

canary-yellow.  $H. = 2$ .  $G. > 3.3$ . Indices, 1.57-1.61. Infusible. Readily soluble in acids. From Gilpin Co., Col.

**Uranopilite.** Perhaps  $\text{CaU}_8\text{S}_2\text{O}_{31} \cdot 25\text{H}_2\text{O}$ . In velvety incrustations; yellow. From Johanngeorgenstadt, Germany.

*Zippeite*, *voglianite*, *uracnite* are uncertain uranium sulphates, from Joachimstal, Bohemia.

**Minasragrite.** An acid hydrous vanadyl sulphate  $(\text{V}_2\text{O}_5)_2(\text{SO}_4)_3 \cdot 15\text{H}_2\text{O}$ . 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,  $\text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 \cdot 9\text{H}_2\text{O}$ . In rhombic plates. Basal cleavage. Colorless. Occurs at Szomolnok, Hungary.

### Tellurates; also Tellurites, Selenites

**Montanite.**  $\text{Bi}_2\text{O}_3 \cdot \text{TeO}_3 \cdot 2\text{H}_2\text{O}$ . 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.

**Urdenite.** Hydrous ferric tellurite,  $\text{Fe}_2(\text{TeO}_3)_3 \cdot 4\text{H}_2\text{O}$ . In small mammillary forms; greenish yellow. Honduras.

**Chalcomenite.** Hydrous cupric selenite,  $\text{CuSeO}_3 \cdot 2\text{H}_2\text{O}$ . 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

<b>Wolframite</b>	$(\text{Fe}, \text{Mn})\text{WO}_4$	$a : b : c = 0.8300 : 1 : 0.8678$	$\beta = 89^\circ 22'$
<b>Hübnerite</b>	$\text{MnWO}_4$	$0.8362 : 1 : 0.8668$	$89^\circ 7\frac{1}{2}'$

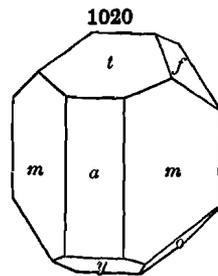
#### WOLFRAMITE.

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  $a$  (100) as comp.-face; (2) tw. pl.  $k$  (023), Fig. 449, p. 171. Crystals commonly tabular  $\parallel a$  (100); also prismatic. Faces in prismatic zone vertically striated. Often bladed, lamellar, coarse divergent columnar, granular.

Cleavage:  $b$  (010) very perfect; also parting  $\parallel a$  (100), 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. magnetic.  $\beta = 1.93$ .



Sometimes weakly

**Comp.** — Tungstate of iron and manganese (Fe,Mn)WO<sub>4</sub>. 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 Bohemia in fine crystals at Schlackenwald, Zinnwald, Bohemia; in Germany at Schneeberg, Freiberg, Altenberg, Neudorf; at Nerchinsk, Siberia; Chanteloup, near Limoges, France; near Redruth and elsewhere in Cornwall with tin ores. From Sardinia; Greenland; Central Provinces, India. In South America, at Oruro in Bolivia. With tin stone at various points in New South Wales.

In the United States at Lane's mine, Monroe, Conn.; Flowe mine, Mecklenburg Co., N. C., with scheelite; in Mo., near Mine la Motte; Laurence Co., S. D.; Boulder Co., Col.; Ariz.

**Use.** — An ore of tungsten.

**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.  $\beta = 2.24$ . Mammoth district, Nev.; Ouray County, Col., and near Silverton, San Juan Co.; Black Hills, S. D.; Dragoon, Ariz. Also in Peru, and in rhodochrosite at Adervielle in the Pyrenees.

**Scheelite Group.** Tetragonal-pyramidal

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

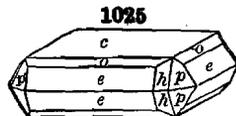
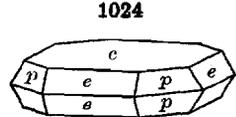
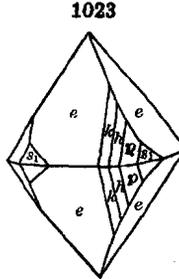
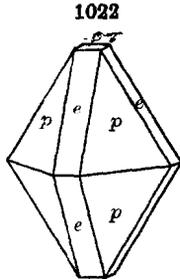
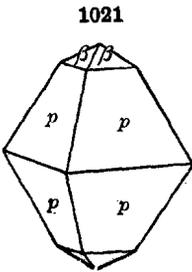
The SCHEELITE GROUP includes the tungstates and molybdates of calcium and lead; also copper. In crystallization they belong to the Pyramidal class of the Tetragonal System. Wulfenite is probably hemimorphic.

**SCHEELITE.**

Tetragonal-pyramidal. Axis  $c = 1.5356$ .

$ee'$ , 101  $\wedge$  011 = 72° 40½'.  
 $ce$ , 001  $\wedge$  101 = 56° 56'.

$pp'$ , 111  $\wedge$   $\bar{1}\bar{1}\bar{1}$  = 79° 55½'.  
 $cp$ , 001  $\wedge$  111 = 65° 16½'.



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

Twins: (1) tw. pl. *a* (100), both contact- and penetration-twins (Fig. 416, p. 167). Habit octahedral, also tabular. Symmetry shown by faces *k*, *h*, *s* (Fig. 1023). 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:  $\omega = 1.918$ .  $\epsilon = 1.934$ .

**Comp.** — Calcium tungstate,  $\text{CaWO}_4 = \text{Tungsten trioxide } 80.6, \text{ lime } 19.4 = 100$ .

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. The hydrochloric acid solution treated with tin and boiled assumes a blue color, later changing to brown.

**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, Germany; the Knappenwand in the Untersulzbachtal, Tyrol, Austria; Carrock Fells in Cumberland, England; Traversella in Piedmont, Italy; Meymac, Corrèze, France (containing  $\text{Ta}_2\text{O}_5$ ); Sweden; Pitkäranta in Finland. In New South Wales, at Adelong, from a gold mine; New Zealand, massive; Mt. Ramsay, Tasmania, with cassiterite. From Sonora, Mexico.

In the United States, at Lane's Mine, Monroe, and at Trumbull, Conn.; Flowe mine, Mecklenburg Co., N. C.; the Mammoth mining district, Nev.; with gold at the Charity mine, Warren's, Idaho; Lake Co., Col.; Atolia mining field, Cal.; White Pine Co., Nev.; Dragoon, Ariz. In quartz veins in Risborough and Marlow, Beauce county, Quebec.

**Use.** — Au ore of tungsten.

**Cuprotungstite.** Cupric tungstate,  $\text{CuWO}_4$ . From the copper mines of Llamuco, near Santiago, Chile. **CUPROSHEELITE**, from the vicinity of La Paz, Lower California, is  $(\text{Ca,Cu})\text{WO}_4$ , with 6.8 p. c.  $\text{CuO}$ ; color green. From Montoro, Spain; from Yeoral, New South Wales.

**Powellite.** Calcium molybdate with calcium tungstate (10 p. c.  $\text{WO}_3$ ),  $\text{Ca}(\text{Mo,W})\text{O}_4$ . In minute yellow tetragonal pyramids. *G.* = 4.349.  $\omega = 2.00$ . From western Idaho; Houghton Co., Mich.; from Llano Co., Texas, and Nye Co., Nev.

**Stolzite.** Lead tungstate,  $\text{PbWO}_4$ . In pyramidal tetragonal crystals. *H.* = 2.75–3. *G.* = 7.87–8.13. Color green to gray or brown. Optically –.  $\omega = 2.269$ . Zinnwald, Bohemia; Sardinia; Minas Geraes, Brazil; Broken Hill, New South Wales. From Loudville, Mass.

**Raspite.** Has the same composition as stolzite, but is referred to the monoclinic system. In small tabular crystals. Color brownish yellow. Index, 2.60. From the Broken Hill mines, New South Wales; Minas Geraes, Brazil.

**Chillagite.**  $3\text{PbWO}_4 \cdot \text{PbMoO}_4$ . In tabular tetragonal crystals, apparently hemimorphic. Color yellow to brownish. *H.* = 3.5. *G.* = 7.5. From Chillagoe, Queensland.

#### WULFENITE.

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

*cu*, 001  $\wedge$  102 = 38° 15'.

*ce*, 001  $\wedge$  101 = 57° 37'.

*cn*, 001  $\wedge$  111 = 65° 51'.

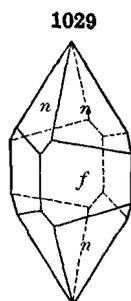
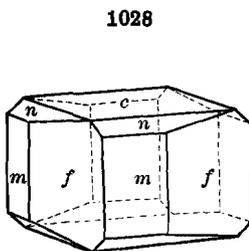
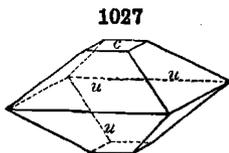
*uu'*, 102  $\wedge$  012 = 51° 56'.

*ee'*, 101  $\wedge$  011 = 73° 20'.

*nn'*, 111  $\wedge$  111 = 80° 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;  $c$  (001),  $s$  (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,  $PbMoO_4 =$  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; Pflibram, Austria; Moldawa in the Banat, Hungary; Annaberg, Schneeberg, Germany; Sardinia; Broken Hill, New South Wales.

In the United States, sparingly at the Southampton lead mine, and at Quincy, Mass., and near Sing Sing, N. Y.; near Phenixville, Pa.; at the Comstock lode and at Eureka in Nev.; in large thin orange-yellow tables at the Tecomah mine, Utah. In N. M., pale yellow crystals in the Organ Mts. In Ariz., 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).

**Use.** — An ore of molybdenum.

**Reinite.** Ferrous tungstate,  $FeWO_4$ . In blackish brown tetragonal pyramids, perhaps pseudomorphous.  $H. = 4$ .  $G. = 6.64$ . Kimbosan, Japan.

**Koehlinite.** A molybdate of bismuth,  $Bi_2O_3.MoO_3$ . Orthorhombic. In minute tabular crystals. Cleavage,  $a$  (100). Color, greenish yellow. Index, 2.55. Easily fusible. From Schneeberg, Saxony, Germany.

**Ferritungstite.**  $Fe_2O_3.WO_3.6H_2O$ . In microscopic hexagonal plates. Color pale yellow to brownish yellow. Decomposed by acids leaving yellow tungstic oxide. Product of oxidation of Wolframite from Germania Tungsten mine. Deer Trail district, Wash.

## VII. SALTS OF ORGANIC ACIDS

### Oxalates, Mellates

**Whewellite.** Calcium oxalate,  $CaC_2O_4.H_2O$ . In small colorless monoclinic crystals. Optically +.  $\beta = 1.555$ . From Saxony, with coal; also from Bohemia and Alsace.

**Oxammite.** Ammonium oxalate,  $(NH_4)_2C_2O_4.2H_2O$ . From the guano of the Guafiapu Islands, Peru.