sulphohalite. $3\text{Na}_2\text{SO}_4 \cdot 2\text{NaCl}$. In pale greenish yellow dodecahedrons. From Borax lake, San Bernardino Co., Cal.

Caracolite. Perhaps $\text{Pb}(\text{OH})\text{Cl} \cdot \text{Na}_2\text{SO}_4$. As a crystalline incrustation. Colorless. From Atacama.

Kainite. $\text{MgSO}_4 \cdot \text{KCl} + 3\text{H}_2\text{O}$. Usually granular massive and in crusts. Color white to dark flesh-red. From Stassfurt; Kalusz, Galicia.

Connellite. Probably $\text{Cu}_3(\text{Cl}, \text{OH})_4\text{SO}_4 \cdot 15\text{H}_2\text{O}$. Crystals slender, hexagonal prisms (Fig. 204, p. 69). Color fine blue. From Cornwall.

Spangolite. A highly basic sulphate of aluminium and copper, $\text{Cu}_6\text{AlClSO}_{10} \cdot 9\text{H}_2\text{O}$. In dark green hexagonal crystals (hemimorphic), tabular or short prismatic. From the neighborhood of Tombstone, Arizona.

Hanksite. $9\text{Na}_2\text{SO}_4 \cdot 2\text{Na}_2\text{CO}_3 \cdot \text{KCl}$. In hexagonal prisms, short prismatic to tabular; also in quartzoids (Figs. 202, 203, p. 69). Color white to yellow. From Borax Lake, San Bernardino Co., California; 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.

BROCHANTITE.

Orthorhombic. Axes $a : b : c = 0.7739 : 1 : 0.4871$.

In groups of prismatic acicular crystals ($mm''' = 75^\circ 28'$) and drusy crusts; massive with reniform structure.

Cleavage: b very perfect; m in traces. Fracture uneven. $H. = 3.5-4$. $G. = 3.907$. Luster vitreous; a little pearly on the cleavage-face b . Color emerald-green, blackish green. Streak paler green. Transparent to translucent.

Comp.—A basic sulphate of copper, $\text{CuSO}_4 \cdot 3\text{Cu}(\text{OH})_2$ or $4\text{CuO} \cdot \text{SO}_3 \cdot 3\text{H}_2\text{O} =$ 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; the *königine* (or *königite*) was from Gumeshevsk; near Roughten Gill, in Cumberland; in Cornwall (in part *waringtonite*); at Rezbánya; in small beds at Krisuvig in Iceland (*krisuvigite*); in Mexico (*brongnartine*); Atacama. In the U. States, at Monarch mine, Chaffee Co., Colorado; in Utah, Tintic district, at the Mammoth mine.

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

Dolerophanite. A basic cupric sulphate, $\text{Cu}_2\text{SO}_5(?)$. In small brown monoclinic crystals. From Vesuvius (eruption of 1868).

Caledonite. A basic sulphate of lead and copper, perhaps $2(\text{Pb}, \text{Cu})\text{O} \cdot \text{SO}_3 \cdot \text{H}_2\text{O}$. In small prismatic crystals. Color deep verdigris-green or bluish green. From Leadhills; Red Gill, Cumberland, etc.; Inyo Co., Cal.

Linarite. A basic sulphate of lead and copper, $(\text{Pb}, \text{Cu})\text{SO}_4 \cdot (\text{Pb}, \text{Cu})(\text{OH})_2$. In deep blue monoclinic crystals. From Leadhills; Cumberland; the Ural, etc. Also Inyo Co., California.

ANTLERITE. Perhaps $3\text{CuSO}_4 \cdot 7\text{Cu}(\text{OH})_2$. In light green soft lumps. From the Antler mine, Mohave Co., Arizona.

Alumian. Perhaps $\text{Al}_2\text{O}_3 \cdot 2\text{SO}_3$. 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, $\text{RSO}_4 + 7\text{H}_2\text{O}$, 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. $(\text{Na}, \text{NH}_4, \text{K})_2\text{SO}_4 + 2\text{H}_2\text{O}$. 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 perfect; c, b , in traces. $H. = 1.5-2$. $G. = 1.481$. Luster vitreous. Color white. Transparent to opaque. Taste cool, then feebly saline and bitter.

Comp.—Hydrous sodium sulphate, $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O} =$ 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 Carlbad, etc. Large quantities of this sodium sulphate are obtained from the waters of Great Salt Lake, Utah.

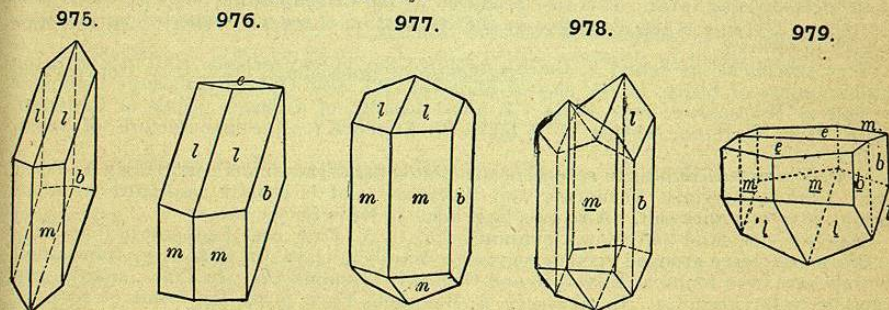
Kieserite. $\text{MgSO}_4 + \text{H}_2\text{O}$. Usually massive, granular to compact. Color white, grayish, yellowish. From Stassfurt; Hallstadt; India.

Szmkite. $\text{MnSO}_4 + \text{H}_2\text{O}$. Stalactitic. Whitish, reddish. From Felsöbánya, Hungary.

GYPSUM.

Monoclinic. Axes $a : b : c = 0.6899 : 1 : 0.4124$; $\beta = 80^\circ 42'$.

mm'' , $110 \wedge \bar{1}\bar{1}0 = 68^\circ 30'$	ll' , $111 \wedge \bar{1}\bar{1}1 = 36^\circ 12'$
cd , $001 \wedge 101 = 28^\circ 17'$	nn' , $\bar{1}\bar{1}1 \wedge \bar{1}\bar{1}1 = 41^\circ 20'$
ct , $001 \wedge \bar{1}01 = 33^\circ 8\frac{1}{2}'$	ml , $110 \wedge 111 = 49^\circ 9'$
ce , $001 \wedge \bar{1}03 = 11^\circ 29'$	mn , $110 \wedge \bar{1}\bar{1}1 = 59^\circ 15'$
vv' , $011 \wedge 0\bar{1}1 = 44^\circ 17\frac{1}{2}'$	



Crystals usually simple in habit, common form flattened $\parallel b$ or prismatic to acicular $\parallel c$; 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/m''), hence the apparent hemimorphic character of the twin (Fig. 979). 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 , very common, often the familiar swallow-tail twins.

Cleavage: b eminent, yielding easily thin polished folia; a (100), giving a surface with conchoidal fracture; n ($\bar{1}11$), with a fibrous fracture $\parallel t$ ($\bar{1}01$); a cleavage fragment has the rhombic form of Fig. 549, p. 222, with plane angles of 66° and 114° . $H. = 1.5-2$. $G. = 2.314-2.328$, when in pure crystals. Luster of b 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. $\parallel b$, and $Bx \wedge c = +52\frac{1}{2}^\circ$ (at $9.4^\circ C.$), (cf. Figs. 549, 550, p. 222). Dispersion $\rho > \nu$; also inclined strong. $Bx_r \wedge Bx_{bl} = 0^\circ 30'$. $2E_r = 95^\circ 14'$ at 20° . $\beta_r = 1.5226$, $\gamma - \alpha = 0.009$. On the effect of heat on the optical properties, see p. 225.

Var.—1. *Crystallized*, or *Selenite*; colorless, transparent; in distinct crystals, or broad folia, often large. Usually flexible and yielding a fibrous fracture $\parallel t$ ($\bar{1}01$), but the variety from Montmartre 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. 528. Ignited at a temperature not exceeding $260^\circ C.$, 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 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; the sulphur mines of Sicily; in the clay of Shotover Hill, near Oxford; and large lenticular crystals at Montmartre, near Paris. A noted locality of alabaster occurs at Castelino, 35 m. from Leghorn, 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. York, Ohio, Illinois, Virginia, Tennessee, and Arkansas, 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. York*, near Lockport in limestone. In *Maryland*, 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 *Kentucky*, 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 U. S. In enormous crystals, several feet in length, in Wayne Co., Utah. In *N. Scotia*, in Sussex, Kings Co., large single and grouped crystals, which mostly contain much symmetrically disseminated sand.

Named from $\gamma\acute{\upsilon}\phi\omicron\varsigma$, the Greek for the mineral, but more especially for the *calcined* mineral. The derivation ordinarily suggested, from $\gamma\eta$, *earth*, and $\acute{\epsilon}\psi\acute{\epsilon}\iota\nu$, *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.

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	$MgSO_4 + 7H_2O$	$\alpha : \beta : \epsilon = 0.9902 : 1 : 0.5709$
	$(Fe,Mg)SO_4 + 7H_2O$	
Goslarite	$ZnSO_4 + 7H_2O$	0.9807 : 1 : 0.5631
Ferro-goslarite	$(Zn,Fe)SO_4 + 7H_2O$	
Morenosite	$NiSO_4 + 7H_2O$	0.9816 : 1 : 0.5655

EPSOMITE. Epsom Salt.

Orthorhombic. Usually in botryoidal masses and delicately fibrous crusts. Cleavage: b 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.

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 Saldschütz (or Saldschütz) in Bohemia. At Idria in Carniola it occurs in silky fibers, and is hence called *hair-salt* 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.

Goslarite. $ZnSO_4 + 7H_2O$. Commonly massive. Color white, reddish, yellowish. Formed by the decomposition of sphalerite, and found in the passages of mines, as at the Rammelsberg mine near Goslar, in the Harz, etc. In Montana at the Gagnon mine, Butte. *Ferro-goslarite* (4.9 p. c. $FeSO_4$) occurs with sphalerite at Webb City, Jasper Co., Missouri.

Morenosite. $NiSO_4 + 7H_2O$. In acicular crystals; also fibrous, as an efflorescence. Color apple-green to greenish white. A result of the alteration of nickel ores, as near Cape Horteagal, in Galicia; Riechelsdorf, in Hesse, etc.

Melanterite Group. $RSO_4 + 7H_2O$. Monoclinic.

Melanterite	$FeSO_4 + 7H_2O$	$\alpha : \beta : \epsilon = 1.1828 : 1 : 1.5427$	$\beta = 75^\circ 44'$
Luckite	$(Fe,Mn)SO_4 + 7H_2O$		
Mallardite	$MnSO_4 + 7H_2O$		
Pisanite	$(Fe,Cu)SO_4 + 7H_2O$	1.1609 : 1 : 1.5110	$74^\circ 38'$
Bieberite	$CoSO_4 + 7H_2O$	1.1815 : 1 : 1.5325	$75^\circ 20'$
Cupromagnesite	$(Cu,Mg)SO_4 + 7H_2O$		

Chalcanthite $\text{CuSO}_4 + 5\text{H}_2\text{O}$ Triclinic
 $\alpha : \beta : \gamma = 0.5656 : 1 : 0.5507; \alpha = 82^\circ 21', \beta = 73^\circ 11', \gamma = 77^\circ 37'$

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 diverges from the others in crystallization, and contains but 5 of water.

MELANTERITE. Copperas.

Monoclinic. Usually capillary, fibrous, stalactitic, and concretionary; also massive, pulverulent. Cleavage: *c* perfect; *m* 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.

Comp.—Hydrous ferrous sulphate, $\text{FeSO}_4 + 7\text{H}_2\text{O} =$ 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; Bodenmais in Bavaria; Falun, Sweden, and elsewhere. Usually accompanies pyrite in the U. States, as an efflorescence. *Luckite* (1.9 p. c. MnO) is from the "Lucky Boy" mine, Butterfield Cañon, Utah.

Mallardite. $\text{MnSO}_4 + 7\text{H}_2\text{O}$. Fibrous, massive; colorless. From the mine "Lucky Boy," south of Salt Lake, Utah.

Pisanite. $(\text{Fe,Cu})\text{SO}_4 + 7\text{H}_2\text{O}$. CuO 10 to 15 p. c. In concretionary and stalactitic forms. Color blue. From Turkey.

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

Bieberite. $\text{CoSO}_4 + 7\text{H}_2\text{O}$. Usually in stalactites and crusts. Color flesh- and rose-red. From Bieber, in Hesse, etc. *Cupromagnesite* is from Vesuvius.

CHALCANTHITE. Blue Vitriol. Kupfervitriol *Germ.*

Triclinic. Crystals commonly flattened $\parallel p(111)$ (Figs. 339-341, p. 109). Occurs also massive, stalactitic, reniform, sometimes with fibrous structure.

Cleavage: *M, m, p* 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.

Comp.—Hydrous cupric sulphate, $\text{CuSO}_4 + 5\text{H}_2\text{O} =$ 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; Falun in Sweden; Parys mine, Anglesea; at various mines in Co. of Wicklow; Rio Tinto mine, Spain. From the Hiwassee copper mine, also in large quantities at other mines, in Polk Co., Tennessee. In Arizona, near Clifton, Graham Co., and Jerome, Yavapai Co.

Syngenite. *Kaluszite.* $\text{CaSO}_4 \cdot \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$. In prismatic (monoclinic) crystals. Colorless or milky-white. From Kalusz, Galicia.

Löweite. $\text{MgSO}_4 \cdot \text{Na}_2\text{SO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$. Massive, cleavable. Color pale yellow. From Ischl, Austria.

Blödite. $\text{MgSO}_4 \cdot \text{Na}_2\text{SO}_4 + 4\text{H}_2\text{O}$. Crystals short prismatic, monoclinic; also massive granular or compact. Colorless to greenish, yellowish, red. From the salt mines of Ischl; at Hallstadt (*simonyite*); at Stassfurt; the salt lakes of Astrakhan (*astrakanite*), Asia; India; Chili, etc.

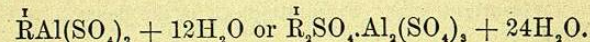
Leonite. $\text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}$. In monoclinic crystals from Westeregeln and Leopoldshall, Germany.

Boussingaultite. $(\text{NH}_4)_2\text{SO}_4 \cdot \text{MgSO}_4 + 6\text{H}_2\text{O}$. From the boric acid lagoons, Tuscany.

Picromerite. $\text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 + 6\text{H}_2\text{O}$. As a white crystalline incrustation. From Vesuvius with *cyanochroite*, an isomorphous species in which copper replaces the magnesium. Also at Stassfurt (*schoenite*); at Aschersleben; Galusz in East Galicia.

Polyhalite. $2\text{CaSO}_4 \cdot \text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$. Usually in compact fibrous or lamellar masses. Color flesh- or brick-red. Occurs at the mines of Ischl, Hallstadt, etc., in Austria; Berchtesgaden, Bavaria; Stassfurt.

Alum Group. Isometric.



Kalinite	Potash Alum	$\text{KAl}(\text{SO}_4)_2 + 12\text{H}_2\text{O}$
Tschermigite	Ammonia Alum	$(\text{NH}_4)\text{Al}(\text{SO}_4)_2 + 12\text{H}_2\text{O}$
Mendozite	Soda Alum	$\text{NaAl}(\text{SO}_4)_2 + 12\text{H}_2\text{O}$

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 here included 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. $\text{MgSO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$. In long fibrous masses; and in efflorescences.

Halotrichite. Iron Alum. $\text{FeSO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$. In yellowish silky fibrous forms.

Apiohnite. Manganese Alum. $\text{MnSO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$. Bushmanite contains MgO. In fibrous or asbestiform masses; also as crusts and efflorescences.

Dietrichite. $(\text{Zn,Fe,Mn})\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$.

MASRITE. A fibrous alum from Egypt supposed to contain a new element, masrium.

Coquimbite. $\text{Fe}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$. Rhombohedral. Granular massive. Color white, yellowish, brownish. From the Tierra Amarilla near Copiapo. Chili (not from Coquimbo).

Quesstedtite. $\text{Fe}_2(\text{SO}_4)_3 + 10\text{H}_2\text{O}$. In reddish tabular crystals. With coquimbite Chili.

Ihlöite. $\text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$? An orange yellow efflorescence on graphite. From Mugrau, Bohemia.

Alunogen. $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$. Usually in delicate fibrous masses or crusts; massive. Color white, or tinged with yellow or red. From near Bilin, Bohemia; Bodenmais; Pusterthal, Tyrol.

Kröhnkite. $\text{CuSO}_4 \cdot \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$. Massive, coarsely fibrous. Color azure-blue. From Calama, Atacama.

PHILLIPITE. Perhaps $\text{CuSO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 + n\text{H}_2\text{O}$. In blue fibrous masses, Chili. Found at the copper mines in the Cordilleras of Condes, province of Santiago, Chili.

Ferronatrite. $3\text{Na}_2\text{SO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$. Rarely in acicular crystals; usually in spherical forms. Color greenish or gray to white. From Sierra Gorda near Caracoles, Chili.

Römerite. Perhaps $\text{FeSO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$. In tabular crystals; granular, massive. Color chestnut-brown. From Goslar in the Harz; Persia, Chili.

Basic Hydrous Sulphates.

Langite. Near brochantite. $\text{CuSO}_4 \cdot 3\text{Cu}(\text{OH})_2 + \text{H}_2\text{O}$. Usually in fibro-lamellar, concretionary crusts. Color blue to greenish blue. From Cornwall.

Herrengrundite. $2(\text{CuOH})_2\text{SO}_4 \cdot \text{Cu}(\text{OH})_2 + 3\text{H}_2\text{O}$ with one-fifth of the copper replaced by calcium. In thin tabular crystals; usually in spherical groups. Color emerald-green, bluish green. From Herrengrund, Hungary.

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

Cyanotrichite. Lettsomite. Perhaps $4\text{CuO} \cdot \text{Al}_2\text{O}_3 \cdot \text{SO}_3 \cdot 8\text{H}_2\text{O}$. In velvet-like druses; in spherical forms. Color bright blue. From Moldawa in the Banat; 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.

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.

Comp.—A basic ferric sulphate, perhaps $2\text{Fe}_2\text{O}_3 \cdot 5\text{SO}_3 \cdot 18\text{H}_2\text{O} = \text{Sulphur trioxide } 38.3$, 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.

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, Chili.

Other hydrated ferric sulphates:

Castanite. $\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 8\text{H}_2\text{O}$. Color chestnut-brown. From Sierra Gorda, Chili.

Utahite. $3\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 7\text{H}_2\text{O}$. In aggregates of fine scales. Color orange-yellow from the Tintic distr., Utah.

Amarantite. $\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 7\text{H}_2\text{O}$. Usually in columnar or bladed masses, also radiated. Color amaranth-red. From near Caracoles, Chili. *Hohmannite* is the same partially altered; this is probably also true of *paposite*.

Fibroferrite. $\text{Fe}_2\text{O}_3 \cdot 2\text{SO}_3 \cdot 10\text{H}_2\text{O}$. In delicately fibrous aggregates. Color pale yellow, nearly white. From the Tierra Amarilla near Copiapo, Chili.

Raimondite. $2\text{Fe}_2\text{O}_3 \cdot 3\text{SO}_3 \cdot 7\text{H}_2\text{O}$. In thin six-sided tables. Color between honey- and ocher-yellow. From the tin mines of Ehrenfriedersdorf; mines of Bolivia.

Carphosiderite. $3\text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 10\text{H}_2\text{O}$. In reniform masses, and incrustations; also in micaceous lamellæ. Color straw-yellow. From Greenland.

Glockerite. $2\text{Fe}_2\text{O}_3 \cdot \text{SO}_3 \cdot 6\text{H}_2\text{O}$. Massive, sparry or earthy; stalactitic. Color brown to ocher-yellow to pitch-black; dull green. From Goslar and Modum.

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

REDINGTONITE. A hydrous chromium sulphate, in finely fibrous masses of a pale purple color. Same locality as knoxvillite.

Cyprusite. Perhaps $7\text{Fe}_2\text{O}_3 \cdot \text{Al}_2\text{O}_3 \cdot 10\text{SO}_3 \cdot 14\text{H}_2\text{O}$. An aggregation of microscopic crystals. Color yellowish. From the island of Cyprus.

Aluminite (Websterite). $\text{Al}_2\text{O}_3 \cdot \text{SO}_3 \cdot 9\text{H}_2\text{O}$. Usually in white earthy reniform masses, compact. From near Halle, in clay; also at Newhaven, Sussex, and elsewhere.

Paraluminite. Near aluminite, but supposed to be $2\text{Al}_2\text{O}_3 \cdot \text{SO}_3 \cdot 15\text{H}_2\text{O}$.

Felsöbányite. $2\text{Al}_2\text{O}_3 \cdot \text{SO}_3 \cdot 10\text{H}_2\text{O}$. Massive; in scaly concretions. Color snow-white. From near Felsöbánya, Hungary.

Botryogen. Perhaps $\text{MgO} \cdot \text{FeO} \cdot \text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 18\text{H}_2\text{O}$. Usually in reniform and botryoidal shapes. Color deep hyacinth-red, ocher-yellow. From Falun, Sweden; also from Persia.

Sideronatrite. $2\text{Na}_2\text{O} \cdot \text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 7\text{H}_2\text{O}$. Fibrous, massive. Color yellow. From the province of Tarapacá, Chili. Also on the Urus plateau, near Sarakaya, on the island, Cheleken, in the Caspian Sea (*urusite*).

Voltaite. Perhaps $5(\text{K}_2, \text{Fe})\text{O} \cdot 2(\text{Al}, \text{Fe})\text{O}_3 \cdot 10\text{SO}_3 \cdot 15\text{H}_2\text{O}$. In octahedrons, etc. Color dull oil-green to brown or black. From the solfatara near Naples; also Persia.

Metavoltine. Perhaps $5(\text{K}_2, \text{Na}_2, \text{Fe})\text{O} \cdot 3\text{Fe}_2\text{O}_3 \cdot 12\text{SO}_3 \cdot 18\text{H}_2\text{O}$. In aggregates of minute yellow scales. Occurs with voltaite in Persia.

ALUNITE. Alumstone. Alaunstein.

Rhombohedral. Axis $l = 1.2520$. In rhombohedrons, resembling cubes ($rr' = 90^\circ 50'$). Also massive, having a fibrous, granular, or impalpable texture.

Cleavage: c distinct; r 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 positive.

Comp.—Hydrous sulphate of aluminium and potassium, $\text{K}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 6\text{H}_2\text{O} = \text{Sulphur trioxide } 38.6$, alumina 37.0 , potash 11.4 , water $13.0 = 100$. The formula may be written $\text{K}(\text{AlO})_3(\text{SO}_4)_2 + 3\text{H}_2\text{O}$.

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 Civita Vecchia; in Hungary; on Milo, Grecian Archipelago; at Mt. Dore, France. In the U. S., associated with diaspore, in rhombohedral crystals, tabular through the presence of $c(0001)$ at the Rosita Hills, Custer Co., Colorado.

JAROSITE. Gelbeisenerz.

Rhombohedral. Axis $l = 1.2492$; $rr' = 90^\circ 45'$, $cr = 55^\circ 16'$. Often in druses of minute crystals; also fibrous, granular massive; in nodules, or as an incrustation.

Cleavage: c distinct. Fracture uneven. Brittle. $H. = 2.5-3.5$. $G. = 3.15-3.26$ cryst. Luster vitreous to subadamantine; brilliant, also dull. Color ocher-yellow, yellowish brown, clove-brown. Streak yellow, shining.

Comp.— $\text{K}_2\text{O} \cdot 3\text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 6\text{H}_2\text{O} = \text{Sulphur trioxide } 31.9$, iron sesquioxide 47.9 , potash 9.4 , water $10.8 = 100$. The formula may be written $\text{K}(\text{FeO})_3(\text{SO}_4)_2 + 3\text{H}_2\text{O}$.

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; also from other points. In the U. S., on quartz in the Vulture mine, Arizona; in Chaffee County, Col.; Tintic district, Utah.

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

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

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

Zincaluminite. $2ZnSO_4 \cdot 4Zn(OH)_2 \cdot 6Al(OH)_3 + 5H_2O$. 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 Joachimsthal.

Uranopilite. Perhaps $CaU_2S_2O_{31} \cdot 25H_2O$. In velvety incrustations; yellow. From Johanngeorgenstadt.

Zippeite, voglianite, uraconite are uncertain uranium sulphates, also from Joachimsthal.

Tellurates; also Tellurites, Selenites.

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

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

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	$(Fe, Mn)WO_4$	$a : b : c = 0.8300 : 1 : 0.8678$	$\beta = 89^\circ 22'$
Hübnerite	$MnWO_4$	$0.8362 : 1 : 0.8668$	$89^\circ 7\frac{1}{2}'$

WOLFRAMITE. Wolfram.

Monoclinic. Axes: $a : b : c = 0.8300 : 1 : 0.8678$; $\beta = 89^\circ 22'$.

mm'' , $110 \wedge 1\bar{1}0 = 79^\circ 23'$. ay' , $100 \wedge 10\bar{2} = 62^\circ 54'$.

at , $100 \wedge 102 = 61^\circ 54'$. ff' , $011 \wedge 0\bar{1}1 = 81^\circ 54'$.

Twins: (1) tw. axis c with a as comp.-face; (2) tw. pl. k (023), Fig. 419, p. 130. Crystals commonly tabular $\parallel a$; also prismatic. Faces in prismatic zone vertically striated. Often bladed, lamellar, coarse divergent columnar, granular.

Cleavage: b very perfect; also parting $\parallel a$, and $\parallel t$ (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.

Comp., Var.—Tungstate of iron and manganese $(Fe, Mn)WO_4$. $Fe : Mn =$ chiefly 4 : 1 (FeO 18.9, MnO 4.7 p. c.) and 2 : 3 (FeO 9.5, MnO 14.0).

Pyr., etc.—Fuses B.B. easily ($F. = 2.5-3$) to a globule, which has a crystalline surface and is magnetic. With salt of phosphorus gives a clear reddish yellow glass while hot, which is paler on cooling; in R.F. becomes dark red; on charcoal with tin, if not too saturated, the bead assumes on cooling a green color, which continued treatment in R.F. changes to reddish yellow. With soda and niter on platinum foil fuses to a bluish green manganate. Decomposed by aqua regia with separation of tungstic acid as a yellow powder. Sufficiently decomposed by concentrated sulphuric acid, or even hydrochloric acid, to give a colorless solution, which, treated with metallic zinc, becomes intensely blue, but soon bleaches on dilution.

Obs.—Wolframite is often associated with tin ores; also in quartz, with native bismuth, scheelite, pyrite, galena, sphalerite, etc. In fine crystals at Schlackenwald, Zinnwald; Schneeberg, Freiberg, Altenberg; at Nerchinsk, Siberia; Chanteloup, near Limoges, France; near Redruth and elsewhere in Cornwall with tin ores. In S. America, at Oruro in Bolivia. With tin stone at various points in New South Wales.

In the U. States at Lane's mine, Monroe, Conn.; Flowe mine, Mecklenburg Co., N. C., with scheelite; in Missouri, near Mine la Motte.

Hübnerite. Near wolframite, but containing 20 to 25 p. c. MnO. Usually in bladed forms, rarely in distinct terminated crystals. Color brownish red to hair-brown to nearly

