

**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 tetradyomite.

**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.

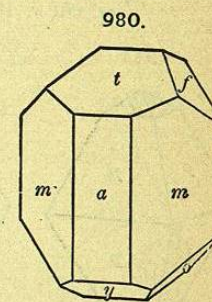
**Comp., Var.**—Tungstate of iron and manganese  $(Fe, Mn)WO_4$ .  $Fe : Mn =$  chiefly 4 : 1 (FeO 18.9, MnO 4.7 p. c.) and 2 : 3 (FeO 9.5, MnO 14.0).

**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



black. Streak yellowish brown, greenish gray. Often translucent. Mammoth dist., Nevada; Ouray County, Col.; near Silverton, San Juan Co.; Black Hills, S. Dakota, etc. Also in Peru, and in rhodochrosite at Adervielle in the Pyrenees.

**Scheelite Group.** Tetragonal-pyramidal.

Scheelite	CaWO <sub>4</sub>	$pp'$ (111 $\wedge$ $\bar{1}\bar{1}1$ ) = 79° 55½'	$c = 1.5360$
Cuprotungstite	CuWO <sub>4</sub>		
Cuproscheelite	(Ca,Cu)WO <sub>4</sub>		
Powellite	Ca(Mo,W)O <sub>4</sub>	80° 1'	$c = 1.5445$
Stolzite	PbWO <sub>4</sub>	80° 15'	$c = 1.5667$
Wulfenite	PbMoO <sub>4</sub>	80° 22'	$c = 1.5771$

The SCHEELITE GROUP includes the tungstates and molybdates of calcium and lead; also copper. In crystallization they belong to the Pyramidal Group of the Tetragonal System. Wulfenite is probably hemimorphic.

**SCHEELITE.**

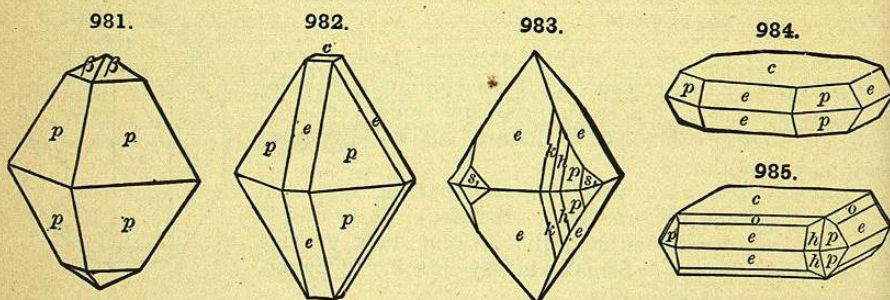
Tetragonal-pyramidal. Axis  $c = 1.5356$ .

$$ee', 101 \wedge 011 = 72^\circ 40\frac{1}{2}'$$

$$ce, 001 \wedge 101 = 56^\circ 56'$$

$$pp', 111 \wedge \bar{1}\bar{1}1 = 79^\circ 55\frac{1}{2}'$$

$$cp, 001 \wedge \bar{1}\bar{1}1 = 65^\circ 16\frac{1}{4}'$$



Forms:  $o$  (102),  $e$  (101),  $\beta$  (113),  $p$  (111),  $k$  (515),  $h$  (313),  $s$  (131).

Twins: (1) tw. pl.  $a$ , both contact- and penetration-twins (Fig. 378, p. 125). Habit octahedral, also tabular. Symmetry shown by faces  $k$ ,  $h$ ,  $s$  (Fig. 983). Also reniform with columnar structure; massive granular.

Cleavage:  $p$  (111) most distinct;  $e$  (101) interrupted. Fracture uneven. Brittle.  $H. = 4.5-5$ .  $G. = 5.9-6.1$ . Luster vitreous, inclining to adamantine. Color white, yellowish white, pale yellow, brownish, greenish, reddish. Streak white. Transparent to translucent. Optically +. Indices:  $\omega_r = 1.918$ .  $\epsilon_r = 1.934$ .

Comp.—Calcium tungstate, CaWO<sub>4</sub> = Tungsten trioxide 80.6, lime 19.4 = 100.

Molybdenum is usually present (to 8 p. c.). Copper may replace calcium, see cuproscheelite.

Pyr., etc.—B.B. in the forceps fuses at 5 to a semi-transparent glass. Soluble with borax to a transparent glass, which afterward becomes opaque and crystalline. With salt of phosphorus forms a glass, colorless in outer flame, in inner green when hot, and fine blue when cold; varieties containing iron require to be treated on charcoal with tin before

the blue color appears. In hydrochloric or nitric acid decomposed, leaving a yellow powder soluble in ammonia.

Obs.—Scheelite is usually associated with crystalline rocks, and is commonly found in connection with cassiterite, topaz, fluorite, apatite, molybdenite, or wolframite, in quartz; also associated with gold. Thus at Schlackenwald and Zinnwald, Bohemia; Altenberg, Saxony; Riesengrund in the Riesengebirge; the Knappenwand in the Untersulzbachthal, Tyrol; Carrock Fells in Cumberland; Traversella in Piedmont; Meymac, Corrèze, France (containing Ta<sub>2</sub>O<sub>5</sub>); Sweden; Pitkäranta in Finland. In New South Wales, at Adelong, from a gold mine; New Zealand, massive; Mt. Ramsay, Tasmania, with cassiterite.

In the U. States, at Lane's Mine, Monroe, and at Trumbull; Flowe mine, Mecklenburg Co., N. Carolina; the Mammoth mining district, Nevada; with gold at the Charity mine, Warren's, Idaho; Lake Co., Colorado. In quartz veins in Risborough and Marlow, Beauce county, Quebec.

Cuprotungstite. Cupric tungstate, CuWO<sub>4</sub>. From the copper mines of Llamuco, near Santiago, Chili. CUPROSHEELITE, from the vicinity of La Paz, Lower California, is (Ca,Cu)WO<sub>4</sub>, with 6.8 p. c. CuO; color green.

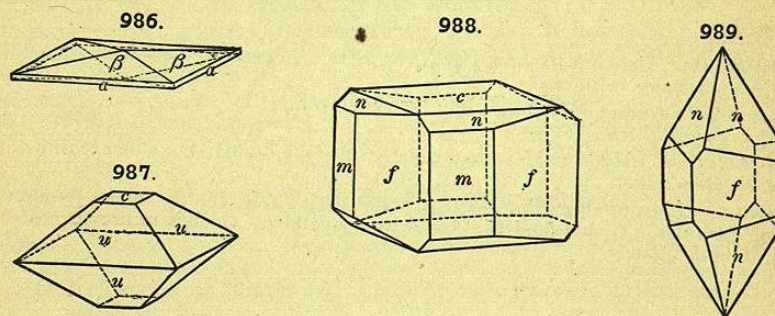
Powellite. Calcium molybdate with calcium tungstate (10 p. c. WO<sub>3</sub>), Ca(Mo,W)O<sub>4</sub>. In minute yellow tetragonal pyramids.  $G. = 4.849$ . From western Idaho; Houghton Co., Mich.

Stolzite. Lead tungstate, PbWO<sub>4</sub>. In pyramidal tetragonal crystals.  $H. = 2.75-3$ .  $G. = 7.87-8.13$ . Color green to gray or brown. Zinnwald.

Raspite. Has the same composition as stolzite, but is referred to the monoclinic system. In small tabular crystals. Color brownish yellow. From the Broken Hill mines, New South Wales.

**WULFENITE.** Gelbbleierz, Molybdänbleispath, *Germ.*

Tetragonal-pyramidal; hemimorphic. Axis  $c = 1.5771$ .



$$cu, 001 \wedge 102 = 38^\circ 15'$$

$$ce, 001 \wedge 101 = 57^\circ 37'$$

$$cn, 001 \wedge 111 = 65^\circ 51'$$

$$uu', 102 \wedge 012 = 51^\circ 56'$$

$$ee', 101 \wedge 011 = 73^\circ 20'$$

$$nn', 111 \wedge \bar{1}\bar{1}1 = 80^\circ 22'$$

Crystals commonly square tabular, sometimes extremely thin; less frequently octahedral; also prismatic. Hemimorphism sometimes distinct. Also granularly massive, coarse or fine, firmly cohesive.

Cleavage:  $n$  (111) very smooth;  $c$ ,  $s$  (113) less distinct. Fracture subconchoidal. Brittle.  $H. = 2.75-3$ .  $G. = 6.7-7.0$ . Luster resinous or adamantine. Color wax- to orange-yellow, siskin- and olive-green, yellowish gray, grayish white to nearly colorless, brown; also orange to bright red. Streak white. Subtransparent to subtranslucent. Optically negative. Indices:  $\omega_r = 2.402$ ,  $\epsilon_r = 2.304$ .

Comp.—Lead molybdate, PbMoO<sub>4</sub> = Molybdenum trioxide 39.3, lead oxide 60.7 = 100. Calcium sometimes replaces the lead.

**Pyr., etc.**—B.B. decrepitates and fuses below 2. With salt of phosphorus in O.F. gives a yellowish-green glass, which in R.F. becomes dark green. With soda on charcoal yields metallic lead. Decomposed on evaporation with hydrochloric acid, with the formation of lead chloride and molybdic oxide; on moistening the residue with water and adding metallic zinc, it gives an intense blue color, which does not fade on dilution of the liquid.

**Obs.**—Occurs in veins with other ores of lead. At Bleiberg, Carinthia; Rezbánya, Hungary; Příbram; Moldava in the Banat; Annaberg, Schneeberg, etc.

In the U. States, sparingly at the Southampton lead mine, Mass., and near Sing Sing, N. Y.; near Phenixville, Pa.; at the Comstock lode in Nevada; in large thin orange-yellow tables at the Tecamah mine, Utah. In New Mexico, pale yellow crystals in the Organ Mts. In Arizona, large deep red crystals at the Hamburg and other mines, Yuma Co., often with red vanadinite; also at the Castle Dome district, 30 miles distant; at the Mammoth gold mine near Oracle, Pinal Co., with vanadinite and descloizite.

Named after the Austrian mineralogist Wulfen (1728-1805).

**Reinite.** Ferrous tungstate,  $\text{FeWO}_4$ . In blackish-brown tetragonal pyramids, perhaps pseudomorphous.  $H. = 4$ .  $G. = 6.64$ . Kimbosan, Japan.

**Belonesite.** Perhaps  $\text{MgMoO}_4$ . In minute acicular crystals at Vesuvius.

## VII. SALTS OF ORGANIC ACIDS.

### Oxalates, Mellates.

**Whewellite.** Calcium oxalate,  $\text{CaC}_2\text{O}_4 + \text{H}_2\text{O}$ . In small colorless monoclinic crystals. From Saxony, with coal.

**Oxammite.** Ammonium oxalate,  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + 2\text{H}_2\text{O}$ . From the guano of the Guañape Islands, Peru.

**Humboldtine.** Hydrous ferrous oxalate,  $2\text{FeC}_2\text{O}_4 + 3\text{H}_2\text{O}$ . Color yellow. From near Bilin, Bohemia.

**Mellite.** Hydrous aluminium mellate,  $\text{Al}_2\text{C}_{12}\text{O}_{12} + 18\text{H}_2\text{O}$ . In square pyramids; also massive, granular.  $G. = 1.55-1.65$ . Color honey-yellow. Occurs in brown coal in Thuringia, Bohemia, etc.

## VIII. HYDROCARBON COMPOUNDS.

The Hydrocarbon compounds in general, with few exceptions, are *not homogeneous substances*, but mixtures, which by the action of solvents or by fractional distillation may be separated into two or more component parts. They are hence not definite mineral species and do not strictly belong to pure Mineralogy, rather, with the recent gums and resins, to Chemistry or, so far as they are of practical value, to Economic Geology. In the following pages they are treated for the most part with great brevity.

### 1. Simple Hydrocarbons. Chiefly members of the Paraffin Series $\text{C}_n\text{H}_{2n+2}$ .

**SCHEEERERITE.** In whitish monoclinic crystals. Perhaps a polymer of marsh-gas ( $\text{CH}_4$ ). Found in brown coal at Uznach, Switzerland.

**HATCHETTITE.** Mountain Tallow. In thin plates, or massive. Like soft wax. Color yellowish. Ratio of C to H = nearly 1 : 1. From the Coal-measures near Merthyr-Tydvil in Glamorganshire, England.

**PARAFFIN.** A native crystallized paraffin has been described as occurring in cavities in basaltic lava near Paterno, Sicily.

**OZOCERITE.** Mineral wax pt. Like wax or spermaceti in appearance and consistency. Colorless to white when pure; often leek-green, yellowish, brownish yellow, brown. Essentially a paraffin, and consisting chiefly of one of the higher members of the series. Occurs in beds of coal, or associated bituminous deposits, as at Slanik, Moldavia; Boryslaw in the Carpathians. Also occurs in southern Utah on a large scale.

*Zietrisikite, Chrismatite, Urpethite* are near ozocerite.

**FICHELITE.** In white monoclinic tabular crystals. Perhaps  $\text{C}_8\text{H}_8$ . Occurs in thin layers of pine wood from peat-beds near Redwitz, in the Fichtelgebirge, Bavaria. *Hartite* has a similar occurrence.

**NAPALITE.** A yellow bituminous substance of the consistency of shoemaker's wax.  $\text{C}_8\text{H}_8$ . From the Phoenix mercury mine in Pope Valley, Napa county, California.

### 2. Oxygenated Hydrocarbons.

**AMBER.** Bernstein, *Germ.* In irregular masses, with conchoidal fracture.  $H. = 2-2.5$ .  $G. = 1.096$ . Luster resinous. Color yellow, sometimes reddish, brownish, and whitish, often clouded, sometimes fluorescent. Transparent to translucent. Heated to  $150^\circ$  begins to soften, and finally melts at  $250^\circ-300^\circ$ . Ratio for C, H, O = 40 : 64 : 4.

Part of the so-called amber is separated mineralogically as *succinite* (yielding succinic acid). Other related fossil resins from many other regions (e. g., the Atlantic coast of the United States) have been noted. Some of them have been called *retinite, gedanite, glessite, rumänite, simelite, krantzite, chemawinite*, etc.

Amber occurs abundantly on the Prussian coast of the Baltic from Dantzic to Memel; also on the coasts of Denmark, Sweden, and the Russian Baltic provinces. It is mined extensively, and is also found on the shores cast up by the waves after a heavy storm. Amber and the similar fossil resins are of vegetable origin, altered by fossilization; this is inferred both from its native situation with coal, or fossil wood, and from the occurrence of insects incased in it. Amber was early known to the ancients, and called *ἤλεκτρον, electrum*, whence, on account of its electrical susceptibilities, has been derived the word *electricity*.

**COPALITE,** or Highgate resin, is from the London blue clay. It is like the resin copal in hardness, color, luster, transparency, and difficult solubility in alcohol. Color clear pale yellow to dirty gray and dirty brown. Emits a resinous aromatic odor when broken.

The following are oxygenated hydrocarbons occurring with coal and peat deposits, etc.:

**BATHVILLITE.** Occurs in dull, brown, porous lumps in the torbanite or Boghead coal (of the Carboniferous formation) adjoining the lands of Torbane Hill, Bathville, Scotland.