solution yield an abundant precipitate of silver chloride. In the open tube gives a white sublimate of tellurium dioxide which near the assay is gray; when treated with the blowpipe flame the sublimate fuses to clear transparent drops. B.B. on charcoal fuses to a dark gray globule, covering the coal with a white coating, which treated in R.F. disappears, giving a bluish green color to the flame; after long blowing a yellow, malleable metallic globule is obtained.

Obs. — With gold, at Offenbánya, Transylvania; also at Nagyág. With calaverite at Kalgoorlie district, West Australia. In Cal., Calaveras Co., at the Melones and Stanislaus mines. In Boulder Co., at Cripple Creek and elsewhere in Col. Named from Transylvania, where first found, and in allusion to *sylvanium*, one of the names at first proposed for the metal tellurium.

Use. — An ore of gold

Krennerite. A telluride of gold and silver $(Au,Ag)Te_2$ like sylvanite. In prismatic crystals (orthorhombic), vertically striated. G. = 8·353. Color silver-white to brass-yellow. From Nagyág, Transylvania; Cripple Creek, Col.

Calaverite. A gold telluride, $AuTe_2$ with small amounts of silver. Monoclinic. In small lath-shaped crystals striated parallel to their length. Massive granular to crystalline. H. = 2·5. G. = 9·043. Color silver-white with often a faint yellow tinge. Tests similar to those for sylvanite with smaller amount of silver showing. Occurs with petzite at the Stanislaus mine, Calaveras county, Cal. An important gold ore at the Cripple Creek district, Col. Found elsewhere in that state. Occurs abundantly at Kalgoorlie, West Australia.

Muthmannite. (Ag,Au)Te. In tabular crystals usually elongated in one direction. One perfect cleavage parallel to elongation. H. = 2·5. Color bright brass-yellow, on fresh fracture gray-white. Probably from Nagyág, Transylvania. *Empressite*, AgTe, from the Empress-Josephine mine, in the Kerber Creek District, Col., is probably a gold-free variety. Massive. H. = 3–3·5. G. = 7·5. Color pale bronze.

Nagyagite. A sulpho-telluride of lead and gold; some analyses show also about 7 p. c. of antimony which was probably due to impurities. Orthorhombic. Crystals tabular ‖ $b(010)$; also granular massive, foliated. Cleavage: b perfect; flexible. H. = 1–1·5. G. = 6·85–7·2. Luster metallic, splendent. Streak and color blackish lead-gray. Opaque. From Nagyág, Transylvania; and at Offenbánya. Reported from Colorado and Tararu Creek, New Zealand.

Oxysulphides

Here are included Kermesite, Sb_2S_2O, and Voltzite, Zn_5S_4O.

Kermesite. Pyrostibite. Antimony oxysulphide, Sb_2S_2O or $2Sb_2S_3.Sb_2O_3$. Monoclinic. Usually in tufts of capillary crystals. Cleavage: $a(100)$ perfect. H. = 1–1·5. G. = 4·5–4·6. Luster adamantine. Color cherry-red.

Results from the alteration of stibnite. Occurs at Malaczka, Hungary; Bräunsdorf, Saxony; Allemont, Dauphiné, France. At South Ham, Wolfe Co., Quebec, Canada; with native antimony and stibnite at the Prince William mine, York Co., New Brunswick.

Named from *kermes*, a name given (from the Persian *qurmizq*, crimson) in the older chemistry to red amorphous antimony trisulphide, often mixed with antimony trioxide.

Voltzite. Zinc oxysulphide, Zn_5S_4O or $4ZnS.ZnO$. In implanted spherical globules. H. = 4–4·5. G. = 3·66–3·80. Color dirty rose-red, yellowish. Occurs near Pontgibaud, Puy-de-Dôme, France; Joachimstal, Bohemia; Marienberg, Saxony, Germany.

III. SULPHO-SALTS

I. Sulpharsenites, Sulphantimonites, Sulphobismuthites.

II. Sulpharsenates, Sulphostannates, etc.

I. Sulpharsenites, Sulphantimonites, etc.

In these sulpho-salts, as further explained on p. 320, sulphur takes the place of the oxygen in the commoner and better understood oxygen acids (as carbonic acid, H_2CO_3, sulphuric acid, H_4SO_4, phosphoric acid, H_3PO_4, etc.).

The species included are salts of the sulpho-acids of trivalent *arsenic*, *antimony* and *bismuth*. The most important acids are the ortho-acids,

H_3AsS_3, etc., and the meta-acids, H_2AsS_2, etc.; but $H_4As_2S_5$, etc., and a series of others are included. The metals present as bases are chiefly *copper, silver, lead;* also *zinc, mercury, iron,* rarely others (as *nickel, cobalt*) in small amount. In view of the hypothetical character of many of the acids whose salts are here represented, there is a certain advantage, for the sake of comparison, in writing the composition after the dualistic method, $RS.As_2S_3$, $2RS.As_2S_3$, etc.

As a large part of the species here included are rare and hence to be mentioned but briefly, the classification can be only partially developed. The divisions under the first and more important section of sulpharsenites, etc., with the prominent species under each, are as follows:

A. Acidic Division. $RS : (As,Sb,Bi)_2S_3 = 1 : 3,\ 1 : 2,\ 2 : 3,\ 3 : 4,\ 4 : 5.$

B. Meta- Division. $RS : (As,Sb,Bi)_2S_3 = 1 : 1.$

General formula: $RAs_2S_4, RSb_2S_4, RBi_2S_4.$

Zinkenite Group

Zinkenite	$PbS.Sb_2S_3$	**Emplectite**	$Cu_2S.Bi_2S_3$
Sartorite	$PbS.As_2S_3$	**Chalcostibite**	$Cu_2S.Sb_2S_3$, etc.
Also			
Miargyrite	$Ag_2S.Sb_2S_3$	**Lorandite**	$Tl_2S.As_2S_3$

C. Intermediate Division. $RS : (As,Sb,Bi)_2S_3 = 5 : 4,\ 3 : 2,\ 2 : 1,\ 5 : 2$

Here belong

Plagionite	$5PbS.4Sb_2S_3$.		
Schirmerite	$3(Ag_2,Pb)S.2Bi_2S_3$	**Klaprotholite**	$3Cu_2S.2Bi_2S_3$, etc.

Jamesonite Group

Jamesonite	$2PbS.Sb_2S_3$	**Cosalite**	$2PbS.Bi_2S_3$, etc.
Dufrenoysite	$2PbS.As_2S_3$		
Also **Freieslebenite**	$5(Ag_2,Pb)S.2Sb_2S_3$	**Boulangerite**	$5PbS.2Sb_2S_3$

D. Ortho- Division. $RS : (As,Sb,Bi)_2S_3 = 3 : 1$

General formula: $\overset{I}{R}_3AsS_3, \overset{I}{R}_3SbS_3;\ \overset{II}{R}_3As_2S_6, \overset{II}{R}_3Sb_2S_6$, etc.

Bournonite Group

Bournonite	$3(Cu_2,Pb)S.Sb_2S_3$	**Wittichenite**	$3Cu_2S.Bi_2S_3$
Seligmannite	$3(Cu_2,Pb)S.As_2S_3$	**Lillianite**	$3PbS.Bi_2S_3$, etc.
Aikinite	$3(Pb,Cu_2)S.Bi_2S_3$		

Pyrargyrite Group

Pyrargyrite	$3Ag_2S.Sb_2S_3$	**Proustite**	$3Ag_2S.As_2S_3$

E. Basic Division. $RS : (As,Sb,Bi)_2S_3 = 4 : 1,\ 5 : 1,\ 6 : 1,\ 9 : 1,\ 12 : 1$

Tetrahedrite Group

Tetrahedrite	$4Cu_2S.Sb_2S_3$	**Tennantite**	$4Cu_2S.As_2S_3$

Jordanite Group

Jordanite	$4PbS.As_2S_3$	**Meneghinite**	$4PbS.Sb_2S_3$
Also			
Geocronite	$5PbS.Sb_2S_3$	**Stephanite**	$5Ag_2S.Sb_2S_3$
Kilbrickenite	$6PbS.Sb_2S_3$	**Beegerite**	$6PbS.Bi_2S_3$

Polybasite Group

Polybasite	$9Ag_2S.Sb_2S_3$	**Pearceite**	$9Ag_2S.As_2S_3$
Polyargyrite	$12Ag_2S.Sb_2S_3$		

A. Acidic Division

Eichbergite. $(Cu,Fe)_2S.3(Bi,Sb)_2S_3$. Color iron-gray. H. > 6. G. = 5·36. From Eichberg, Semmering district, Austria.

Livingstonite. $HgS.2Sb_2S_3$. Resembles stibnite in form. Color lead-gray; streak red. H. = 2. G. = 4·81. From Huitzuco, Mexico.

Histrixite. $5CuFeS_2.2Sb_2S_3.7Bi_2S_3$. Orthorhombic. In radiating groups of prismatic crystals. H. = 2. Color and streak steel-gray. Found at Ringville, Tasmania.

Chiviatite. $2PbS.3Bi_2S_3$. Foliated massive. Color lead-gray. From Chiviato, Peru.

Cuprobismutite. Probably $3Cu_2S.4Bi_2S_3$, in part argentiferous. Resembles bismuthinite. G. = 6·3–6·7. From Hall valley, Park Co., Col.

Rezbanyite. $4PbS.5Bi_2S_3$. Fine-granular, massive. Color lead-gray. G. = 6·1–6·4. From Rezbanya, Hungary.

B. Meta- Division. $RS.As_2S_3$, $RS.Sb_2S_3$, etc.

Zinkenite Group. Orthorhombic

ZINKENITE. Zinckenite.

Orthorhombic. Axes $a : b : c = 0·5575 : 1 : 0·6353$. Crystals seldom distinct; sometimes in nearly hexagonal forms through twinning. Lateral faces longitudinally striated. Also columnar, fibrous, massive.

Cleavage not distinct. Fracture slightly uneven. H. = 3–3·5. G. = 5·30–5·35. Luster metallic. Color and streak steel-gray. Opaque.

Comp. — $PbSb_2S_4$ or $PbS.Sb_2S_3$ = Sulphur 22·3, antimony 41·8, lead 35·9 = 100. Arsenic sometimes replaces part of the antimony.

Pyr., etc. — Decrepitates and fuses very easily; in the closed tube gives a faint sublimate of sulphur, and antimony trisulphide. In the open tube sulphurous fumes and a white sublimate of oxide of antimony; the arsenical variety gives also arsenical fumes. On charcoal is almost entirely volatilized, giving a coating which on the outer edge is white, and near the assay dark yellow; with soda in R.F. yields globules of lead. Soluble in hot hydrochloric acid with evolution of hydrogen sulphide and separation of lead chloride on cooling.

Obs. — Occurs at Wolfsberg in the Harz Mts.; Kinzigtal, Baden; Val Sugana, Tyrol; Oruro, Bolivia; Sevier County, Ark.; San Juan Co., Col.

Andorite. $Ag_2S.2PbS.3Sb_2S_3$. In prismatic, orthorhombic crystals. H. = 3–3·5. G. = 5·5. Color dark gray to black. From Felsöbánya, Hungary; Oruro, Bolivia. *Webnerite* and *Sundtite* are identical with andorite.

Sartorite. $PbS.As_2S_3$. In slender, striated crystals, probably monoclinic. G. = 5·4. Color dark lead-gray. Occurs in the dolomite of the Binnental.

Platynite. $PbS.Bi_2Se_3$. Rhombohedral. Basal and rhombohedral cleavages. H. = 2–3. G. = 7·98. Color like graphite. Streak shining. In small lamellæ in quartz at Falun, Sweden.

Emplectite. $Cu_2S.Bi_2S_3$. In thin striated prisms. G. = 6·3–6·5. Color grayish white to tin-white. Occurs in quartz at Schwarzenberg and Annaberg, Saxony.

Chalcostibite. Wolfsbergite. $Cu_2S.Sb_2S_3$. In small aggregated prisms; also fine granular, massive. G. = 4·75–5·0. Color between lead-gray and iron-gray. From Wolfsberg in the Harz Mts.; from Huanchaca, Bolivia. *Guejarite* from Spain is the same species.

Galenobismutite. $PbS.Bi_2S_3$; also with Ag,Cu. Crystalline columnar to compact. Color lead-gray to tin-white. G. = 6·9. From Nordmark, Sweden; Poughkeepsie Gulch, Col. (*alaskaite*, argentiferous); material from Falun, Sweden, containing selenium has been named *weibullite* and given the formula, $2PbS.Bi_4S_3Se_3$.

Berthierite. $FeS.Sb_2S_3$. Fibrous massive, granular. G. = 4·0. Color dark steel-gray. From Chazelles and Martouret, Auvergne, France; Charbes, Val de Villé, Alsace; Bräunsdorf, Saxony, etc.

Matildite. $Ag_2S.Bi_2S_3$. In slender, prismatic crystals. G. = 6·9. Color gray. From Morochoca, Peru; Lake City, Col. PLENARGYRITE, from Schapbach, Baden, similar in composition, has been shown to be a mixture.

Miargyrite. $Ag_2S.Sb_2S_3$. In complex monoclinic crystals, also massive. H. = 2–2·5. G. = 5·1–5·30. Luster metallic-adamantine. Color iron-black to steel-gray, in thin splinters deep blood-red. Streak cherry-red. From Bräunsdorf, Saxony; Felsöbánya and Nagybánya, Hungary; Přibram, Bohemia; Zacatecas, Mexico; Bolivia.

Smithite. $Ag_2S.Sb_2S_3$. Monoclinic. Crystals resemble a flattened hexagonal pyramid. One perfect cleavage. H. = 1·5–2. G. = 4·9. Color light red changing to orange-red on exposure to light. Streak vermilion. From the Binnental, Switzerland.

Trechmanite. $Ag_2S.As_2S_3$. Rhombohedral, tetartohedral. Crystals minute with prismatic habit. Good rhombohedral cleavage. H. = 1·5–2. Color and streak scarlet-vermilion. From the Binnental, Switzerland.

Lorandite. A sulpharsenide of thallium, $TlAsS_2$. Monoclinic. Color cochineal-red. From Allchar, Macedonia; Rambler mine, Encampment, Wy.

Vrbaite. $TlAs_2SbS_5$. Orthorhombic. H. = 3·5. G. = 5·3. Color gray-black to dark red in thin splinters. Streak light red. From Allchar, Macedonia.

Hutchinsonite. $(Tl,Ag,Cu)_2S.As_2S_3+PbS.As_2S_3$(?). Orthorhombic. In flattened rhombic prisms. Cleavage $a(100)$ good. H. = 1·5–2. G. = 4·6. Color scarlet to red. From the Binnental, Switzerland.

C. Intermediate Division

Baumhauerite. $4PbS.3As_2S_3$. Monoclinic. In complex crystals with varied habit. One perfect cleavage. H. = 3. G. = 3·3. Metallic. Color lead to steel-gray. From the Binnental, Switzerland.

Schirmerite. $3(Ag_2,Pb)S.2Bi_2S_3$. Massive, granular. G. = 6·74. Color lead-gray. Treasury lode, Park Co., Col.

KLAPROTHOLITE. $3Cu_2S.Bi_2S_3$. In furrowed prismatic crystals. G. = 4·6. Color steel-gray. Wittichen, Baden. Probably a mixture and not a definite species.

Rathite. $3PbS.2As_2S_3$. Orthorhombic, in prismatic crystals. Cleavage, $b(010)$. H. = 3. G. = 5·41. From the Binnental, Switzerland. *Wiltshireite* is the same species.

Jamesonite Group. $2RS.As_2S_3$, $2RS.Sb_2S_3$, etc. Monoclinic

JAMESONITE.

Monoclinic. Axes: $a : b : c = 0{\cdot}8316 : 1 : 0{\cdot}4260$. $\beta = 88° 36'$. mm''' $110 \wedge 1\bar{1}0 = 79° 28'$. In acicular crystals; common in capillary forms; also fibrous massive, parallel or divergent; compact massive.

Cleavage: basal, perfect. Fracture uneven to conchoidal. Brittle. H. = 2–3. G. = 5·5–6·0. Luster metallic. Color steel-gray to dark lead-gray. Streak grayish black. Opaque.

Comp. — $Pb_2Sb_2S_5$ or $2PbS.Sb_2S_3$ = Sulphur 19·7, antimony 29·5, lead

50·8 = 100. Most varieties show a little iron (1 to 3 p. c.), and some contain also silver, copper, and zinc.

It has been suggested that the iron shown by the analyses is an integral part of the mineral and that the formula should be $4PbS.FeS.3Sb_2S_3$ and that the usual jamesonite formula, $2PbS.Sb_2S_3$, belongs to the material commonly called *plumosite*.

Pyr. — Same as for zinkenite, p. 385.

Obs. — Occurs principally in Cornwall; also in Siberia; Hungary; at Valentia d'Alcantara in Spain; at the antimony mines in Sevier Co., Ark.; from Bolivia. Named after Prof. Robert Jameson of Edinburgh (1774–1854).

The *feather ore* occurs at Wolfsberg, etc., in the Harz Mts.; Freiberg, Germany; Schemnitz, Hungary; in Tuscany, near Bottino, Italy. These so-called feather ores may be divided into flexible and brittle, all the latter being referred to jamesonite and the former to either zinkenite, plumosite, boulangerite, or meneghinite.

Warrenite has been shown to probably be a mixture of jamesonite and zinkenite.

Dufrenoysite. $2PbS.As_2S_3$. In highly modified crystals; also massive. Cleavage: *b*(010) perfect. H. = 3. G. = 5·55–5·57. Color blackish lead-gray. From the Binnental, Switzerland, in dolomite.

Cosalite. $2PbS.Bi_2S_3$. Usually massive, fibrous or radiated. G. = 6·39–6·75. Color lead- or steel-gray. Cosala, Province of Sinaloa, Mexico; Bjelke mine (*bjelkite*), Nordmark, Sweden; Deer Park, Wash.; Col.

Kobellite. $2PbS.(Bi,Sb)_2S_3$. Fibrous radiated or granular massive. G. = 6·3. Color lead-gray to steel-gray. From Hvena, Sweden; Ouray, Col.

BRONGNIARDITE. Lead, silver, antimony sulphide. Shown in some cases to be a mixture. A doubtful species.

Plagionite. Heteromorphite. Semseyite. Lead, antimony sulphides ranging from $5PbS_4.Sb_2S_3$ to $9PbS.4Sb_2S_3$. Perhaps a morphotropic series with the vertical crystallographic axis increasing in length with increase in the percentage of lead. Monoclinic. G. = 5·4–5·9. Plagionite from Wolfsberg, Harz Mts.; heteromorphite from Arnsberg, Westphalia; semseyite from Felsöbánya, Hungary and Wolfsberg. *Liveingite* from the Binnental, Switzerland, is said to have the same composition as plagionite. *Bismutoplagionite*, a variety containing bismuth instead of antimony. From Wickes, Jefferson Co., Mon.

SCHAPBACHITE. A lead, silver, bismuth sulphide. From Schapbach, Baden. Shown to be a mixture.

FREIESLEBENITE.

Monoclinic. Axes $a : b : c = 0·5871 : 1 : 0·9277$; $\beta = 87° 46'$. Habit prismatic. G. = 6·2–6·4. Luster metallic. Color and streak light steel-gray inclining to silver-white, also to blackish lead-gray.

Comp. — $(Pb,Ag_2)_5Sb_4S_{11}$ or $5(Pb,Ag_2)S.2Sb_2S_3$.

Obs. — From Freiberg, Saxony; Kapnik and Felsöbánya, Hungary; Hiendelencina, Spain; also from the Augusta Mt., Gunnison Co., Col.

Diaphorite. Like freieslebenite in composition but orthorhombic in form. G. = 5·9. From Přibram, Bohemia; Lake Chelan district, Wash.

BOULANGERITE.

Orthorhombic. Axes $a : b : c = 0·5527 : 1 : 0·7478$. In prismatic or tabular crystals or crystalline plumose masses; granular, compact. H. = 2·5–3. G. = 6·18. Luster metallic. Color bluish lead-gray; often covered with yellow spots from oxidation. Opaque.

Comp. — $Pb_5Sb_4S_{11}$ or $5PbS.2Sb_2S_3$ = Sulphur 18·9, antimony 25·7, lead 55·4 = 100.

Pyr. — Same as for zinkenite, p. 385.

Obs. — In good crystals from Sala, Sweden; Molières, Depart. du Gard, France; at Nerchinsk, Siberia; Wolfsberg in the Harz Mts. Přibram, Bohemia; near Bottino, Tuscany, Italy. Echo District, Union county, Nev.

Embrithite and *plumbostib* are from Nerchinsk; they correspond nearly to $10PbS.3Sb_2S_3$, but the material analyzed may not have been quite pure.

Mullanite. $5PbS.2Sb_2S_3$. In slender orthorhombic (?) prisms. Cleavage, $c(001)$ and $b(010)$. Color, steel-gray. Streak, brownish black. H. = 3·5. G = 6·35. Found at Gold Hunter mine, near Mullan, Idaho, and at Iron Mountain mine, near Superior, Mon.

D. Ortho- Division. $3RS.As_2S_3$, $3RS.Sb_2S_3$, etc.

Bournonite Group. Orthorhombic. Prismatic angle 86° to 87°

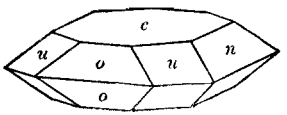
BOURNONITE. Wheel Ore.

Orthorhombic. Axes: $a : b : c = 0{\cdot}9380 : 1 : 0{\cdot}8969$.

mm''', $110 \wedge 1\bar{1}0 = 86° 20'$ cn, $001 \wedge 011 = 41° 53'$

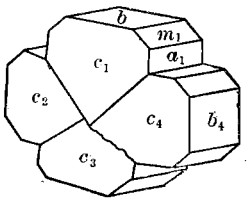
co, $001 \wedge 101 = 43° 43'$ cu, $001 \wedge 112 = 33° 15'$

668



Harz

669



Kapnik

Twins: tw. pl. $m(110)$, often repeated, forming cruciform and wheel shaped crystals. Also massive; granular, compact.

Cleavage: $b(010)$ imperfect; $a(100)$, $c(001)$ less distinct. Fracture subconchoidal to uneven. Rather brittle. H. = 2·5–3. G. = 5·7–5·9. Luster metallic, brilliant. Color and streak steel-gray, inclining to blackish lead-gray or iron-black. Opaque.

Comp. — $(Pb,Cu_2)_3Sb_2S_6$ or $3(Pb,Cu_2)S.Sb_2S_3 = PbCuSbS_3$ (if Pb : Cu_2 = 2 : 1) = Sulphur 19·8, antimony 24·7, lead 42·5, copper 13·0 = 100.

Pyr., etc. — In the closed tube decrepitates, and gives a dark red sublimate. In the open tube gives sulphur dioxide, and a white sublimate of oxide of antimony. B.B. on charcoal fuses easily, and at first coats the coal white; continued blowing gives a yellow coating of lead oxide; the residue, treated with soda in R.F., gives a globule of copper. Decomposed by nitric acid, affording a blue solution, and leaving a residue of sulphur, and a white powder containing antimony and lead.

Obs. — From Neudorf in the Harz Mts.; also Wolfsberg, Claustal, and Andreasberg; Pribram, Bohemia; Kapnik and Nagybánya, Hungary; Horhausen, Prussia; Liskeard, Cornwall.

In the United States at the Boggs mine, Yavapai Co., Ariz.; also Montgomery Co., Ark.; reported from San Juan Co., Col; Austin, Nev. In Canada, in the township of Marmora, Hastings Co., and Darling, Lanark Co., Ontario.

Seligmannite. $(Pb,Cu_2)_3As_2S_6$ isomorphous with bournonite. Orthorhombic. $a : b : c$ = 0·9233 : 1 : 0·8734. In small complex crystals. Commonly twinned with $m(110)$ as tw. pl. Color lead-gray. Chocolate streak. H. = 3. Found at Lengenbach quarry, Binnental, Switzerland; reported from Emery, Mon.

Aikinite. $2PbS.Cu_2S.Bi_2S_3$. Acicular crystals; also massive. G. = 6·1–6·8. Color blackish lead-gray. From Berezov near Ekaterinburg, Ural Mts.

Wittichenite. $3Cu_2S.Bi_2S_3$. Rarely in crystals resembling bournonite; also massive. G. = 4·5. Color steel-gray or tin-white. Wittichen, Baden, etc.

Stylotypite. $3(Cu_2,Ag_2,Fe)S.Sb_2S_3$. In orthorhombic crystals, in cruciform twins like bournonite. G. = 4·7–5·2. Color iron-black. Copiapo, Chile; Peru.

Lillianite. $3PbS.BiSbS_3$ and $3PbS.Bi_2S_3$. Orthorhombic. Crystalline and massive. Color steel-gray. Gladhammar, Sweden; Leadville, Col. (argentiferous).

Guitermanite. Perhaps $3PbS.As_2S_3$. Massive, compact. G. = 5·94. Color bluish gray. Zuñi mine, Silverton, Col.

Lengenbachite. $7[Pb,(Ag,Cu)_2]S.2As_2S_3$. Probably triclinic. In thin blade-shaped crystals. One perfect cleavage. Soft. G. = 5·8. Color steel-gray. Streak black. From the Lengenbach quarry, Binnental, Switzerland.

TAPALPITE. A sulpho-telluride of bismuth and silver, perhaps $3Ag_2(S,Te).Bi_2(S,Te)_3$. Study of polished specimen shows it to be a mixture of unknown components. Massive, granular. G. = 7·80. Sierra de Tapalpa, Jalisco, Mexico.

Pyrargyrite Group. Rhombohedral-hemimorphic

PYRARGYRITE. Ruby Silver Ore. Dark Red Silver Ore.

Rhombohedral-hemimorphic. Axis: $c = 0{\cdot}7892$; $0001 \wedge 1011 = 42° 20\frac{1}{2}'$.

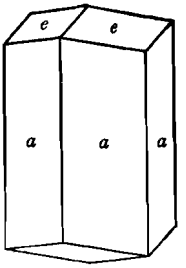
ee', $01\bar{1}2 \wedge \bar{1}012 = 42° 5'$ $\quad vv'$, $21\bar{3}1 \wedge \bar{2}3\bar{1}1 = 74° 25'$

rr', $10\bar{1}1 \wedge \bar{1}101 = 71° 22'$ $\quad vv^v$, $21\bar{3}1 \wedge 3\bar{1}\bar{2}1 = 35° 12'$

Crystals commonly prismatic. Twins: tw. pl. $a(11\bar{2}0)$, very common, the c axes parallel; $u(10\bar{1}4)$, also common. Also massive, compact.

Cleavage: $r(10\bar{1}1)$ distinct; $e(01\bar{1}2)$ imperfect. Fracture conchoidal to uneven. Brittle. H. = 2·5. G. = 5·77–5·86; 5·85 if pure. Luster metallic-adamantine. Color black to grayish black, by transmitted light deep red. Streak purplish red. Nearly opaque, but transparent in very thin splinters. Optically − . Refractive indices, $\omega = 3{\cdot}084$, $\epsilon = 2{\cdot}881$.

670



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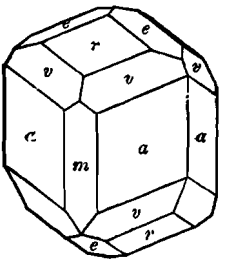


Comp. — Ag_3SbS_3 or $3Ag_2S.Sb_2S_3$ = Sulphur 17·8, antimony 22·3, silver 59·9 = 100. Some varieties contain small amounts of arsenic.

Pyr., etc. — In the closed tube fuses and gives a reddish sublimate of antimony oxysulphide; in the open tube sulphurous fumes and a white sublimate of oxide of antimony. B.B. on charcoal fuses with spirting to a globule, coats the coal white, and the assay is converted into silver sulphide, which, treated in O.F., or with soda in R.F., gives a globule of silver. In case arsenic is present it may be detected by fusing the pulverized mineral with soda on charcoal in R.F. Decomposed by nitric acid with the separation of sulphur and of antimony trioxide.

Obs. — Occurs at Andreasberg in the Harz Mts.; Freiberg, Saxony; Přibram and Joachimstal, Bohemia; Schemnitz and Nagybánya, Hungary; Kongsberg, Norway; Gaudalcanal, Spain; in Cornwall. In Mexico it is worked at Guanajuato and elsewhere as an ore of silver. In Chile with proustite at Chañarcillo near Copiapo.

In Col., not uncommon; thus in Ruby district, Gunnison Co.; with sphalerite in Sneffle's district, Ouray Co., etc. In Nev., at Washoe in Daney Mine; about Austin, Reese river; at Poorman lode, Idaho, in masses with cerargyrite. In N. M., Utah, and Ariz. with silver ores at various points. At Cobalt, Ontario.

Named from πῦρ, *fire*, and ἄργυρος, *silver*, in allusion to the color.

PROUSTITE. Ruby Silver Ore. Light Red Silver Ore.

Rhombohedral-hemimorphic. Axis $c = 0{\cdot}8039$; $0001 \wedge 10\bar{1}1 = 42° 52'$.

ee', $01\bar{1}2 \wedge \bar{1}012 = 42° 46'$ $\quad vv'$, $21\bar{3}1 \wedge 23\bar{1}1 = 74° 39'$

rr', $10\bar{1}1 \wedge \bar{1}101 = 72° 12'$ $\quad vv^v$, $21\bar{3}1 \wedge 3\bar{1}\bar{2}1 = 35° 18'$

Crystals often acute rhombohedral or scalenohedral. Twins: tw. pl. $u(10\bar{1}4)$ and $r(10\bar{1}1)$. Also massive, compact.

Cleavage: $r(10\bar{1}1)$ distinct. Fracture conchoidal to uneven. Brittle. H. = 2–2·5. G. = 5·57–5·64; 5·57 if pure. Luster admantine. Color scarlet-vermilion; streak same, also inclined to aurora-red. Transparent to translucent. Optically negative. $\omega = 3{\cdot}084$. $\epsilon = 2{\cdot}881$.

Comp. — Ag_3AsS_3 or $3Ag_2S.As_2S_3$ = Sulphur 19·4, arsenic 15·2, silver 65·4 = 100.

Pyr., etc. — In the closed tube fuses easily, and gives a faint sublimate of arsenic trisulphide; in the open tube sulphurous fumes and a white crystalline sublimate of arsenic

trioxide. B.B. on charcoal fuses and emits odors of sulphur and arsenic; with soda in R.F. gives a globule of silver. Decomposed by nitric acid, with separation of sulphur.

Obs. — Occurs at Freiberg, Johanngeorgenstadt, etc., in Saxony; Joachimstal, Bohemia; in France at Chalanches in Dauphiné and Markirch, Alsace; Guadalcanal in Spain; Sarrabus, Sardinia; in Mexico; Peru; Chile, at Chañarcillo in magnificent crystallizations.

In Col., Ruby distr., Gunnison Co.; Sheridan mine, San Miguel Co.; Yankee Girl mine, Ouray Co.; Montezuma, Summit Co. In Ariz., with silver ores at various points. In Nev., in the Daney mine, and in Comstock lode, rare; Idaho, at the Poorman lode.

Named after the French chemist, J. L. Proust (1755–1826).

Sanguinite. Near proustite in composition. In glittering scales, hexagonal or rhombohedral. From Chañarcillo, Chile.

FALKENHAYNITE. Perhaps $3Cu_2S.Sb_2S_3$. Massive, resembling galena. From Joachimstal, Bohemia. Perhaps identical with stylotypite.

Pyrostilpnite. Like pyrargyrite, $3Ag_2S.Sb_2S_3$. In tufts of slender (monoclinic) crystals. G. = 4·25. Color hyacinth-red. From Andreasberg in the Harz Mts.; Freiberg, Saxony; Přibram, Bohemia; Heazlewood, Tasmania.

Samsonite. $2Ag_2S.MnS.Sb_2S_3$. Monoclinic. Habit prismatic. Color, steel-black, red in transmitted light. Occurs in Samson vein of Andreasberg silver mines, Harz Mts., Germany.

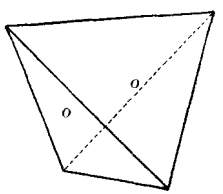
E. Basic Division

Tetrahedrite Group. Isometric-tetrahedral

TETRAHEDRITE. Gray Copper Ore. Fahlerz.

Isometric-tetrahedral. Habit tetrahedral. Twins: tw. pl. *o*(111); also with parallel axes (Fig. 392, p. 163, Fig. 408, p. 166). Also massive; granular, coarse or fine; compact.

672



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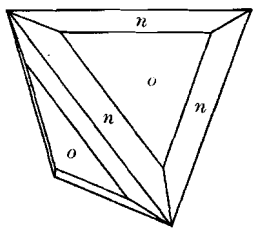

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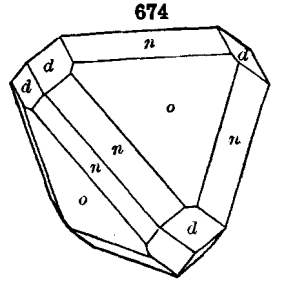


Cleavage none. Fracture subconchoidal to uneven. Rather brittle. H. = 3–4. G. = 4·4–5·1. Luster metallic, often splendent. Color between flint-gray and iron-black. Streak like color, sometimes inclining to brown and cherry-red. Opaque; sometimes subtranslucent (cherry-red) in very thin splinters.

Comp. — Essentially $Cu_8Sb_2S_7$ or $4Cu_2S.Sb_2S_3$ = Sulphur 23·1, antimony 24·8, copper 52·1 = 100.

Antimony and arsenic are usually both present and thus tetrahedrite graduates into the allied species tennantite. There are also varieties containing bismuth, chiefly at the arsenical end of the series, rarely selenium. Further the copper may be replaced by iron, zinc, silver, mercury, lead, manganese, and rarely cobalt and nickel.

Var. — *Ordinary.* Contains little or no silver. Color steel-gray to dark gray and iron-black. G. = 4·75–4·9.

Argentiferous; Freibergite. Contains 3 to 30 p. c. of silver. Color usually steel-gray, lighter than the ordinary varieties; sometimes iron-black; streak often reddish. G. = 4·85–5·0.

Mercurial; Schwatzite. Contains 6 to 17 p. c. of mercury. Color dark gray to iron-black. Luster often dull. G. = 5·10 chiefly.

Malinowskite, from Peru and a similar variety from Arizona, contain 13–16 p. c. of lead.

Pyr., etc. — Differ in the different varieties. In the closed tube all the antimonial kinds fuse and give a dark red sublimate of antimony oxysulphide; if much arsenic is present, a sublimate of arsenic trisulphide first forms. In the open tube fuses, gives sulphurous fumes and a white sublimate of antimony oxide; if arsenic is present, a crystalline volatile sublimate condenses with the antimony; if the ore contains mercury it condenses in minute metallic globules. B.B. on charcoal fuses, gives a coating of the oxides of antimony and sometimes arsenic, zinc, and lead; arsenic is detected by the odor when the coating is treated in R.F. The roasted mineral gives with the fluxes reactions for iron and copper; with soda yields a globule of metallic copper. Decomposed by nitric acid, with separation of sulphur and antimony trioxide.

Diff. — Distinguished by its form, when crystallized, by its deep black color on fracture and brilliant metallic luster. It is harder than bournonite and much softer than magnetite; the blowpipe characters are usually distinctive.

Micro. — In polished sections shows a grayish white color with a smooth surface. Fumes from HNO_3 tarnish mineral slowly to a light brown. With aqua regia slowly effervesces leaving a coating of sulphur and a pitted surface.

Obs. — Often associated with chalcopyrite, pyrite, sphalerite, galena, and various other silver, lead, and copper ores; also siderite. Occurs at many Cornish mines; thus at the Herodsfoot mine, Liskeard, in tetrahedral crystals often coated with iridescent chalcopyrite; the Levant mine near St. Just. In Germany from Andreasberg and Claustal in the Harz Mts.; Freiberg, Saxony; Dillenburg and Horhausen in Nassau; at Müsen, Prussia; various mines in the Black Forest. From Přibram, Bohemia; Kogel near Brixlegg in Tyrol, Austria; Kapnik, Herrengrund, Hungary. In Mexico, at Durango, Guanajuato; Chile; Bolivia, etc. The *argentiferous* variety occurs especially at Freiberg; Přibram; Huallanca in Peru, and elsewhere. The *mercurial* variety at Schmölnitz, Hungary; Schwatz, Tyrol; valleys of Angina and Castello, Tuscany, Italy.

In the United States, tetrahedrite occurs at the Kellogg mines, Ark. In Col., in Clear Creek, Summit and Gilpin Cos.; the Ulay mine, Lake Co.; with pyrargyrite in Ruby district, Gunnison Co., etc. Much of the Colorado "gray copper" is tennantite (see below). In Nev., abundant in Humboldt Co.; near Austin in Lander Co.; Isabella mine, Reese river. In Utah at Bingham Canyon. In Ariz. at the Heintzelman mine; at various points in British Columbia.

Use. — An ore of copper and frequently ore of the other metals, like silver, etc., that it may contain.

TENNANTITE.

Isometric-tetrahedral. Crystals often dodecahedral. Also massive, compact. H. = 3–4. G. = 4·37–4·49. Color blackish lead-gray to iron-black.

Comp. — Essentially $Cu_3As_2S_7$ or $4Cu_2S.As_2S_3$ = Sulphur 25·5, arsenic 17·0, copper 57·5 = 100.

Var. — Often contains antimony and thus graduates into tetrahedrite. The original tennantite from Cornwall contains only copper and iron. In crystals, habit dodecahedral.

Sandbergerite contains 7 p. c. of zinc. *Fredricite* from Sweden has, besides copper, also iron, lead, silver, and tin. *Binnite* from Binnental, Switzerland, is tennantite.

Found at the Cornish mines, particularly at Wheal Jewel in Gwennap, and Wheal Unity in Gwinear; in Germany at Freiberg, Saxony, and at the Wilhelmine mine in the Spessart; at Skutterud, Norway. Near Central City, Idaho Springs and Aspen in Col. At Butte, Mon. At Capelton, Quebec, Canada. Named after the chemist, Smithson Tennant (1761–1815). See further above.

Jordanite. $4PbS.As_2S_3$ Monoclinic; often pseudohexagonal by twinning. G. = 6·39. Color lead-gray. From the Binnental, Switzerland; Nagyág, Transylvania.

Meneghinite. $4PbS.Sb_2S_3$. Orthorhombic. In slender prismatic crystals; also massive. G. = 6·34–6·43. Color blackish lead-gray. From Bottino, Tuscany, Italy; Marble Lake, Barrie Township, Ontario.

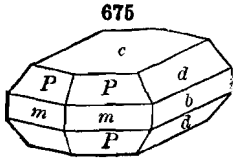
GOLDFIELDITE. $5Cu_2S.(Sb,As,Bi)_2(S,Te)_3$. As a crust. Color, dark lead-gray. Conchoidal fracture. H. = 3–3·5. At Mohawk mine, Goldfield, Nev. Probably a mixture.

STEPHANITE. Brittle Silver Ore.

Orthorhombic. Axes $a : b : c = 0{\cdot}6292 : 1 : 0{\cdot}6851$.

mm''',	$110 \wedge 1\bar{1}0 = 64° 21'$	cd,	$001 \wedge 021 = 53° 52'$
$c\beta$,	$001 \wedge 101 = 47° 26'$	ch,	$001 \wedge 112 = 32° 45'$
ck,	$001 \wedge 011 = 34° 25'$	cP,	$001 \wedge 111 = 52° 9'$

675



Crystals usually short prismatic or tabular || $c(001)$. Twins: tw. pl. $m(110)$, often repeated, pseudo-hexagonal. Also massive, compact and disseminated.

Cleavage: $b(010)$, $d(021)$ imperfect. Fracture subconchoidal to uneven. Brittle. H. = 2–2·5. G. = 6·2–6·3. Luster metallic. Color and streak iron-black. Opaque.

Comp. — Ag_5SbS_4 or $5Ag_2S.Sb_2S_3$ = Sulphur 16·3, antimony 15·2, silver 68·5 = 100.

Pyr. — In the closed tube decrepitates, fuses, and after long heating gives a faint sublimate of antimony oxysulphide. In the open tube fuses, giving off antimonial and sulphurous fumes. B.B. on charcoal fuses with projection of small particles, coats the coal with oxide of antimony, which after long blowing is colored red from oxidized silver, and a globule of metallic silver is obtained. Soluble in dilute heated nitric acid, sulphur and antimony trioxide being deposited.

Obs. — In veins, with other silver ores, at Freiberg, Schneeberg, etc., in Saxony; Přibram, Bohemia; Schemnitz, Hungary; Andreasberg in the Harz Mts., Germany; Kongsberg, Norway; Sarrabus, Sardinia; Wheal Newton, Cornwall; Arispe, Sonora and elsewhere, Mexico; Peru; Chañarcillo, Chile.

In Nev., in the Comstock lode, Reese river, etc. In Idaho, at the silver mines at Yankee Fork, Queen's River district.

Named after the Archduke Stephen, Mining Director of Austria.

Geocronite. $5PbS.Sb_2S_3$. Rarely in orthorhombic crystals closely resembling those of stephanite; usually massive, granular. G. = 6·4. Color lead-gray. From Sala, Sweden; Val Castello, Tuscany. *Kilbrickenite* from Kilbricken, Co. Clare, Ireland, is the same species.

Beegerite. $6PbS.Bi_2S_3$. Massive, indistinctly crystallized. G. = 7·27. Color light to dark gray. From Park Co., Col.

Ultrabasite. $11Ag_2S.28PbS.2Sb_2S_3.3GeS_2$ Orthorhombic. Color and streak gray-black. H. = 5. G. = 6. From Freiberg, Germany.

Polybasite Group. $9RS_2As_2S_3$, $9RS.Sb_2S_3$. Monoclinic, pseudo-rhombohedral

POLYBASITE.

Monoclinic. Axes $a : b : c = 1{\cdot}7309 : 1 : 1{\cdot}5796$, $\beta = 90° 0'$. Prismatic angle 60° 2′. In short six-sided tabular prisms, with beveled edges; $c(001)$ faces with triangular striations; in part repeated twins, tw. pl. m (110).

Cleavage: $c(001)$ imperfect. Fracture uneven. H. = 2–3. G. = 6·0–6·2. Luster metallic. Color iron-black, in thin splinters cherry-red. Streak black. Nearly opaque.

Comp. — Ag_9SbS_6 or $9Ag_2S.Sb_2S_3$ = Sulphur 15·0, antimony 9·4, silver 75·6 = 100. Part of the silver is replaced by copper; also the antimony by arsenic.

Pry., etc. — In the open tube fuses, gives sulphurous and antimonial fumes, the latter forming a white sublimate, sometimes mixed with crystalline arsenic trioxide. B.B. fuses

with spirting to a globule, gives off sulphurous (sometimes arsenical) fumes, and coats the coal with antimony trioxide; with long-continued blowing some varieties give a faint yellowish white coating of zinc oxide, and a metallic globule, which with salt of phosphorus reacts for copper, and cupelled with lead gives pure silver. Decomposed by nitric acid.

Obs. — Occurs in the mines of Guanajuato, from Las Chipas and Arispe, Sonora, Mexico; at Tres Puntos, desert of Atacama, Chile; At Freiberg, Saxony; and P̌ibram, Bohemia; at Sarrabus, Sardinia. In Nev., at the Reese mines and at the Comstock Lode. In Col., at the Terrible Lode, Clear Creek Co., at Ouray. In Ariz., at the Silver King mine; at Neihart, Mon.

Named from πολύς, *many*, and βάσις, *base*, in allusion to the basic character of the compound.

Pearceite. $9Ag_2S.As_2S_3$. Monoclinic, pseudo-rhombohedral. The arsenical variety of polybasite. From Aspen, Col.; Marysville, Lewis and Clarke Co., Mon.

Polyargyrite. $12Ag_2S.Sb_2S_3$. In indistinct isometric crystals. G. = 6·97. Color iron-black. Wolfach, Baden, Germany.

II. Sulpharsenates, Sulphantimonates; Sulpho-stannates, etc.

Here are included a few minerals, chiefly sulpho-salts of quintivalent arsenic and antimony; also several sulpho-stannates and rare sulpho-germanates.

ENARGITE.

Orthorhombic. Axes: $a : b : c = 0{\cdot}8711 : 1 : 0{\cdot}8248$.

Crystals usually small; prismatic faces vertically striated. Twins: tw. pl. $x(320)$ in star-shaped trillings. Also massive, granular, or columnar.

Cleavage : $m(110)$ perfect; $a(100)$, $b(010)$ distinct; $c(001)$ indistinct. Fracture uneven. Brittle. H. = 3. G. = 4·43–4·45. Luster metallic. Color grayish black to iron-black. Streak grayish black. Opaque.

Comp. — Cu_3AsS_4 or $3Cu_2S.As_2S_5$ = Sulphur 32·6, arsenic 19·1, copper 48·3 = 100. Antimony is often present, cf. famatinite.

Pyr. — In the closed tube decrepitates, and gives a sublimate of sulphur; at a higher temperature fuses, and gives a sublimate of sulphide of arsenic. In the open tube, heated gently, the powdered mineral gives off sulphurous and arsenical fumes, the latter condensing to a sublimate containing some antimony oxide. B.B. on charcoal fuses, and gives a faint coating of the oxides of arsenic, antimony, and zinc; the roasted mineral with the fluxes gives a globule of metallic copper. Soluble in aqua regia.

Micro. — In polished sections shows a white color with a smooth surface. With KCN turns black quickly and surface is etched; quickly brown with aqua regia.

Obs. — From Morococha, and Caudalosa, Peru; in Chile and Argentina; Mexico; Matzenköpfl, Brixlegg, Tyrol, Austria; Mancayan, island of Luzon; Kinkwaseki, Formosa.

In the United States, at Brewer's gold mine, Chesterfield dist., S. C.; in Col., at mines near Central City, Gilpin Co.; in Park Co., at the Missouri mine; from Red Mountain district. In southern Utah; also in the Tintic district; Butte, Mon.

Clarite, from the Clara Mine, Schapback, Baden, and *luzonite* from the island of Luzon, Philippines, are identical with enargite.

Use. — Serves as an ore of copper and arsenic.

Famatinite. $3Cu_2S.Sb_2S_5$, isomorphous with enargite. G. = 4·57. Color gray with tinge of copper-red. From the Sierra de Famatina, Argentina; Goldfield, Nev.

Sulvanite. $3Cu_2S.V_2S_5$. Massive. H. = 3·5. G. = 4·0. Color bronze-yellow. Streak nearly black. From near Burra, South Australia.

Xanthoconite. — $3Ag_2S.As_2S_5$. In thin tabular rhombohedral crystals; also massive, reniform. G. = 5. Color orange-yellow. From Freiberg, Germany. *Rittingerite* is the same species.

Epiboulangerite. — $3PbS.Sb_2S_3$. In striated prismatic needles and granular. G. = 6·31. Color dark bluish gray to black. From Altenberg, Saxony, Germany.

Epigenite. — Perhaps $4Cu_2S.3FeS.As_2S_5$. In short prisms resembling arsenopyrite. Color steel-gray. From Wittichen, Baden, Germany.

STANNITE. Tin Pyrites. Bell-metal Ore.

Tetragonal-sphenoidal. Pseudo isometric-tetrahedral through twinning. Twinning, (1) always interpenetrant with $e(101)$ as tw. pl., (2) interpenetrant with twin axis $\perp$ to $p(111)$. Also massive, granular, and disseminated.

Cleavage: cubic, indistinct. Fracture uneven. Brittle. H. = 4. G. = 4·3–4·522; 4·506 Zinnwald. Luster metallic. Streak blackish. Color steel-gray to iron-black, the former when pure; sometimes a bluish tarnish; often yellowish from the presence of chalcopyrite. Opaque.

Comp. — A sulpho-stannate of copper, iron and sometimes zinc, Cu_2FeSnS_4 or $Cu_2S.FeS.SnS_2$ = Sulphur 29·9, tin 27·5, copper 29·5, iron 13·1 = 100.

Pyr., etc.— In the closed tube decrepitates, and gives a faint sublimate; in the open tube sulphurous fumes. B.B. on charcoal fuses to a globule, which in O.F. gives off sulphur dioxide and coats the coal with tin dioxide; the roasted mineral treated with borax gives reactions for iron and copper. Decomposed by nitric acid, affording a blue solution, with separation of sulphur and tin dioxide.

Obs. — In Cornwall formerly found at Wheal Rock; and at Carn Brea; more recently in granite at St. Michael's Mount; also at Stenna Gwynn, etc.; at the Cronebane mine, Co. Wicklow, in Ireland; Zinnwald, in the Erzgebirge, Germany. Crystallized at Oruro, Bolivia. From the Black Hills, S. D.

Argyrodite. A silver sulpho-germanate, Ag_8GeS_6 or $4Ag_2S.GeS_2$. Isometric, crystals usually indistinct; at times they show octahedral and dodecahedral forms with frequent twinning according to the Spinel Law; also massive, compact. H. = 2·5. G. = 6·085–6·266. Luster metallic. Color steel-gray on a fresh fracture, with a tinge of red turning to violet. From the Himmelsfürst mine, Freiberg, Saxony; from Colquechaca and Aullagas, Bolivia.

Canfieldite. Ag_8SnS_6 or $4Ag_2S.SnS_2$, the tin in part replaced by germanium. Isometric, in octahedrons with $d(110)$. Twins according to Spinel Law. G. = 6·28. Luster metallic. Color black. Colquechaca, Bolivia.

Teallite. $PbSnS_2$. Orthorhombic? In thin flexible folia. Perfect basal cleavage. H. = 1–2. G. = 6·4. Color blackish gray. Streak black. Probably from Bolivia, exact locality unknown.

Franckeite. $Pb_5Sn_3FeSb_2S_{14}$ or $3PbSnS_2 + Pb_2FeSb_2S_6$. Massive. G. = 5·55. Color blackish gray to black. Las Animas, Bolivia.

Cylindrite. $Pb_3Sn_4FeSb_2S_{14}$ or $3PbSnS_2 + SnFeSb_2S_6$. H. = 2·5–3. G. = 5·42. Luster metallic. Color blackish lead-gray. In cylindrical forms separating under pressure into distinct shells or folia. Poopó, Bolivia.

IV. HALOIDS. — CHLORIDES, BROMIDES, IODIDES; FLUORIDES

I. Anhydrous Chlorides, Bromides, Iodides; Fluorides.
II. Oxychlorides; Oxyfluorides.
III. Hydrous Chlorides; Hydrous Fluorides.

The Fourth Class includes the haloids, that is, the compounds with the halogen elements, chlorine, bromine, iodine, and also the less closely related fluorine.