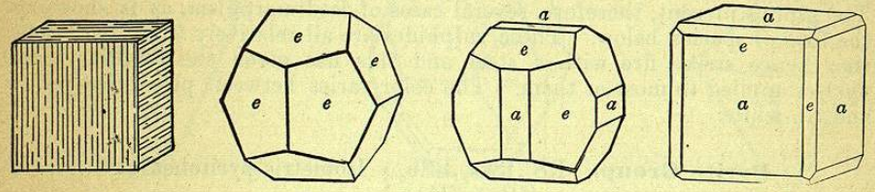
Pyrite Group.

PYRITE. Schwefelkies, Eisenkies, *Germ.* Iron Pyrites.

Isometric-pyritohedral. Cube and pyritohedron *e* (210) the common forms, the faces of both often with striations ‖ edge *a*/*e*, due to oscillatory combination of these forms and tending to produce rounded faces; pyritohedral faces also striated ⊥ to this edge; octahedron also common. See Figs. 610–617, also Figs. 117–123, pp. 44, 45. Twins: tw. ax *a*, usually penetration-twins with parallel axes (Fig. 369, p. 124); rarely contact-twins. Frequently massive, fine granular; sometimes subfibrous radiated; reniform, globular, stalactitic.

Cleavage: *a*, *o* indistinct. Fracture conchoidal to uneven. Brittle. H. = 6–6·5. G. = 4·95–5·10; 4·967 Traversella, 5·027 Elba. Luster metallic,

610. 611. 612. 613.



614. 615. 616. 617.

splendent to glistening. Color a pale brass-yellow, nearly uniform. Streak greenish black or brownish black. Opaque.

Comp., Var.—Iron disulphide, FeS_2 = Sulphur 53·4, iron 46·6 = 100.

Nickel, cobalt, and thallium, and also copper in small quantities, sometimes replace part of the iron, or else occur as mixtures; selenium is sometimes present in traces. Gold is sometimes distributed invisibly through it, auriferous pyrite being an important source of gold. Arsenic is rarely present, as in octahedral crystals from French Creek, Penn. (0·2 p. c. As).

Pyr., etc.—In the closed tube a sublimate of sulphur and a magnetic residue. B.B. on charcoal gives off sulphur, burning with a blue flame, leaving a magnetic residue which reacts like pyrrhotite (p. 296). Insoluble in hydrochloric, but decomposed by nitric acid.

Diff.—Distinguished from chalcopyrite by its greater hardness and paler color; in form and specific gravity different from marcasite, which has also a whiter color.

Obs.—Pyrite occurs abundantly in rocks of all ages, from the oldest crystalline to the most recent alluvial deposits. It usually occurs in small cubes, pyritohedrons, or in more highly modified forms; also (often with marcasite) in irregular spheroidal nodules and in veins, in clay slate, argillaceous sandstones, the coal formation, etc.

Fine crystals have been found in some of the Cornish mines; also in great variety with hematite on the island of Elba, and with magnetite at Traversella and Brosso in Piedmont. Other localities for crystals are Müsen near Siegen; Freiberg, Saxony; Schneeberg; Waldenstein in Carinthia; Přibram, Bohemia; Schemnitz, Hungary; Persberg, Falun, and Långban in Sweden; Kongsberg in Norway.

In *Maine*, at Peru, Waterville, etc. In *N. Hampshire*, at Unity, massive. In *Mass.*, at Rowe, Hawley, massive. In *Vermont*, at Shoreham, in limestone; Hartford. In *Conn.*, at Roxbury, finely crystallized. In *N. York*, at Rossie, fine crystals; at Schoharie; at Chester, Warren Co.; in Orange Co., at Warwick; massive in Franklin, Putnam, and Orange Cos.,

etc. In *Pennsylvania*, at Chester, Delaware Co.; at Knauertown, Chester Co.; at French Creek mines, octahedrons and other forms, sometimes tetragonal or orthorhombic in symmetry; Cornwall, Lebanon Co.; in *N. Car.*, near Greensboro', Guilford Co., in crystals. In *Colorado*, crystals near Central City, Gilpin Co., and elsewhere. Auriferous pyrite is common at the mines of Colorado, and many of those of California, as well as in Virginia and the States south. In *Canada*, 2 miles N. W. of Brockville, Ontario, a cobaltiferous variety.

Large quantities of massive pyrite are mined at the Rio Tinto and other mines in Spain, also in Portugal. Among important deposits in the U. S. are those at Rowe, Mass.; Herman, St. Lawrence Co., and Ellenville, Ulster Co., N. Y.; Tolersville, Louisa Co., Va.; Dallas, Paulding Co, Ga.

The name *pyrite* is derived from $\pi\tilde{\upsilon}\rho$, *fire*, and alludes to the sparks from friction; hence the early name *pyrites* (p. 299).

Pyrite readily changes to an iron sulphate by oxidation, some sulphur being set free. Also to limonite on its surface, and afterward throughout, by the action of a solution of bicarbonate of lime carrying off the sulphuric acid as change proceeds, and from limonite to red iron oxide.

Hauerite. Manganese disulphide, MnS_2. In octahedral or pyritohedral crystals; also massive. G. = 3·46. Color reddish brown or brownish black. From Kalinka, Hungary; Raddusa, Catania, Sicily.

SMALTITE-CHLOANTHITE. Speiskobalt *Germ.*

Isometric-pyritohedral. Commonly massive; in reticulated and other imitative shapes.

Cleavage: *o* distinct; *a* in traces. Fracture granular and uneven. Brittle. H. = 5·5–6. G. = 6·4 to 6·6. Luster metallic. Color tin-white, inclining, when massive, to steel-gray, sometimes iridescent, or grayish from tarnish. Streak grayish black. Opaque.

Comp.—SMALTITE is essentially cobalt diarsenide, $CoAs_2$ = Arsenic 71·8, cobalt 28·2 = 100. CHLOANTHITE is nickel diarsenide, $NiAs_2$ = Arsenic 71·9, nickel 28·1 = 100.

Cobalt and nickel are usually both present, and thus these two species graduate into each other, and no sharp line can be drawn between them. Iron is also present in varying amount; the variety of chloanthite containing much iron has been called *chathamite*. Further sulphur is usually present, but only in small quantities. Many analyses do not conform even approximately to the formula RAs_2, the ratio rising from less than 1 : 2 to 1 : 2·5 and nearly 1 : 3, thus showing a tendency toward skutterudite (RAs_3), perhaps due to either molecular or mechanical mixture.

Much that has been called smaltite (speiskobalt) is shown by the high specific gravity to belong to the orthorhombic species safflorite.

Pyr., etc.—In the closed tube gives a sublimate of metallic arsenic; in the open tube a white sublimate of arsenic trioxide, and sometimes traces of sulphur dioxide. B.B. on charcoal gives an arsenical odor, and fuses to a globule, which, treated with successive portions of borax-glass, affords reactions for iron, cobalt, and nickel.

Obs.—Usually occurs in veins, accompanying ores of cobalt or nickel, and ores of silver and copper; also, in some instances, with niccolite and arsenopyrite. Found at the Saxon mines; Joachimsthal, Bohemia; Wheal Sparnon, Cornwall; Riechelsdorf, Hesse; Tunaberg, Sweden; Allemont, Dauphiné. In the U. S., at Chatham, Conn., the *chathamite* occurs in mica slate, with arsenopyrite and niccolite; at Franklin Furnace, N. J.

COBALTITE.

Isometric-pyritohedral. Commonly in cubes, or pyritohedrons, or combinations resembling common forms of pyrite. Also granular massive to compact.

Cleavage: cubic, rather perfect. Fracture uneven. Brittle. H. = 5·5. G. = 6–6·3. Luster metallic. Color silver-white, inclined to red; also steel-gray, with a violet tinge, or grayish black when containing much iron. Streak grayish black.

Comp.—Sulpharsenide of cobalt, CoAsS or $CoS_2.CoAs_2$ = Sulphur 19·3, arsenic 45·2, cobalt 35·5 = 100.

Iron is present, and in the variety *ferrocobaltite* in large amount.

Pyr., etc.—Unaltered in the closed tube. In the open tube gives sulphurous fumes, and a crystalline sublimate of arsenic trioxide. B.B. on charcoal gives off sulphur and arsenic, and fuses to a magnetic globule; with borax a cobalt-blue color. Soluble in warm nitric acid, with the separation of sulphur.

Obs.—Occurs at Tunaberg and Hakansbö in Sweden; at the Nordmark mines; also at Skutterud in Norway; at Schladming, Styria; Siegen in Westphalia; Botallack mine, near St. Just, in Cornwall; Khetri mines, Rajputana, India.

Gersdorffite. Sulpharsenide of nickel, NiAsS or $NiS_2.NiAs_2$. Iron, and sometimes cobalt, replace more or less of the nickel. Isometric-pyritohedral; usually massive. H. = 5·5. G. = 5·6–6·2. Color silver-white to steel-gray. From Loos, Sweden; the Harz; Schladming, Styria, etc.

Corynite is near gersdorffite, but contains also antimony. From Olsa, Carinthia.

Willyamite. $CoS_2.NiS_2CoSb_2.NiSb_2$. Cleavage cubic. Color tin-white to steel-gray. Broken Hill mines, New South Wales.

Ullmannite. Sulphantimonide of nickel, NiSbS or $NiS_2.NiSb_2$; arsenic is usually present in small amount. Isometric-tetartohedral; both pyritohedral and tetrahedral forms occur (see Figs. 146, 147, p. 51). Usually massive, granular. H. = 5–5·5. G. = 6·2–6·7. Color steel-gray to silver-white. Occurs in the mines of Freusburg, Nassau; Siegen, Prussia; Lölling, Carinthia (tetrahedral); Montenarba, Sarrabus, Sardinia (pyritohedral).

KALLILITE. Wismuthantimonnickelglanz *Germ.* Ni(Sb,Bi)S or $NiS_2.Ni(Sb,Bi)_2$. Massive, color light bluish gray. From the Friedrich mine near Schönstein a. d. Sieg, Germany.

Sperrylite. Platinum diarsenide, $PtAs_2$. In minute cubes, or cubo-octahedrons. H. = 6–7. G. = 10·602. Luster metallic. Color tin-white. Streak black. Found at the Vermillion mine, 22 miles west of Sudbury, Ontario, Canada; also in Macon Co., N. Carolina. This is the only known native compound of platinum.

Laurite. Sulphide of ruthenium and osmium, probably essentially RuS_2. In minute octahedrons; in grains. H. = 7·5. G. = 6·99. Luster metallic. Color dark iron-black. From the platinum washings of Borneo. Also reported from Oregon.

Skutterudite. Cobalt arsenide, $CoAs_3$. Isometric-pyritohedral. Also massive granular. Cleavage: *a* distinct. H. = 6. G. = 6·72–6·86. Color between tin-white and pale lead-gray. From Skutterud, Norway.

NICKEL-SKUTTERUDITE. $(Ni,Co,Fe)As_3$. Massive, granular. Color gray. From near Silver City, New Mexico.

BISMUTO-SMALTITE. $Co(As,Bi)_3$. A skutterudite containing bismuth. Color tin-white. G. = 6·92. Zschorlau, near Schneeberg.

Marcasite Group.

For the list of species and their relations, see p. 299.

MARCASITE. White iron pyrites.

Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c} = 0{\cdot}7662 : 1 : 1{\cdot}2342$.

mm''',	$110 \wedge 1\bar{1}0 = 74° 55'$.	ll',	$011 \wedge 0\bar{1}1 = 101° 58'$.
ee',	$101 \wedge \bar{1}01 = 116° 20'$.	cs,	$001 \wedge 111 = 63° 46'$.

Twins: tw. pl. *m* (Fig. 619), sometimes in stellate fivelings (Fig. 406, p. 128, cf. Fig. 620); also tw. pl. *e* (101), less common the crystals crossing at angles of nearly 60°. Crystals commonly tabular ∥ *c*, also pyramidal; the brachydomes striated ∥ edge *b/c*. Often massive; in stalactites; also globular, reniform, and other imitative shapes.

Cleavage: *m* rather distinct; *l* (011) in traces. Fracture uneven. Brittle. H. = 6–6·5. G. = 4·85–4·90. Luster metallic. Color pale bronze-yellow, deepening on exposure. Streak grayish or brownish black. Opaque.

Comp.—Iron disulphide, like pyrite, FeS_2 = Sulphur 53·4, iron 46·6 = 100. Arsenic is sometimes present in small amount.

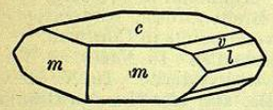
Var.—The varieties named depend mainly on state of crystallization. *Radiated* (*Strahlkies* Germ.): Radiated; also the simple crystals. *Cockscomb P.* (*Kammkies* Germ.): Aggregations of flattened twin crystals in crest-like forms. *Spear P.* (*Speerkies* Germ.): Twin crystals, with re-entering angles a little like the head of a spear in form. *Capillary* (*Haarkies* Germ.): In capillary crystallizations.

Pyr., etc.—Like pyrite. Very liable to decomposition, more so than pyrite.

Diff.—Resembles pyrite, but has a lower specific gravity, and the color when fresh (*e.g.* after treatment with acid) is paler; when crystallized easily distinguished by the forms. More subject to tarnish and final decomposition than pyrite.

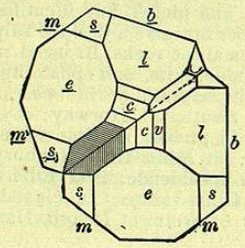
Obs.—Occurs abundantly at Littmitz and Altsattell, near Carlsbad in Bohemia; also at Joachimsthal, Bohemia, and in Saxony and the Harz. Occurs with galena and fluorite in Derbyshire; in chalk-marl between Folkestone and Dover; near Alston Moor, Cumberland;

618.



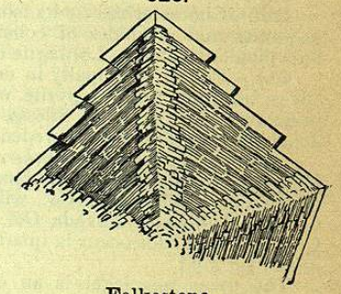
Common Form.

619.



Galena, Ill.

620.



Folkestone.

Schemnitz, Hungary. At Warwick, N. Y., in crystals; massive at Cummington, Mass., and at Lane's mine, Monroe, Conn.; at Galena, Ill., in stalactites with concentric layers of sphalerite and galena; Mineral Point, Wis., in fine crystals; on sphalerite at Joplin, Mo.

The word *marcasite*, of Arabic or Moorish origin (and variously used by old writers, for bismuth, antimony), was the name of common crystallized pyrite among miners and mineralogists in later centuries, until near the close of the last. It was first given to this species by Haidinger in 1845.

Löllingite. Essentially iron diarsenide, $FeAs_2$, but passing into Fe_3As_4 (*leucopyrite*); also tending toward arsenopyrite (FeAsS) and safflorite ($CoAs_2$). Bismuth and antimony are sometimes present. Usually massive. H. = 5–5·5. G. = 7·0–7·4 chiefly, also 6·8. Luster metallic. Color between silver-white and steel-gray. Streak grayish black. Occurs in the Lölling-Hüttenberg district in Carinthia; with niccolite at Schladming, etc. In the U. S., löllingite occurs in Gunnison Co., Colorado, etc.

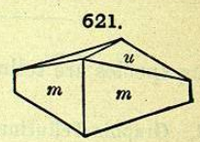
GEYERITE is near löllingite, but contains sulphur; from Geyer, Saxony.

ARSENOPYRITE, or MISPICKEL. Arsenkies *Germ.*

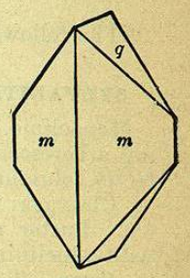
Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c} = 0{\cdot}6773 : 1 : 1{\cdot}1882$.

mm''',	$110 \wedge 1\bar{1}0 =$	$68° 13'$.
ee',	$101 \wedge \bar{1}01 =$	$120° 38'$.
uu',	$014 \wedge 0\bar{1}4 =$	$33° 5'$.
nn',	$012 \wedge 0\bar{1}2 =$	$61° 26'$.
qq',	$011 \wedge 0\bar{1}1 =$	$99° 50'$.

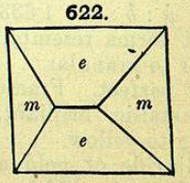
621.



623.



622.



Twins: tw. pl. *m*, sometimes repeated like marcasite (Fig. 407, p. 128); *e* (101) cruciform twins, also trillings (Figs. 402, 403, p. 128). Crystals prismatic *m*, or flattened vertically by the oscillatory combination of brachydomes. Also columnar, straight, and divergent; granular, or compact.

Cleavage: *m* rather distinct; *c* in faint traces. Fracture uneven. Brittle.

H. = 5·5–6. G. = 5·9–6·2. Luster metallic. Color silver-white, inclining to steel-gray. Streak dark grayish black. Opaque.

Comp., Var.—Sulpharsenide of iron, FeAsS or $FeS_2.FeAs_2$ = Arsenic 46·0, sulphur 19·7, iron 34·3 = 100. Part of the iron is sometimes replaced by cobalt, as in the variety *danaite* (3 to 9 p. c. Co).

Pyr., etc.—In the closed tube at first gives a red sublimate of arsenic trisulphide, then a black lustrous sublimate of metallic arsenic. In the open tube gives sulphurous fumes and a white sublimate of arsenic trioxide. B.B. on charcoal gives arsenical fumes and a magnetic globule. The varieties containing cobalt give, after the arsenic has been roasted off, a blue color with borax-glass when fused in O.F. with successive portions of flux until all the iron is oxidized. Gives fire with steel, emitting an alliaceous odor. Decomposed by nitric acid with the separation of sulphur.

Diff.—Characterized by its hardness and tin-white color; closely resembles some of the sulphides and arsenides of cobalt and nickel, but identified, in most cases easily, by its blowpipe characters. Löllingite does not give a decided sulphur reaction.

Obs.—Found principally in crystalline rocks, its usual mineral associates being ores of silver, lead, and tin, also pyrite, chalcopyrite, and sphalerite. Abundant at Freiberg, etc., in Saxony; Reichenstein, Silesia, in serpentine; in beds at Breitenbrunn, Andreasberg, Joachimsthal; Tunaberg, Sweden; Skutterud, Norway; at several points in Cornwall.

In the U. S., in *N. Hampshire*, in gneiss, at Franconia (*danaite*). In *Maine*, at Blue Hill, etc. In *Conn.*, at Chatham; at Mine Hill, Roxbury, with siderite. In *N. York*, massive, in Lewis, Essex Co., with hornblende; near Edenville, and elsewhere in Orange Co. In *California*, Nevada Co., Grass valley. In crystals at St. François, Beauce Co., Quebec; large beds occur in quartz ore veins at Deloro, Hastings Co., Ontario, where it is mined for gold.

The name mispickel is an old German term of doubtful origin. *Danaite* is from J. Freeman Dana of Boston (1793–1827), who made known the Franconia locality.

Safflorite. Like smaltite, essentially cobalt diarsenide, $CoAs_2$. Form near that of arsenopyrite. Usually massive. H. = 4·5–5. G. = 6·9–7·3. Color tin-white, soon tarnishing. From Schneeberg, Saxony; Bieber, Hesse; Wittichen, Baden; Tunaberg, Sweden.

Rammelsbergite. Essentially nickel diarsenide, $NiAs_2$, like chloanthite. Crystals resembling arsenopyrite; also massive. G. = 6·9–7·2. Color tin-white with tinge of red. Occurs at Schneeberg and at Riechelsdorf.

Glaucodot. Sulpharsenide of cobalt and iron, (Co,Fe)AsS. In orthorhombic crystals (axes, etc., p. 299). Also massive. H. = 5. G. = 5·90–6·01. Luster metallic. Color grayish tin-white. Occurs in the province of Huasco, Chili; at Hakansbö, Sweden. Named from γλαυκός, *blue*, because used for making smalt.

Alloclasite. Probably essentially Co(As,Bi)S with cobalt in part replaced by iron; or a glaucodot containing bismuth. Commonly in columnar to hemispherical aggregates. H. = 4·5. G. = 6·6. Color steel-gray. From Orawitza.

Wolfachite. Probably Ni(As,Sb)S, near corynite. In small crystals resembling arsenopyrite; also columnar radiated. H. = 4·5–5. G. = 6·372. Color silver-white to tin-white. From Wolfach, Baden.

The following species are tellurides of gold, silver, etc.

SYLVANITE. Graphic Tellurium. Schrift-Tellur *Germ.*

Monoclinic. $\dot{a} : \dot{b} : \dot{c} = 1·6339 : 1 : 1·1265$; $\beta = 89° 35'$. Often in branching arborescent forms resembling written characters; also bladed and imperfectly columnar to granular.

Cleavage: *b* perfect. Fracture uneven. Brittle. H. = 1·5–2. G. = 7·9–8·3. Luster metallic, brilliant. Color and streak pure steel-gray to silver-white, inclining to yellow.

Comp.—Telluride of gold and silver $(Au,Ag)Te_2$ with Au : Ag = 1 : 1; this requires: Tellurium 62·1, gold 24·5, silver 13·4 = 100.

Pyr., etc.—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. Most varieties give a faint coating of lead oxide and antimony oxide on charcoal.

Obs.—With gold, at Offenbánya, Transylvania; also at Nagyág. In California, Calaveras Co., at the Melones and Stanislaus mines. In Boulder Co., and elsewhere in Colorado. Named from Transylvania, where first found, and in allusion to *sylvanium*, one of the names at first proposed for the metal tellurium.

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 Colorado.

Calaverite. A gold-silver telluride. Like sylvanite $(Au,Ag)Te_2$ with Au : Ag = 6 : 1 or 7 : 1. Massive. H. = 2·5. G. = 9·043. Color pale bronze-yellow. Occurs with petzite at the Stanislaus mine, Calaveras county, California. Also at the Red Cloud and other mines, Colorado.

Calaverite has the same general formula as sylvanite but a much higher percentage of gold, and may belong with it; or, as seems probable, krennerite may be the crystallized form of calaverite.

Nagyagite. A sulpho-telluride of lead and gold; containing also about 7 p. c. of antimony. Orthorhombic. Crystals tabular ‖ *b*; 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.

Oxysulphides.

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

Kermesite. Antimonblende, Rothspiessglanzerz *Germ.* Pyrostibite. Antimony oxysulphide, Sb_2S_2O or $2Sb_2S_3.Sb_2O_3$. Monoclinic. Usually in tufts of capillary crystals. Cleavage: *a* 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. 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 at Rosières, Puy de Dôme; Joachimsthal; Marienberg, Saxony (*leberblende*).