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A

TREATISE

ON

MINERALOGY.

BY

CHARLES UPHAM SHEPARD.

No. II.

THIRD EDITION,

WITH 237 ILLUSTRATIONS;

AND 725 IN THE COMPLETE WORK.

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~~Geological Sciences~~

Geol Sciences

ORDER X. ORE.

Section A. *Colors various. Lustre generally resinous.*

Sp. 1. Cuprite, *Haidinger;* Red Oxide of Copper, *Phillips.* Tile Ore. Zigueline.

[H.=3·5...4·0 G.=5·89...6·15. Xls. modified cubes and octahedrons. Massive, granular and earthy. Color from cochineal-red to lead-grey.]

Primary form, cube.

Secondary forms.

Fig. 489.

Fig. 490.

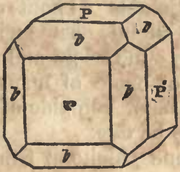


Fig. 491.

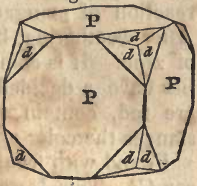
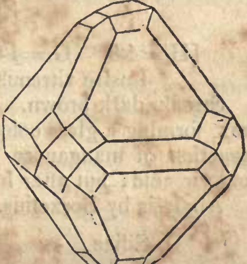


Fig. 492.



Cleavage parallel with octahedral faces, smooth, but interrupted. Frac. conchoidal to uneven. Surface smooth and splendent. Semi-transparent, to translucent on the edges. Lustre adamantine, inclining to metallic. Color, as above. Streak brownish-red, shining. Brittle.

B. B. on charcoal, in the inner flame, is reduced. In the forceps, colors the flame green; moistened with hydrochloric acid, colors the flame blue. Soluble in nitric acid with effervescence; in hydrochloric acid, without effervescence: also soluble in ammonia.

Copper 88·79, oxygen 11·21.

The earthy variety has been called *Tile ore* and Zigueline. It is of a reddish brown color, in consequence of the presence of peroxide of iron.

Occurs in beds and veins in granite and crystalline slate rocks, attended by redruthite, copper, chalcopyrite, azurite, malachite, galena and blende.

In gneiss at Moldawa in the Bannat, in beds in sandstone at Katherinenburg in Siberia, and at Chessy near Lyons in France. In veins of tin and copper ore in Cornwall, South Australia, Peru and Chili. In the copper mines of New Jersey and of Lake Superior.

Sp. 2. Chalcotrichite, *Glocker;* Kupferblüthe, *Hausmann;* Capillary Red Oxide of Copper.

[In fine capillary xls. much interlaced. Cochineal and crimson red.]

In prisms of 140°–150°, having the angles and obtuse edges truncated (Kenngott). Cleavage rhombohedral, perfect. G.=5·8.

Composition identical with cuprite.

Rheinbreitenbach, Moldawa, and N. Tagilsk.

Sp. 3. Zincite, *Haidinger;* Spartalite, *Brooke* and *Miller;* Red Oxide of Zinc, *Phillips*,

[H.=4·0...4·5. Gr.=5·43...5·53. Massive: foliated. Color deep red. Streak orange-yellow.]

Primary form rhomboid.

Secondary form, double six-sided pyramid with truncated apices (quartzoid), and broad six-sided tables.

Cleavage distinct, parallel with truncating faces of the quartzoid. Massive, often in broad foliæ. Fracture conchoidal to granular. Translucent on the edges. Lustre adamantine. When pure, colorless; but almost universally red. Brittle.

B. B. on charcoal is infusible, phosphorescing strongly. With soda, gives a sublimate of zinc. With borax and salt of phosphorus, yields the reaction of manganese. Soluble without effervescence in nitric acid. After weathering, becomes slightly coated with a white crust of carbonate of zinc. It is composed of zinc 80·26 and oxygen 19·74. Some varieties have a decided trace of oxide of manganese; and all those which are red, contain also traces of peroxide of iron, to which foreign substances the color appears to be due.

Found with franklinite and calcite at Stirling Hill and Franklin, Sussex Co., New Jersey.

Sp. 4. Thorite, *Beudant*.

[H.=4·5. G.=4·63. Massive. Fracture conchoidal. Black. Lustre vitreous.]

Streak dark brown. Brittle. B. B. infusible. Easily soluble in borax, forming a glass colored by iron; on the addition of nitre, yields the reaction of manganese. Before ignition, easily decomposed by hydrochloric acid; but after heating, is but slightly acted upon by it.

Analysis by Berzelius.

Silica, - - - - -	18·98
Thorina, - - - - -	56·91
Lime, - - - - -	2·58
Red ox. iron, - - - -	3·40
Ox. mang., - - - -	2·39
Magnesia, - - - - -	0·36
Ox. uranium, - - - -	1·61
Ox. lead, - - - - -	0·80
Ox. tin, - - - - -	0·01
Potash, - - - - -	0·14
Soda, - - - - -	0·10
Alumina, - - - - -	0·06
Water, - - - - -	9·50
Insoluble matter, - - - -	1·70

Found with brown mesotype (bergmannite), on the island of Lōvö, near Brevig, Norway.

*Orangite, *Bergemann.*

[H.=4·5. G.=5·34...5·397. Massive, but cleavable in one direction. Orange to brown.]

Fracture conchoidal to splintery. Transparent to translucent. Streak yellowish-white.

In the matrass, yields water and becomes dark brown; but on cooling, regains the orange color. B. B. infusible. By fusion with soda, the silica is dissolved, leaving insoluble yellow fragments in the bead. With borax, forms a glass, which is yellow while hot, but colorless when cold. With salt of phosphorus, in the outer flame, yields a reddish glass; in the inner one, a yellowish glass. The glass in either case, is colorless when cold. With hydrochloric acid, forms a perfectly clear, deep yellow jelly. After exposure to a strong red heat, it is not acted upon by acids. Analysis by C. Bergemann:—

Silica, - - - -	17·70
Ox. donarium, probably of thorinum,	71·25
Carb. acid, - - - -	4·04
Red ox. iron, - - - -	0·31
Magnesia and ox. mang., - -	0·21
Potash and soda, - - - -	0·30
Water, - - - -	6·90

Found imbedded in feldspar in Langesundfiord, near Brevig in Norway.

Sp. 5. Warwickite, (S.) Enceladite, *T. S. Hunt.*

[H.=3·0...4·0. G.=3·18...3·29. Xls. slender prismatic. Hair-brown to iron-grey. Metallic, copper-red lustre on face of perfect cleavage. Opaque.]

Prim. form, rhombic prism, apparently oblique. Secondary form, obtuse edges of prism truncated, and the acute, bevelled. Cleavage in direction of longer diagonal very perfect. Fracture uneven. Lustre vitreous to pearly. Brittle.

In the tube, yields water and traces of hydrofluoric acid. B. B. infusible. With salt of phosphorus, gives a bead which is orange, while hot, and purplish-gray and opaque when cold. Reaction of boric acid. Titanic acid 28·20, silica 18·50, alumina 13·84, protox. iron 10·59, magnesia 22·20, lime 1·30, water 7·35 (*T. S Hunt*). Smith and Brush find it to contain over 20 p. c. boric acid. The large iron-grey crystals were found by the author, rich in fluorine, manganese and iron. Found disseminated through the spinel limestone at Edenville, Orange Co., N. Y. First found at Warwick, N. J.

Sp. 6. Perofskite, *Rose;* Perowskite, *Dufrenoy.*

[H.=5·5. Gr.=3·9...4·01. Xls. small, and usually cubes. Massive. Color dark reddish-brown to greyish-black.]

Primary form, cube.

Secondary, cube with edges and angles truncated.

Cleavage parallel with primary faces, tolerably distinct. Translucent on edges, to opaque. Lustre adamantine, inclining, in xls. to metallic. Color as above. Streak greyish-white.

B. B. infusible. Soluble in borax. With a very minute quantity of the pulverized mineral, the bead is light yellowish-green while hot, and colorless when cold; with a larger quantity, the bead is brown when cold. In powder, it is but slightly acted upon by hydrochloric acid.

It is composed of titanic acid 58·9, lime 41·1.

Analyses by Jacobson and Brooks.

Titanic acid,	58·96	59·00
Lime,	39·20	36·76
Magnesia,	*trace*	0·11
Protoxide of iron,	2·06	4·79

Found in a micaceous limestone at Vosburg on the Kaiserstuhl, and in chlorite slate at Achmatovsk, near Slatoust, in the Ural.

Sp. 7. TRITOMITE, *Weibye*.

[H.=5·5. G.=4·16...4·66. Xls. tetrahedra. Dark brown. Opaque.]

Prim. form cube. Secondary form, tetrahedron. Cleavage not observable. Fracture conchoidal. Translucent on the edges...opaque. Lustre vitreous, inclining to metallic on the surface of fracture. Streak yellowish-brown. Very brittle.

In the matrass, yields water and traces of fluorine. B. B. becomes white and cracks. With borax, in the outer flame, forms a reddish yellow glass, which becomes colorless on cooling. Decomposed by hydrochloric acid, leaving a jelly of silica. Approximate analysis of a small quantity, by Berlin:—

Silica,	20·13
Ox. cerium,	40·36
Ox. lanthanium,	15·11
Lime,	5·15
Alumina,	2·24
Yttria,	0·46
Magnesia,	0·22
Soda,	1·46
Protox. iron,	1·83
Mang., cop., tin and tungsten,	4·62
Loss by ignition,	7·86

Near Brevig, Norway, in syenite, with leucophane.

Sp. 8. CERITE; Ochroite, *Hermann;* Cererite, *Hausmann.*

[H.=5·5. G.=4·9...5·0. Massive. Reddish-grey to clove-brown. Fracture uneven.]

Rarely in xls., having the form of short six-sided prs. Cleavage in traces. Opaque. Lustre resinous. Streak greyish-white. Brittle.

In the matrass, yields water. B. B. turns yellow, but is infusible. With borax, in the outer flame, slowly dissolves into a dark yellow glass, which grows paler on cooling; in the inner flame, shows a feeble reaction of iron. With soda, melts into a dark yellow slag. Dissolves in hydrochloric acid, leaving a jelly of silica. Analysis *a* by Hisinger, *b* by Hermann.

	a.	b.
Silica,	18·00	16·06
Protox. cerium,	68·59	26·55
Ox. lanthanium,	——	33·38
Alumina,	——	1·68
Perox. iron,	2·00	3·53
Lime,	1·25	3·56
Ox. mang.	——	0·27
Water,	9·60	9·10

The variety *b* is supposed to have contained carb. lime, as a mechanical mixture.

Bastnäs, near Riddarhyttan in Westmannland, Sweden, forming a bed in gneiss. *Ochroite* is supposed to be a quartzy variety of cerite.

Sp. 9. **Sphene.** Lederite, (*S.*) Greenovite, *Dufrénoy;* Pictite, Ligurite.

[H.=5·0...5·5. G.=3·3...3·7. Xls. very oblique, short rh. prs. generally much modified. Massive, in very perfectly cleavable masses. Yellow, brown, rarely green.]

Prim. form, oblique rh. prism. M on M=133° 30′, P on M=121° 50′. Secondary forms.

Fig. 493.

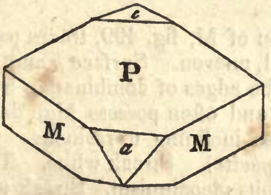
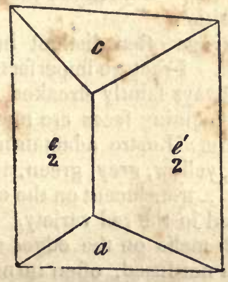


Fig. 494.



Arendal—Lake George.

Fig. 495.

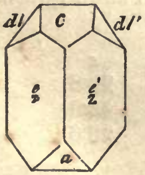


Fig. 496.

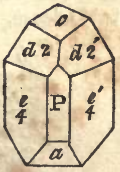
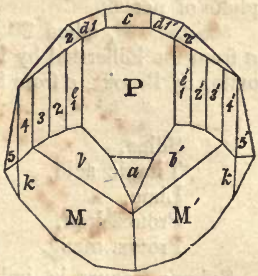


Fig. 497.

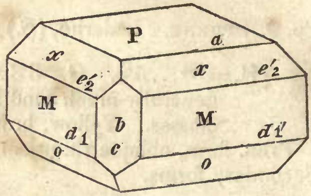


St. Gothard.

P on *a*	159° 44′		M on *e*	120° 2′
c	140 52		*b* on *b*	167 0
e_2	158 18		*b* on *c*	139 30
e_3	154 20		*c* on d_1	146 44
e_5	120 2		*c* on e_2	145 18
M on *a*	139 30		*c* on e_4	154 52
b	124 35	*Phillips.*	d_1 on d_1'	113 24
c	86 20		d_2 on d_2'	135 60
e_2	119 35		d_2 on e_4	152 30
e_3	116 42		d_1 on e_2	152 45
e_5	138 42		e_1 on c_1'	175 42
l	151 20		e_2 on c_2'	136 40
			e_4 on e_4'	113 50

M (d_1) on M (d_1)	113° 28′
P (*a*) on M (d_1)	114 21
x (e_2)	141 36
b (*c*)	119 33
M (d_1) on *o*	135 10
o on *o*	110 54
o on P′	109 37
M (d_1) on *x* (e_2)	151 30

Fig. 498.



Diana, N. Y.

Twin xls., faces of composition parallel; axis of revolution perpendicular to P, fig. 499. Sometimes the individuals are continued beyond the face of composition.

Cleavage often distinct in the direction of M, fig. 499, traces parallel with M. Fracture imperfectly conchoidal, uneven. Surface *b* and M almost always faintly streaked, parallel to the edges of combination with *d*. The remaining faces are mostly smooth, and often possess high degrees of lustre. Lustre adamantine, sometimes inclining to resinous. Color brown, yellow, grey, green, and red (*greenovite*). Streak white. Translucent . . . translucent on the edges. Exhibits pleochroism. Streak white, light red in the red variety. Pyroelectric.

B. B. melts on the edges with intumescence, into a dark glass. The portion not fused, often turns yellow when cold. With borax, yields a transparent yellow glass. With salt of phosphorus and tin, in the inner flame, gives a violet glass. It is partially decomposed by hydrochloric acid, and perfectly so by sulphuric acid, or by fusion with six parts bisulphate of potash.

$3\dot{C}a, 2\dddot{S}i, 3\ddot{T}i$, silica 30·45, titanic acid 41·33, lime 28·22. Analyses, *a* from the Zillerthal by H. Rose, *b* of a red variety from Passau (greenovite) by Brooks, *c* from St. Marcel by Delesse.

	a	*b*	*c*
Silica,	32·29	30·63	29·8
Titanic acid,	41·58	42·56	43·0
Lime,	26·61	25·00	23·6
Protox. iron,	0·96	3·63	
Protox. mang.	——	——	2·9

Sphene occurs in imbedded and attached xls. and massive in broad foliæ, in granite, syenite, gneiss, crystalline slate rocks, limestone, basalt, and lava. Dauphiné, St. Gotthardt, Dissentis in the Grisons, Val Maggia and St. Marcel (greenovite) in Piedmont, Pfitschthal in the Tyrol, near Slatoust in the Ural, Arendal, and near Laurvig in Sweden, Vesuvius, Grenville, Canada, Monroe, Diana and Gouverneur, N. Y., (variety *lederite*, fig. 499, in which figure a new prism is assumed as the primary form, but which still exhibits the old lettering along with the new,) Rogers Rock on Lake George, Bolton, Mass., and numerous other localities in the U. States.

Ligurite, from a talcose rock in the Appenines, is referred to sphene, by Dufrénoy.

Sp. 10. WÖHLERITE, *Scheerer;* Eukolite, *Scheerer.*

[H.=5·5. Gr.=3·0 . . . 3·4. Xls. tabular, massive, granular, reniform. Col. yellow-brown to grey.]

Primary form, right rectangular prism.

Secondary form. Primary, with the edges and angles much replaced. Cleavage distinct in one direction. Lustre vitreous, inclining to resinous. Color light yellow, wine-, honey-, resin-yellow, brownish, greyish. Streak yellowish white. Transparent, subtranslucent. Fracture more or less conchoidal to splintery.

B. B. in a strong heat, melts quietly into a yellowish or yellowish-green glass. With borax and salt of phosphorus, gives the colors of iron and manganese. Decomposed by strong hot, hydrochloric acid, leaving a residue of silicic and pelopic acids.

Analysis by *Scheerer*, of the yellow crystallized variety.

Silica, - - - -	30·62
Pelopic acid, - - - - -	14·47
Zirconia, - - - -	15·17
Perox. iron, - - - - -	2·12
Protox. manganese, - - -	1·55
Magnesia, - - - - -	0·40
Lime, - - - - -	26·19
Soda, - - - - - -	7·78
Water, - - - -	0·24

Analysis by the same chemist, of the brown, reniform variety, called by him, *Eukolite.*

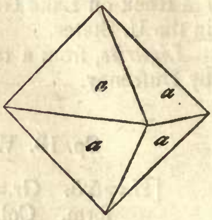
Silica, - - - -	47·85
Metallic acids and some zirconia, - -	14·05
Perox. iron, - - - -	8·24
Lime, - - - - - -	12·06
Protox. cerium, - - -	2·98
Soda, - - - - - -	12·31
Protox. mang., - - -	1·94
Magnesia, - - - - -	*traces*
Water, - - - -	0·94
	100·37

Brevig, Norway, in syenite.

Sp. 11. Pyrochlore. Hydrochlore and Fluochlore, *Hermann.*

[H.=5·0 . . . 5·5. G.=4·19 . . . 4·8. In small 8-dral xls. Dark reddish brown. L. resinous.]

Fig. 499



Prim. form cube. Secondary form, octahedron. Cleavage octahedral, and traces parallel with the cube. Fracture conchoidal. Translucent on the edges, to opaque. Rather brittle. Lustre dull, resinous, inclining to vitreous.

B. B. turns yellow, and melts with great difficulty into a blackish brown slag. With borax, gives a glass which is reddish yellow in the outer flame, and dark red in the inner. Some of the varieties yield the reaction of uranium. The powder is decomposed by concentrated sulphuric acid, and by fusion with bisulphate of potash.

Aanalyses, *a* from Miask by Wöhler, *b* from Brevig by Wöhler, *c* from Miask by Hermann, *d* from Fredericksvärn by Hayes.

	a	*b*	*c*	*d**
Tantalic acid,	67·38	67·62	60·83	53·10
Titanic acid,			4·90	20·20
Oxide cerium, }	13·15	5·16	15·23	
Thorina, }				
Lime,	10·98	9·88	9·80	19·45
Magnesia,	——	——	1·46	
Protox. iron,	1·29	1·33	2·23	
Peroxide iron,	——	——	——	2·35
Protox. mang.	0·15	1·69		
Yttria,	0·81		0·94	
Sodium,	3·93 ox.	} 4·60	2·69	
Fluorine,	3·23 uran.		2·21	
Water,	1·16	7·06		

Found in syenite near Friedricksvärn, and on the island of Lövö near Brevig in Norway; in granite in the Ilman Mts. near Miask; and in the Ural.

Sp. 12. Microlite, (*S.*)

[H.=5·5. G.=5·0—5·64. Xls. 8-dral. Minute. Straw-yellow to yellowish brown.]

Primary form cube. Secondary forms.

Fig. 500.

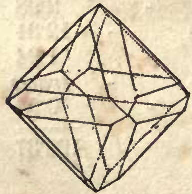
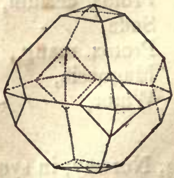


Fig. 501.



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* With oxides of U, Mn, Pb, and Sn.

Cleavage octahedral, imperfect. Lustre resinous. Transparent to translucent, on the edges. Streak white, except where the color of the mineral is brownish: it then resembles the color.

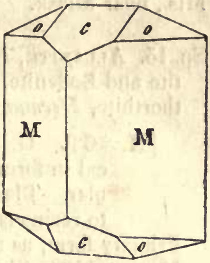
B. B. remains unaltered. It dissolves slowly in borax, rendering it yellow while hot. On cooling, it becomes paler; but remains transparent, unless when subjected to flaming. It then becomes nebulous, and presents a pale yellow enamel. The purest crystals consist of columbate of lime, with mere traces of yttria, oxide of uranium and iron, together with a little hygrometric moisture. The analysis of the author gave columbic acid 75·70, lime 14·84; that of Hayes, columbic acid 79·6, lime 10·87.

Found at Chesterfield, Mass., imbedded in albite and tourmaline.

Sp. 13. Lievrite, *Werner;* Ilvaite, *Hausmann;* Yenite.

[H.=5·5 . . . 6·0. G.=3·9 . . . 4·0. Xls. right rhombic prs. of 112°, with 4 and 6-sided summits. Col. iron-black.]

Fig. 502.



Elba.

Primary form, right rhombic prism. M on M=112° 37′.

Secondary form.

o on *o* = - - -	139° 37′
o on *o* over M - - -	77 16

Also with obtuse lateral edges bevelled.

Lateral faces striated, vertically. Cleavage parallel to P and the diagonals of the prism, indistinct.

Massive, columnar; rarely compact. Lustre sub-metallic, inclining to resinous. Streak black, inclining to green. Brittle. Fracture uneven. Opaque. Feebly magnetic, and conducts electricity.

B. B. on charcoal, melts readily into a black magnetic globule. With borax and salt of phosphorus, gives a glass, with the color of iron. Soluble in warm hydrochloric acid, forming when cold, a yellowish transparent jelly.

Analysis by Rammelsberg.

Silica, - - - - -	27·83
Peroxide of iron, - - - -	24·58
Protoxide of iron, - - - -	30·73
Lime, - - - - - -	12·44
Protox. manganese, - - -	1·51
	97·09

Found in attached xls., also in granular and fibrous masses at Rio la Marina and Cape Calamita in Elba, at Fossum in Norway, in Siberia, Greenland, the Hartz, and in the Tyrol.

Sp. 14. Tscheffkinite, *Hausmann.*

[H.=5·3. G.=4·50 . . . 4·54. Massive, velvet-black, opaque, vitreous; fracture flat conchoidal.]

In thin splinters, by transmitted light, brown. B. B. on the first application of heat, glows, intumesces, turns brown; and at last, melts into a black globule. In powder with borax, fuses readily into a clear glass, slightly colored by iron. Before ignition, gelatinizes in hydrochloric acid. Mean of six analyses by H. Rose:—

Silica,	21·04
Titanic acid,	20·17
Lime,	3·50
Magnesia,	0·22
Protox. mang.,	0·83
Protox. iron,	11·21
Oxides cerium, lanthanium, and didymium,	47·29
Potash and soda,	0·12

The excess of 4·38 p. c. arises from the peroxidation of the cerium during the analysis. The silica, when boiled with carb. soda, left behind a remainder, of from 2·09, to 4·29 p. c. The titanic acid appears to contain glucina, alumina and yttria. Found with feldspar in the Ilmen Mts., near Miask.

Sp. 15. **Allanite**, *Phillips;* Orthite, Pyrorthite, Ural-Orthite, Muromontite and Bodenite, *Kerndt;* Cerine; Bagrationite, *Kokscharov;* Xanthorthite, *Hermann.*

[H.=6·0. G.=3·1 . . . 4·2. Xls. right oblique angled prs., identical in form with those of epidote. Massive, foliated and granular. Black, passing into brown and green. Lustre vitreous to resinous.]

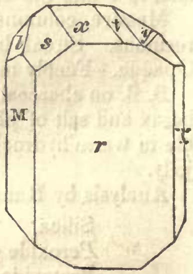
Primary form, as above. Secondary form.

M on *r* 116°, T on *r* 129°, *s* on *r*=135° 30′, *y* on *r* 109.° 1, *s* on *x* 156° 45′, *t* on *x* 164° 30′, *y* on *x* 151°, *y* on *t*=166° 30′

Cleavage parallel to *r* and M, distinct. Fracture imperfectly conchoidal. Lustre imperfectly metallic to resinous. Streak greenish-grey. Opaque, or faintly translucent and brown, in thin splinters. Brittle.

B. B. melts with intumescence into a brown or black magnetic glass. Generally decomposed by hydrochloric acid, forming a jelly. The allanite from Snarum is but very imperfectly attacked by hydrochloric acid; that from Bastnäs, not at all.

Fig. 503.



Analysis of *a* from Snarum by Scheerer, *b* variety orthite from Werchoturie by Hermann, *c* from Finbo by Berzelius, *d* var. cerine from Bastnäs by Hisinger.

	a	*b*	*c*	*d*
Silica,	35·75	32·46	36·25	30·17
Alumina,	15·49	18·09	14·	11·31
Protox. iron,	15·19 (with perox.)	13·84	11·42	20·72
Protox. cerium, and	19·96	6·77	17·39	28·19
Ox. lanthanium,		9·76		
Lime,	11·25	13·18	4·87	9·12
Magnesia,	0·77	1·02	——	
Yttria,	——	1·50	3·80	
Protox. mang.,	——	——	1·36	
Water,		3·40		

The pyrorthite from Kararfvet near Fahlun, is supposed to contain a mechanical mixture of carbon. When ignited at one point, it burns on, without flame or smoke; after which it becomes white, very porous, and may be melted with difficulty, into a black globule. With borax, in the inner flame, forms a blood-red glass, which becomes yellow on cooling. Analysis by Berzelius:—

Silica,	10·43
Alumina,	3·59
Lime,	1·81
Protox. cerium,	13·92
Protox. iron,	6·08
Yttria,	4·87
Protox. mang.,	1·39
Water,	26·50
Carbon and loss,	31·41

The *muromontite* is found in small grains with bodenite, in oligoclase, at Boden, near Marienberg in Saxony. H.=7·0. G.=4·265. B. B. glows, and is slightly fusible on the edges. It is decomposed by acids, leaving a jelly of silica. Analysis by Kerndt.

Silica,	31·09
Alumina,	2·24
Glucina,	5·52
Yttria,	37·14
Protox. iron,	11·23
Protox. mang.	0·91
Protox. cerium,	5·54
Ox. lanthanium,	3·54
Magnesia,	0·42
Lime,	0·71
Soda,	0·65
Potash,	0·17
Water and loss,	0·85

The *bodenite* is found at the same place. It occurs in long xls., and has in other respects, the properties of muromontite. It contains, according to Kerndt:

Silica,	26·12
Alumina,	10·34
Protox. iron,	12·05
Yttria,	17·43
Ox. lanthanium,	7·57
Lime,	6·32
Magnesia,	2·34
Protox. mang.,	1·62
Potash,	1·21
Soda,	0·84
Water,	3·82

Allanite is found at Iglorsoit in Greenland, at Hitteroe in Norway, at Finbo and Stockholm, at Werchoturie, and Minsk in the Ural: the variety called cerine at Riddarhytta in Sweden. At Sillböhle, near Helsingfors, xls. of epidote frequently occur, the interior of which consists of orthite. According to Breithaupt, the xls. are pseudomorphous.

Allanite is found in albite, associated with black muscovite, in granite veins at Haddam, Conn.; in distinct xls. in granite, at Royalston, Mass.; at Bethlehem, Pa., near West Point, and at Moriah and Monroe, N. Y.

Uralorthite (G.=3·4—3·64) from the Ilmen mts., has bitumen. According to Hermann, silica 35·49, alumina 18·21, protox. iron 13·03, protox. cerium 10·85, lime 9·25, magnesia 2·06, sesquiox. manganese 2·37, protox. lanthanium 2·37, water 2.

Xanthorthite. Color yellowish. G.=2·78—2·9. Consists of silica 27·59, alumina 16·14, protox. iron 16·01, protox. cerium 11·75, lime 2·28, magnesia 4·94, yttria 2·12, protox. mang. 1·55, water 11·46, carb. acid 6·71; *Bahr.*

Sp. 16. Gadolinite.

[H.=6·5. G.=4·2 . . . 4·4. Xls. small, rough, prismatic, amd massive; in rounded imbedded grains, often covered with a yellow crust. Black. Vitreous, inclining to resinous.]

Prim. form, oblique rhombic prism. M on M=115°. Secondary forms.

Fig. 504.

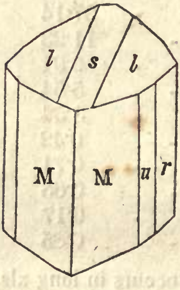
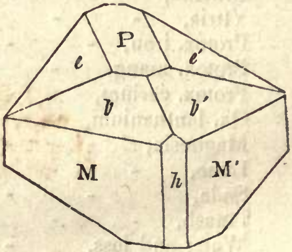


Fig. 505.



(Fig. 506,) M on M=115°, P on h=98°, M on e=100°, M on b=153°, b on b'=120°, e on e'=120°, b' on e'=130°, common goniometer. (Fig. 505, measurements by Haüy,) M on l=143° 12′, M on r=125° 16′, M on u=160° 32′, l on l=142° 8′, l on r=108° 50′, l on s=161° 11′, r on s=90°, r on u=144° 44′.

Cleavage in traces. Fracture conchoidal. Color dark greenish black. Streak, greenish grey. Translucent on the edges . . . opaque. Sometimes magnetic.

B. B. exhibits an instantaneous glow. In the strongest heat, the mass swells up, turns greyish-green, and is traversed by numerous fissures. In very thin fragments, it melts with difficulty into a greyish glass. Some varieties only intumesce. Soluble readily in borax, forming a glass colored by iron. Before ignition, completely decomposed by hydrochloric acid, leaving a jelly of silica.

Analyses, *a* from Hitteroe by Scheerer, *b* from Ytterby by Berlin.

	a	b
Silica,	25·78	24·85
Yttria,	45·67	51·46
Ox. cerium,	1·81	5·24
Ox. lanthanium,	4·75	
Protox. iron,	11·68	13·01
Glucina,	9·57	4·80
Lime,	0·34	0·50
Perox. iron,	1·28	
Protox. mang.,	——	1·11

Found in granite, gneiss, and syenite at Ytterby, Finbo, Broddbo and Korarfvet, Brevig and Hitteröe; in Ceylon, and in trap near Galway, Ireland. It occurs in the U. States, at Becket in Mass.

Sp. 17. Pyromelane, (*S.*)

[H.=6·5. G.=3·87. In loose, rather large, somewhat oblique angular shaped grains, whose surfaces are much pitted, like the grains of chondrodite. Reddish to yellowish brown and black.]

Primary form, unknown. Generally, in what appear to be fragments of crystals. Lustre resinous, to resino-vitreous. Translucent on the edges. Fracture, sub-conchoidal. Streak, somewhat paler than the color. Different shades of color, sometimes mingled in the same individual.

B. B. infusible, but turns black and becomes opaque; and hence its name, in distinction from pyrochlore, which by heating becomes greenish-yellow. It is soluble in the fluxes, with the reaction of titanic acid and iron. It is undecomposable with sulphuric acid, except in a slight degree, but yields to fusion with bisulphate of potash. It is essentially a titanate of alumina and iron, with traces of lime and glucina? It may contain zirconia also. It occurs with zircon, in the gold washings of McDowall county, North Carolina; where it is also attended by rutile, samarskite, monazite, brookite, xenotime, &c.

Sp. 15. Anatase: Octahedrite, *Jameson;* Oisanite.

[H.=5·5...6·0. Xls., octahedrons, with square base, rarely, with summits deeply truncated. Inclination of upper to lower pyramid, 136° 22′.]

Primary form, right square prism. Secondary forms.

Fig. 506.

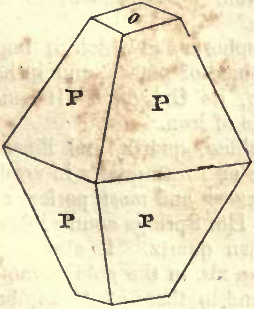
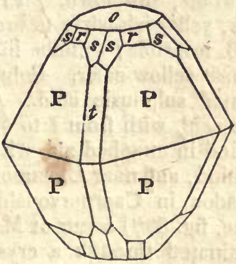


Fig. 507.



P on *o*=111° 17′, *r* on *o*=152° 27′, *r* on *s*=166° 30′, P on *s*=132° 5′. Cleavage parallel with P and *o* perfect. Surfaces generally smooth and bright. Lustre metallic to adamantine. Col., various shades of brown, blue, red and yellow. Streak, white. Brittle. Fracture, conchoidal

B. B. phosphoresces when suddenly heated, but is infusible. By long continued heating, the gravity rises to that of rutile. With borax, melts into a glass, which becomes yellow, and at last violet-blue, in the inner flame. Soluble with difficulty in salt of phosphorus, and produces the same color. It is not decomposed by the acids.

It consists of titanic acid, or titanium 60·13, oxygen 39·87, with upwards of 1 p. c. of peroxide of iron and traces of tin.

Found with feldspar, quartz, axinite, and epidote, in granite veins near Bourg d'Oisans in Dauphiné, in mica slate in the valley of Maggia in the Canton of Tessin, in the Grisons, in Salzburg, at Lichtenberg, and near Hof in the Fichtelgebirge, and in Cornwall, Spain, the Ural; with diamonds also, in the sand of a brook, near Itabira de Matto Dentro in Minas Geraes, in Brazil.

Sp. 16. Brookite, *Phillips;* Arkansite, (*S.*)

[H.=6. G.=3·85...4·17. Xls. small, short prs., often flat and much striated. Yellowish or reddish-brown to black. Lustre adamantine to metallic; shining.]

Prim. form, right rhombic prism. M on M=100. Secondary forms.

Fig. 508.

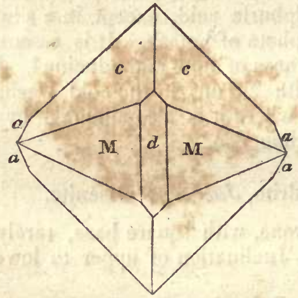


Fig. 509.

M on *d*=139° 55′, *a* on *a*=123°, *c* on *c*=134° 22′.

Cleavage, unknown. Fracture, uneven. Translucent to opaque. Streak, yellowish-white to brown. Brittle.

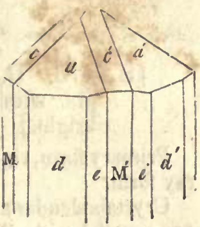
B. B. infusible; soluble in salt of phosphorus, to which it imparts a brownish yellow color. Soluble in bisulphate of potash, and in hot concentrated sulphuric acid. After ignition, its G.=4·19. It consists of titanic acid, with from 1 to 4 p. c. of oxide of iron.

Found in attached xls. with anatase, albite, quartz, and ilmenite, at Dauphiné, and near Chaumoni in Savoy; also with quartz in argillite, at Tremadoc in Caernarvonshire. The largest and most perfect xls. (arkansite, fig. 508) occur at Magnet Cove, Hot Springs county, Arkansas, disseminated through a crystallized brown quartz. It also occurs in grains. It is likewise found in small, loose xls. in the gold stream-works of Rutherford county, North Carolina, and in those of Altän, between Miask and Slatoust in the Urals.

Sp. 17. Rutile.

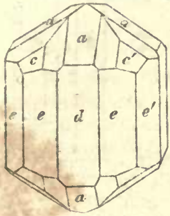
[H.=6·0...6·5. G.=4·22...4·30. Xls. right square prs., often in twins, the axes of the individuals making with each other angles of 114° 25′ and 65° 35′. Red to black. Lustre adamantine to metallic.]

Fig. 510.



Prim. form, right square prism. Secondary forms. M on *d*=135° 5′, M on *e*=161° 40′, M on *c*=122° 45′, *a* on *a*=123° 15′, *a* on *c*=151° 42′, *a* on *d* =123° 15′, *e* on *d*=153° 33′, *a* on *a* over summit, =90°, *c* on *c* over summit, =109° 47′ (*Phillips*).

Fig. 511.



Crowder's Mt., N. C.

Fig. 512.

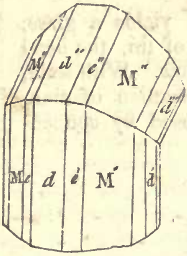
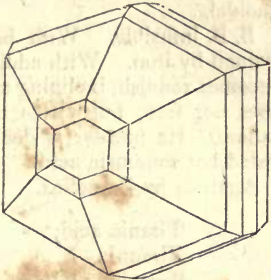


Fig. 513.



Twin xls. very frequent, axis of revolution perpendicular, face of composition parallel to face *a*. The composition produces geniculated groups, and is often repeated in several geniculations, as in fig. 513.

Thin and long individuals, produce after this law, a reticulated composition.

Cleavage parallel with M perfect, with *d* interrupted. Fracture conchoidal, uneven. Surface, *a* and *c* either smooth or rough, but both of the same quality; *d*, *e* and M vertically streaked. Lustre metallic, adamantine. Color, reddish brown, passing into red, sometimes yellowish. Streak, very pale brown. Translucent...opaque, sometimes in a strong light, transparent.

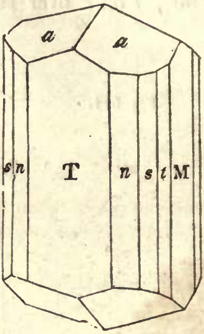
B. B. infusible. With borax, yields a greenish glass in the outer flame, and a dull violet one, in the inner flame; with salt of phosphorus, in the inner flame, yields a columbine-red glass, which on the addition of tin, becomes blue or violet. Soluble in bisulphate of potash. In powder, with soda, melts with intumescence. Soluble with difficulty, if in very fine powder, in hot concentrated sulphuric acid. Analysis by H. Rose:—titanic acid 98·5, per ox. iron 1·5. Ekeberg found chromium in rutile, from Käring-Bricka in Sweden.

This species is found very widely disseminated, in imbedded and attached xls. and massive in veins, in the older rocks, with quartz, feldspar, tourmaline and chlorite. It occurs in acicular xls. enclosed in quartz and in net-like aggregations, in Switzerland, Savoy, Brazil, and Vermont: in implanted xls. in the Saualp, in Karinthia, Stiria, Tyrol; in veins of quartz in chlorite-slate, at Windor, Mass., and in Chester and Lancaster counties, Penn.; at Crowder's mountains, N. C., and many places throughout New England; in pebbles and xls. in alluvium in Transylvania, Ceylon, St. Yrieux in France; at Horcajuelo in the province of Burgos in Spain, and in the gold-washings of Georgia and N. Carolina.

Sp. 18. Polymignite, *Berzelius.*

[H.=6·5. G.=4·77...4·85. Xls. long, slender, right rectangular prs. with edges and angles replaced. Col. black. Lustre bright.]

Fig. 514.



Primary form, right rectangular prism. Secondray form.

Crystals slender and striated lengthwise. Cleavage parallel with P imperfect. Lustre brilliant. Streak dark brown. Opaque. Fracture conchoidal.

B. B. infusible. With borax, yields a glass, stained by iron. With addition of tin, the bead becomes reddish, inclining to yellow. With soda, does not fuse, but yields the reaction of manganese. Its powder is decomposed by concentrated hot sulphuric acid.

Analysis by Berzelius.

Titanic acid, - - - -	46·30
Zirconia, - - - - -	14·14
Peroxide of iron, - - -	12·20
Lime, - - - - -	4·20
Sesquioxide of manganese, - -	2·70
Sesquioxide of cerium, - - -	5·
Yttria, - - - -	11·50
	96·04

with traces of potash, magnesia, silica, and oxide of tin. Found in zircon-syenite at Friedrichswärn in Norway, and with green feldspar, at Beverly, Mass.

Sp. 19. Euxenite, *Dufrénoy.*

[H.=6·5. G.=4·6. Massive. Brownish-black, by transmitted light, reddish brown.]

Lustre resinous, inclining to metallic. Streak reddish-brown.

B. B. infusible. In the outer flame, imparts a brownish yellow color to borax. Not acted upon by acids.

Analyses *a* of a small quantity from Jölster, *b* of a very similar mineral from near Tvedestrand, both by Scheerer:—

	a	*b*
Tantalic acid, with titanic acid,	49·66	53·64
Titanic acid, - -	7·94	
Yttria, - - -	25·09	28·97
Protox. uranium, - -	6·34	7·58

Protox. cerium, - - -	3·18	2·91
Ox. lanthanium, - - -	0·96	——
Protox. iron, - - - -	——	2·60
Lime, - - - -	2·47	——
Magnesia, - - - -	0·29	——
Water, - - - -	3·97	4·04

Jölster in Bergenhuus and Tvedestrand in Norway; also at Arendal, containing niobic, but no tantalic acid.

Appendix to Section B.

Sp. 23. SCHORLOMITE, (*S.*)

[H.=7·0 . . . 7·5. G.=3·78 . . . 3·80. Incomplete xls. and massive; black, vitreous, opaque.]

Primary form, cube.

Secondary form.

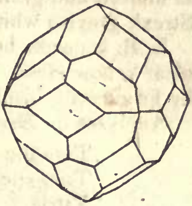


Fig. 515.

B. B. melts on the edges with difficulty, into a black mass. With borax, in the outer flame, forms a yellow bead, which becomes colorless on cooling: in the inner flame, with the addition of tin, yields a green bead. With salt of phosphorus, on charcoal, in the inner flame with tin, forms a violet bead. Partially decomposed by hydrochloric acid, forming a yellow solution, which on the addition of ammonia, yields a yellow precipitate. Analyses; *a* by Whitney, *b* by Rammelsberg, and *c* by Crosby.

	a	*b*	*c*
Silica,	27·89	26·09	28·36
Titanic acid,	20·43	17·36	21·56
Red ox. iron,	21·90	——	22·00
Protox. iron,	——	22·83	——
Lime,	30·05	31·12	30·72
Magnesia,	——	1·55	1·25

In analyses *a* and *c*, the silica contained some titanic acid; and in *a*, the ox. iron contained a little manganese. Found in masses of several ounces weight, along with elæolite, at Magnet Cove, Hot Springs county, Arkansas.

Section B. *Black and heavy. Streak colored.*

Sp. 24. MENGITE, *G. Rose;* Ilmenite, *Brooke.*

[H.=5·0 . . . 5·5. G.=5·48. Xls. short prisms, (2 or 3 lines in length,) having the form of a right rectangular prism, terminated by 4-sided pyramids; black; submetallic and splendent.]

Primary form, right rectangular prism.

Secondary form, as above.

Cleavage not discernible. Lustre of fracture, subvitreous. Fracture uneven.

B. B. infusible, but becomes magnetic. With salt of phosphorus in outer flame, gives a greenish, clear glass: in the inner, a yellowish red, which is deepened by the addition of tin. With soda, affords the test of manganese.

According to *G. Rose*, contains titanic acid, perox. iron and zirconia.

Found in albite, in granite veins, in the Ilmen mountains.

Sp. 25. YTTRO-TANTALITE, *Berzelius.*

[H.=5·0 . . . 5·5. Gr.=5·30 . . . 5·88. Crystalline plates and fragments of 4 to 6-sided prs., but irregular. Black, yellow and brown. Opaque.]

Primary form unknown.

Cleavage in one direction, more or less distinct. Fracture conchoidal to uneven and granular. Lustre imperfect metallic, inclining to resinous. Streak greyish white.

B. B. becomes brown or yellow, but is infusible. With borax, forms a clear yellow glass. It is not attacked by acids, but is wholly decomposed by fusion with bisulphate of potash.

Analyses by *Berzelius.*

Tantalic acid,	60·12
Tungstic acid,	1·04
Yttria,	29·78
Lime,	0·50
Oxide of uranium,	6·62
Perox. iron,	1·16
Water,	4·85

Found in feldspar with gadolinite, at Ytterby Sweden, in the granite veins of Finbo and Kararfsberg near Fahlun; and in the Ilmen Mts. near Miask in the Ural.

Sp. 26. AESCHYNITE, *Berzelius.*

[H.=5·0 . . . 6·0. G.=4·9 . . . 5·14. Xls. striated prs. rather imperfectly terminated at one extremity. Col. nearly black. Lustre dull, submetallic.]

Primary form, right rectangular prism.

Secondary form.

Fig. 516.

Cleavage, only traces. Fracture imperfectly conchoidal to uneven. Faintly translucent on the edges to opaque. Surfaces of fracture, resinous, bright. Streak yellowish-brown. Brittle.

In the matrass, yields a little water and traces of hydrofluoric acid. B. B intumesces and becomes yellow, or brown; but is nearly infusible. With borax, melts into a bead, which is yellow while hot, and colorless when cold. With tin, in the inner flame, becomes red. With salt of phosphorus, soluble with more difficulty into a clear bead, which with tin, in the inner flame, becomes purple. It is partially decomposed by sulphuric acid.

Analysis by *Hartwell.*

Niobic acid,	33·39
Titanic acid,	11·94
Zirconia,	17·52
Protox. iron,	17·65
Yttria,	9·35
Ox. lanthanium,	4·75
Protox. cerium,	2·48
Oxide tin,	2·40
Water, with traces of fluorine,	1·56

Found in a coarse grained rock, consisting of feldspar, albite and mica, near Miask, in the Ural.

Sp. 27. **Samarskite**, *H. Rose;* Uranotantal, *G. Rose;* Yttro-ilmenite, *Hermann.*

[H.=5·5 . . . 6. G.=5·45 . . . 5·69. Xls. tabular. Black. Imperfect metallic.]

Primary form, right rectangular prism.

Crystals imperfect, passing into merely flattened grains. Cleavage indistinct. Fracture granular to subconchoidal. Lustre on surface of fresh fracture, rather bright. Streak dark and reddish brown. Color velvet black. Opaque.

By ignition, Gr. is reduced from 5·7 to 5·3. Slightly heated in the matrass, decrepitates, yields a little moisture, glows like gadolinite, and assumes a blackish brown color. B. B. melts on the edges into a black glass. With borax, in powder, fuses easily; and forms in the inner flame, a yellowish glass; in the outer, one which is yellowish green. With salt of phosphorus, it gives a clear emerald-green glass. Soluble with difficulty in hydrochloric acid, forming a green solution.

Analyses; 1, by *Peretz*, under *G. Rose;* 2, by *Hermann*, both from the Ilmen mountains; 3, by *T. S. Hunt*, from North Carolina.

	1.	2.	3.
Metallic acids,	56·38	57·81	54·81
Yttria,	9·15	18·30	11·11
Protox. iron,	15·43	13·61	14·07
Protox. mangan.	0·92	0·31	—
Lime,		0·50	*traces*
Ox. uranium,	14·16	1·87	17·03
Magnesia,	0·80	—	—
Titanic acid,	—	5·90	—
Oxides cerium and lanthanium,	—	2·27	3·95

The acid is chiefly the columbic, with some tungstic and titanic. Hermann's name for the species, refers to the supposed presence of a new metal, called by him *ilmenium.*

Found in feldspar with æschynite, near Miask in the Ural mountains; and in loose crystals and grains, in the gold washings of Rutherford Co., North Carolina.

Sp. 28. Rutherfordite, (*S.*)

[H.=6·0...6·5. G.=5·58...5·69. Xls. irregular prisms, slightly rhombic; massive in large grains (fragments of crystals). Yellowish brown. Resinous. Fracture conchoidal.]

Primary form, oblique rhombic prism. M on M about 93.

Secondary form, the primary, terminated by irregular 4-sided pyramids, with faces inclining to lateral planes.

Surfaces of xls. dull and rather uneven. Cleavage not visible. Lustre of fracture, shining and resinous. Color often chocolate-brown. Opaque.

When heated in a tube, flies to pieces, glows as if on fire, emits much moisture, and turns yellow. By itself, it is infusible; but with borax, dissolves slowly into a clear yellow glass. Decomposed with difficulty, by long boiling, in hydrochloric acid. It is easily attacked by sulphuric acid; the solution at first formed, subsequently letting fall an abundant white precipitate. The solution, after filtration and boiling, immediately becomes milky. Ammonia throws down no precipitate from the sulphuric solution. Hydrochloric acid was boiled upon the precipitate (produced by the ebullition of the sulphuric solution) and the liquid on being heated with a concentrated solution of sulphate of potash, afforded a copious granular, white precipitate, which yielded oxide of cerium mingled with oxide of uranium? Besides titanic acid, and the oxides of cerium and uranium?, lime and yttria are supposed to enter into the composition of this mineral. Mr. T. S. Hunt gives the titanic acid as high as 58·5 p. c., the lime at 10 p. c.

Found in very small quantity, in the washings of gold mines, in Rutherford county, North Carolina, where it is accompanied by rutile, brookite, samarskite, monazite, zircon, &c.

Rutherfordite has many properties in common, with both samarskite and fergusonite; but in composition, approaches yttro-tantalite, except in having titanic, in place of columbic acid.

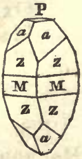
Sp. 29. Fergusonite, *Haidinger.*

[H.=5·5...6. G.=5·83. Xls. acute, double four-sided pyramids, with edges of the oblique base slightly truncated: obtuse angles of pyramidal faces inclining under 91° 59′. Brownish black.]

Primary form, oblique rhombic prism?

Secondary form.

Fig. 517.



Surfaces rather uneven. Cleavage only in traces. Fracture conchoidal. Opaque. In thin splinters, transluscent. Lustre imperfectly metallic, inclining to resinous. Streak pale brown. Brittle.

B. B. infusible, but loses color. With borax, fuses with difficulty into a glass, which is yellow while hot. With soda, decomposed without solution, leaving a reddish slag, which affords globules of tin.

Analysis by *Hartwall.*

Tantalic acid,	47·75
Yttria,	41·91
Protox. cerium,	4·68
Zirconia,	3·02

Oxide of tin, - - -	1·00
Oxide of uranium, - - -	0·95
Protox. iron, - - - -	0·34
	99·65

Found by Gisecké, near Cape Farewell in Greenland, disseminated in quartz; and named in honor of Robert Ferguson, of Caith.

The resemblance between the crystals of this species and those of rutherfordite, is very striking.

Sp. 30. Polycrase, *Dufrénoy*.

[H.=6·0. G.=5·10. Xls. short six-sided prs. Black. Lustre metallic. Fracture conchoidal.]

No cleavage observable. In thin fragments, transluscent. By transmitted light, yellowish brown. Streak greyish-brown.

In the matrass, decrepitates. Ignited, quickly glows, like gadolinite, and assumes a light brown color, but without any change of specific gravity. B. B. infusible. Soluble in borax, imparting a yellow color in the outer flame, and a yellowish brown color in the inner flame. Imperfectly decomposed by hydrochloric acid, and completely, by hot sulphuric acid. According to Scheerer, contains titanic and tantalic acid, zirconia, yttria, red ox. iron, oxide of uranium and cerium, a small quantity of alumina, magnesia, and perhaps some alkali. Found in xls. in granite veins, at Hitteroe in Norway.

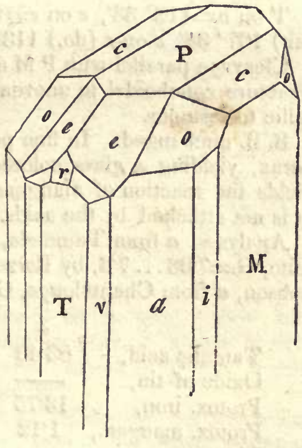
Sp. 31. Columbite; Niobite, *Haidinger;* Baierine, *Damour;* Torrelite, *Thomson.*

[H.=6. G.=5·4...6·3. In rt. rectang. prs. Rarely massive. Greyish black. Often iridescent. Opaque.]

Primary form, right rectangular prism.
Secondary form.

T on *v* - -	157° 40′
T on *a* - - - -	129 30
T on *i* - -	112 10?
v on *a* - - -	150 10
a on *i* - -	162 30?
M on *a* - - -	140 40
M on *v* - -	107 45?
P on *e* - - -	160 23
M on *c* - -	109 37
c on *o* - - -	140 30
a on *o* - -	144 00
M on *o* - - -	128 30
e on *e* - -	150 17
a on *e* - - -	126 30
P on *e* - -	136 36
P on *o* - - -	127 00

Fig. 518.



Middletown, Conn.

Cleavage parallel with M and T, rather distinct, especially that of M; the cleavage parallel with P, less obvious. Fracture imperfectly conchoidal, uneven.

Surface, M and T vertically streaked. Lustre imperfectly metallic. Color, greyish and brownish black. Streak, dark brownish black, on the file, a little shining. Opaque. Brittle.

B. B. on charcoal, infusible. With borax, affords a blackish green glass. Composition, essentially, protoxide of iron and manganese with columbic acid. Analyses: *a* from Bodenmais by H. Rose; *b* from Limoges by Damour; *c* from Middletown by Hermann; *d* from Middletown by Rose.

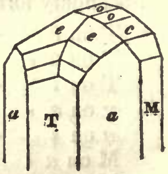
	a	*b*	*c*	*d*
Columbic acid,	81·07	78·44	78·22	79·62
Protox. iron,	14·30	14·96	14·06	16·66
Protox. mang.,	8·85	6·52	5·63	4·44
Stannic acid,	0·45	——	0·40	0·47
Oxide of copper,	0·13	——	——	0·06
Lime,	*trace*	——	——	*trace*
Tungstic acid,	——	——	0·26	
Manganese,	——	——	0·49	

Found in granite, generally associated with beryl, on the Rabenstein, near Twiesel and Bodenmais, in the Ilmen mountains, at Limoges in France; but most abundantly at Middletown and Haddam in Connecticut. At both the last mentioned localities, crystals weighing one pound and upwards, have occurred. Other American localities are Goshen and Chesterfield in Massachusetts, and Acworth, New Hampshire.

Sp. 32. TANTALITE; Ferro-tantalite; Cassitero-tantalite, *Hausmann;* Sidero-tantalite; Tammela-tantalite; Kimito-tantalite.

[H.=6 . . . 6·5. G.=7·0 . . . 8·0. In rt. rectangular prs. and angular imbedded particles. Iron-black. Lustre imperfect metallic. Streak, brown.]

Fig. 519.



Primary form, right rectangular prism.

Secondary form.

T on a=118° 33′, e on e=126°, o on o (over summit) 167° 38′, c on c (do.) 113° 48′.

Cleavage parallel with P M and T, all very imperfect. Fracture conchoidal to uneven. Opaque. Lustre metallic to resinous.

B. B. unchanged. In fine powder, slowly soluble in borax, yielding a glass colored by iron. With soda, yields the reaction of manganese, and traces of tin in the inner flame. It is not attacked by the acids.

Analyses, *a* from Tammela, G.=7·264, by Nordenskiöld, *b* from Kimito, G.=7·03 . . . 7·3, by Berzelius, *c* from Tammela, G.=7·197, by Jacobson, *d* from Chantéloupe, G.=7·65, by Damour.

	a	*b*	*c*	*d*
Tantalic acid,	83·49	83·2	84·15	82·98
Oxide of tin,	——	0·6	0·32	1·21
Protox. iron,	13·75	7·2	14·68	14·62
Protox. mangan.,	1·12	7·4	0·90	*trace*
Lime,	——	——	0·07	——
Ox. copper,	——	——	1·81	0·42

A variety from Broddbo has a black streak, H.=5·0...7·0. G.=6·2...6·4, and has a part of the tantalic acid replaced by tungstic acid, having 6 p. c. of tungstic acid and 8 of oxide of tin.

Found imbedded in granite, containing albite or oligoclase, seldom feldspar, in Finland, at Tammela and Kimito. Also at Finbo, near Fahlun; and at Chantéloupe near Poitiers in France.

Sp. 33. Cassiterite, *Beudant;* Tin-ore, Tin-stone, Wood-tin, Stream-tin.

[H.=6·0...7·0. G.=6·3...7·1. Xls. square prs. with low four-sided summits; often in twins. Massive; reniform, columnar, granular and compact. Brown to black.]

Primary form, right square prism.

Secondary forms.

Fig. 520.

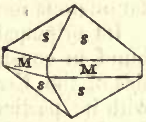
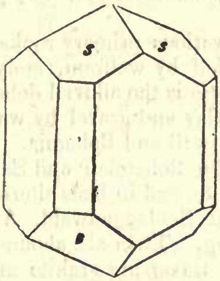
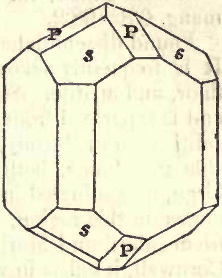


Fig. 521.



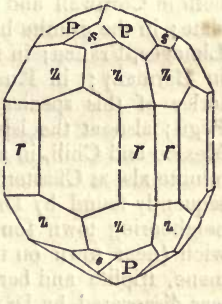
Cornwall.

Fig. 522.



Goshen, Mass

Fig. 523.

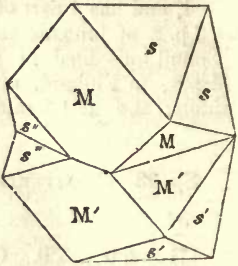


P on P over the prism,		67° 50′
P (contiguous)		133 50
s on *s*		121 35
over M,		87 17
z on *z*	159° 6′, and	118 16
over *r*,		135 17
r on *r*		157 23

Cleavage *s* and M not very distinct, traces of P. Fracture imperfectly conchoidal, uneven. Surface M often uneven, *s* sometimes irregularly striated parallel to the edges of combination with P, and the latter pyramid parallel to those with *s*. The prisms are sometimes vertically streaked. Lustre, adamantine. Color, various shades of white, grey, yellow, red, brown, black. Streak, pale grey; in some varieties, it is pale brown. Semi-transparent, sometimes almost transparent, to nearly opaque. Brittle. Gr. of a crystal, 6·51, of a columnar variety, 7·1.

Compound Varieties.—Twin xls.; axis of revolution perpendicular, face of composition parallel to one of the faces of P. Small reniform, rarely botryoidal shapes; composition very thin, columnar, divergent from common centre, strongly connected, and often forming a second curved lamellar composition. Massive: composition granular, sometimes almost impalpable, strongly connected, fracture uneven. The *wood-tin* of the Cornish miners is only a variety of cassiterite; in the same manner, as the fibrous red hematite, is of crystallized hematite.

Fig. 524.



B. B. in a platina forceps, it is unalterable. Upon charcoal, in a strong heat, it is reduced to the metallic state. The reduction is promoted by the addition of carbonate of soda. It is not attacked by acids. Fused with caustic potash, it yields a mass, which is mostly soluble in water. Hydrochloric acid, added to the solution, occasions a white precipitate, which is again dissolved. Hydriodic acid produces a yellow precipitate.

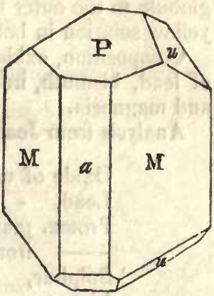
Composition, tin 78·38, oxygen 21·62. Berzelius found in a specimen from Finbo, tin 93·6, columbic acid 2·4, perox. iron 1·4, sesquiox. mang. 0·8=98·2.

Found disseminated in various primary rocks, particularly in granite. It is frequently accompanied by wolfram, molybdenite, blende, topaz, fluor, and apatite. *Stream-tin* is the alluvial debris of stanniferous rocks; and is separated from the clay and gravel by washing. Its principal localities are in Saxony, Cornwall and Bohemia. It is found in considerable abundance, both on the Bohemian and Saxon sides of the Erzgebirge, disseminated in granite, and in beds alternating with it; particular mines in this region, are at Schlaggenwald, Altenberg, Gezer, Ehrenfriedersdorf, and Marienberg. Twin xls. abound at Schlaggenwald. In Cornwall, it exists in veins, traversing granite and schist; and is accompanied by chlorite, fluor, quartz, topaz, tourmaline, mispickel, wolfram and blende. At St. Michael's mount, it is disseminated through granite. The ore is chiefly in the state of single crystals. Stream works exist both in Cornwall and Saxony. It is found in Galicia, Spain, in mica-slate; in the granite hill of Puy des Vignes, Haut Vienne, at Vaulry near Limoges, France; in the mountain chains of Fichtel and Reisengebirge in Germany; in Russia, and at Broddbo in Sweden. Other repositories of this species are, on the east coast of Sumatra, Siam and Pegu; also at the island of Banca and Malacca, and in Australia; in Mexico and Chili, in alluvium. In the U. S. it was first noticed in a few minute xls. at Chesterfield, Mass., in albite and tourmalime. It was subsequently found by Dr. Hitchcock under similar circumstances, in the neighboring town (on the east) of Goshen; and more recently, in Norwich (next town on the south of Chesterfield), in granite with spodumene, triplite and beryl. Also at Jackson, New Hampshire, where it was discovered by Dr. C. T. Jackson, in a slate-rock, in such quantity, as to justify the opinion of its ultimately giving rise to a profitable mine.

Sp. 34. WOLFRAM.

[H.=5·0 . . . 5·5. G.=7·0 . . . 7·5. Xls. prismatic, resembling those of columbite. Also lamellar, columnar and granular. Brownish black. Opaque.]

Fig. 525.



Primary form, oblique rhombic prism. M on M =101° 5′.

Secondary form.
M on *a*=140° 32′.
P on *a*=117 20.
u on *u* over P=99° 12′.

Cleavage parallel with *a* perfect. Fracture uneven. Surface, M and *a* streaked vertically. P sometimes curved. Lustre metallic adamantine, or imperfectly metallic. Streak dark reddish brown. Not very brittle. Twin xls.: 1. Face of composition parallel, axis of revolution perpendicular to *a*. 2. Face of composition parallel, axis of revolution perpendicular to a face of *u*. In columnar massive varieties, the individuals are large, straight or divergent; and often strongly coherent. Pseudomorphoses, in the shape of tungsten.

B. B. on charcoal, in a strong heat melts into a magnetic globule, the surface of which is covered with crystals. With borax, yields the reaction of iron. With salt of phosphorus, forms a bead which in the inner flame, is dark red, and with the addition of tin becomes green. It imparts a green color to soda. Soluble in bisulphate of potash. The powder, is decomposed by hydrochloric acid, leaving a yellow residuum.

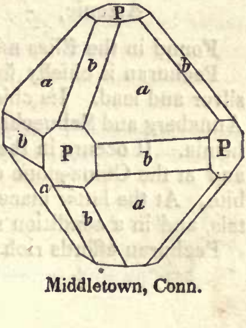
Composition, tungstate of protoxide iron and manganese. Analyses of *a* from Ehrenfriedersdorf, G.=7·5, *b* from Chantéloupe, G.=7·48, *c* from Monroe, Conn., G.=7·41, *d* from Trumbull, Conn., G.=7·23, all by *Kerndt.*

	a	*b*	*c*	*d*
Tungstic acid,	75·85	75·83	75·47	75·76
Protox. iron,	19·26	19·33	9·53	9·74
" mang.,	4·87	4·84	14·26	14·50

Found with cassiterite in Bohemia at Schlackenwald and Zinnwald; in Saxony at Schneeberg, Freiberg and Altenberg; in France at Limoges; in the Hartz, in veins with galena; in Cornwall England, Nertschinsk in Siberia, and at Monroe and Trumbull in Conn.; at the latter place, often in pseudomorphous crystals.

Sp. 35. **Pechuran**, ***Hausmann;*** Pitch-blende, ***Phillips;*** Uranine, ***Haidinger;*** Pecherz, ***Werner;*** Nasturan, ***Kobel;*** Gummierz, Pittinerz, ***Breithaupt;*** Coracite, ***Leconte;*** Eliasite, ***Haidinger;*** Uranpecherz.

Fig. 526.



Middletown, Conn.

[H.=5·5. G.=6·4 . . . 6·71. Rarely in 8-dral xls., generally massive. Fracture conchoidal. Black, opaque.]

Primary form, cube.

Secondary forms.

Lustre imperfectly metallic. Color greyish black, to iron-black; also greenish black and brownish black. Streak black, a little shining. Brittle. Sometimes, reniform; composition, curved lamellar, and columnar.

B. B. infusible. With borax and salt of phosphorus, yields a yellow globule in the outer flame, and a green one in the inner flame. Forms a yellow solution in hot nitric acid.

Composition, oxide of uranium, with from 20 to 24 p. c. of the oxides of lead, bismuth, iron, arsenic and hydrated intermixtures of silica, lime and magnesia.

Analysis from Joachimsthal by *Ebelmen.*

Oxide of uranium,	75·94
Lead,	4·22
Protox. manganese,	0·82
—— iron,	3·10
Sulphur,	0·60
Lime,	5·24
Magnesia,	2·07
Silica,	3·48
Water,	1·85
Soda,	0·25
Carbonic acid,	3·32

The *pittinerz* has an olive green streak. H.=3·0 . . 3·5. G.=4·8 . . . 5·0. The *gummierz* has H.=2·5 . . . 3·0. G.=3·9 . . . 4·18. Color hyacinth red, yellowish and reddish brown, and resembles gum. Besides containing traces of phosphoric acid, it has 15 p. c. of water. Coracite is black and compact. H.=3·0. According to Whitney, it is composed of ox. uran. 72·60, ox. lead 6·56, lime 5·99, perox. iron 2·74, alumina 1·10, water 5·68, silica 5·33. *Eliasite* occurs in flattened pieces, half an inch thick. H.=3·5. G.=4·0 . . . 4·23. Lustre greasy to subvitreous. Color dull reddish brown, inclining to hyacinth red, on thinnest edges. Streak dull, wax-yellow to orange. Subtranslucent.

Analysis by *F. Ragsky.*

Ox. uranium,	61·33
Alumina,	1·17
Perox. iron,	6·63
Protox. iron,	1·09
Lime,	3·09
Magnesia,	2·20
Ox. lead,	4·62
Silica,	5·13
Carbonic acid,	2·52
Phosphoric acid,	0·84
Water,	10·68
Arsenic,	*traces*

Found in the Elias mine at Joachimstahl.

Pechuran is chiefly found in silver veins, attended by various ores of silver and lead. Its chief localities are Johanngeorgenstadt, Marienberg, Annaberg and Schneeberg in Saxony, and Joachimsthal and Fribus in Bohemia. It occurs in the tin-mines of Tincroft and Tolcarn in Cornwall, and at the China-stone quarry in Middletown, Conn., along with columbite. At the latter place, it has been found not only massive, but in crystals, and in a condition resembling the pittinerz.

Pechuran affords rich orange and black colors in porcelain painting.

Section C. *Semi-heavy, black when in crystals,—a few species, brown and red-brown, if massive.*

Sp. 36. **Chromite**, *Haidinger*. Chrome-Iron, Chromate of Iron.

[H.=5·5. G.=4·32...4·56. Xls. 8-dral. Iron black. Opaque.]

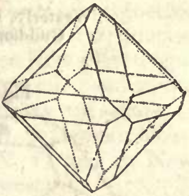
Primary form, cube.

Secondary form.

Cleavage octahedral, imperfect. Fracture conchoidal to uneven Lustre imperfectly metallic. Color between iron-black and brownish black. Streak brown. Brittle. Massive: composition granular.

B. B. alone, infusible; but acts upon the magnetic needle, after having been exposed to the reducing flame. It is soluble with difficulty in borax, to which, it imparts a beautiful green color.

Fig. 527.



Bare Hills & Hoboken.

Composition, one atom of protox. iron to one of sesquiox. chromium, with a partial substitution of magnesia for the former, and of alumina for the latter. Analyses; *a* from Baltimore by Abich, *b* from the same locality by Rivot, *c* from Siberia by Laugiers, *d* from Chester Co., Pa., by Seybert.

	a	*b*	*c*	*d*
Protox. iron,	20·13	30·04	24·00	35·14
Magnesia	7·45			
Sesquiox. chromium,	60·04	63·37	53·00	51·56
Alumina,	11·85	1·95	11·00	9·72
Silica,			1·00	2·90
Protox. mang.,			1·	

Found mostly in serpentine, embraced in irregular veins and beds. It was first noticed in the department of du Var, in France. It occurs in Stiria, in the Gulsen mountains near Kraubat. Other localities are Portsoy in Banffshire, and in Buchannan in Stirlingshire, in Scotland; at Unst and Fetlar in the Shetland isles, in Silesia, Bohemia, in Asia Minor, and in the Ural mountains. It is still more abundant in the U. S., existing at Bare Hills, near Baltimore, Md. (where it is mined to the extent of above 1000 tons annually); in Montgomery Co., six miles north of the Potomac; at Cooptown, Harford Co., and, in the north part of Cecil Co., Md.; in West Goshen, Pa., Nottingham, Mineral Hill, and elsewhere; and very abundantly at Texas, Lancaster Co.; very frequent in the western counties of North Carolina; at Milford and West Haven, Conn.; in Chester and Blanford, Mass.; in New Fane, Jay, Troy, and Westfield, Vt.; and in the gold sands of California.

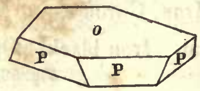
Used for extracting the oxide of chromium, which is employed either alone, or in various combinations, both for painting on porcelain, and for painting in oil.

Sp. 37. **Ilmenite**, *Kupffer;* Crichtonite, *Bournon;* Titanate of Iron, Menaccanite, Kibdelophan, Basanomelan, *Kobel;* Hystitite, Mohsite, *Levy;* Washingtonite, (*S.*)

[H.=5·0...6·0. G.=4·5...5·0. Xls. mostly tabular,—the hexagonal form preponderating. Cleavage, terminal. Massive, in thin plates, and granular, in loose grains. Iron-black.]

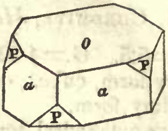
Primary form, rhomboid of 86°.
Secondary forms.

Fig. 528.



Westerly, R. I., and
Guildford, Vt.

Fig. 529.



Litchfield, Conn.

Fig. 530.

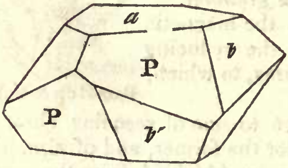
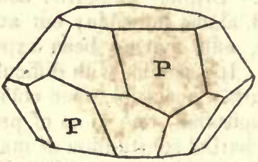


Fig. 531.



P on *a* = 122° 23′
b = 128 1
a on *a* = 120° 00′

Cleavage imperfect parallel to P, and rarely in traces, with *a*. Fracture, chonchoidal. No cleavage parallel to *o* except from interlamination of quartz, or composition. Surfaces rarely smooth; P and *o*, the most so. Lustre, imperfectly metallic. Color, dark iron-black. Opaque. Brittle.

Twin xls.: axis of revolution perpendicular, face of composition parallel to *o;* angle of revolution =60°. These compositions are not quite regularly formed. It also occurs massive, columnar, and granular, the latter giving rise to loose grains and sand.

B. B. infusible; but changes to a greyish black color. Unmagnetic before, and after ignition. With borax, it fuses, with effervescence, into a clear, green glass, having a shade of yellow. With salt of phosphorus, it dissolves, forming an opaque, orange-yellow glass, which on cooling, passes to an opaque pearl-white. Its powder is decomposed by long boiling in hydrochloric acid; an abundance of titanic acid separates from the solution, and the clear fluid, after neutralization by ammonia and precipitation by succinate of ammonia, yields with carbonate of potash, a slight precipitate of carbonate of manganese.

Composition, perox. titanium and perox. iron, in somewhat variable proportions. The following table by Dana, exhibits these proportions as the result of 20 analyses by different chemists.

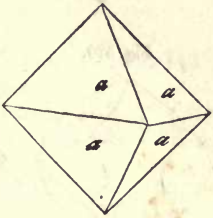
	Ti		Fe						
Anal. 1,	5	:	4	(G.=4·66)=53·6	perox.	Ti to	46·4	perox.	Fe.
" 2,	1	:	1	(4·727)=48·1	"	"	51·9	"	"
" 3–5,	4	:	5	(4·77)=42·5	"	"	57·5	"	"
" 6–9,	2	:	3	(4·74)=38·2	"	"	61·8	"	"
" 11,	1	:	3	(4·93)=23·6	"	"	76·4	"	"
" 14,	1	:	4	(" 4·96)=18·8	"	"	81·2	"	"
" 15,	1	:	6	(" 4·78)=13·4	"	"	86·6	"	"
" 17,	1	:	8	=10·4	"	"	89·6	"	"
" 20,	1	:	10	(" 5·127)= 8·5	"	"	91·5	"	"

H. Rose supposes that the titanic acid and protoxide of iron found in the analyses of ilmenite, arise from an oxidation of the titanic oxide, at the expense of the perox. iron, during the process. The ilmenite of Egersund gave H. Rose the following result:—titanic acid 43·73, perox. iron 42·70, protox. iron 13·57.

Found with dolomite in talc, at Gastein in Salzburg, Lappach in the Tyrol, in miascite on Lake Ilmen near Miask, in Norway at Tvedestrand, Friedrichswärn in zircon-syenite, Arendal in beds of magnetite, Bourg d'Oisans in Dauphiné in drusy cavities with albite, quartz, anatase and brookite, in isolated grains in alluvium at Iserwiese in the Kiesengebirge, in the gold stream-works at Ohlapian in Transylvania, and in the U. States, at Washington and Litchfield, Conn. in quartzy mica-slate, at Westerly, R. Island in granite, at Guildford, Vermont, at Canton, Cherokee Co., Georgia, at several places in Orange Co., N. Y., and in New Jersey in connection with spinel and serpentine, in limestone.

Sp. 38. IRITE, *Hermann*.

Fig. 532.



[Gr.=6·506. Xls. 8-drons. Black, shining.]
Primary form, cube.
Secondary form.
Structure thin foliated. Magnetic.
Analysis by Hermann.

Perox. iridium, - - -	62·86
Protox. osmium, - - -	10·30
Protox. iron, - - - -	12·50
Perox. chromium with traces of manganese,	13·70
	99·36

Found in the Ural with platinum, ilmenite, iridosmine and zircon.

Sp. 39. ISERINE.

[H.=6·0 . . . 6·5. Gr.=4·85 . . . 5·1. In cubic xls., also in grains. Iron-black, metallic.]

Primary form, cube. Secondary forms.

Fig. 533.

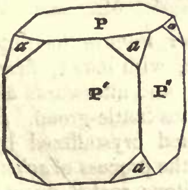
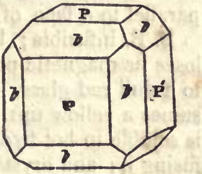


Fig. 534.

Fig. 535.



Streak black. Brittle. Magnetic.

Analyses; *a*, by Rammelsberg; *b*, by Rhodius; *c*, by Walterhausen.

	a	*b*	*c*
Sesquiox. titanium,	11·51	8·69	11·14
Sesquiox. iron,	48·07	61·27	58·86
Protox. iron,	39·16	31·80	30·00
	98·74	101·76	100·00

Variety *a*, from Unkel, Rhine, has been called *slag-like magnetite.* It is found in basalt, in Bohemia, Saxony, Calabria, and near Puy-de-dome in France.

Sp. 40. MAGNETITE, *Haidinger;* Oxydulated Iron, Magnetic Iron-ore.

[H.=5·5 . . . 6·5. G.=4·9 . . . 5·2. Xls. 8-dral, rarely 12-dral. Massive, granular. Iron black, magnetic.]

Primary form, cube.

Secondary forms.

Fig. 536.

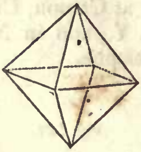


Fig. 537.

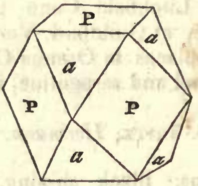


Fig. 538.

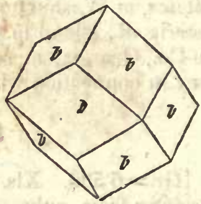
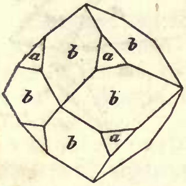


Fig. 539.



Amherst, N. H.
Haddam, Conn.

Fig. 540.

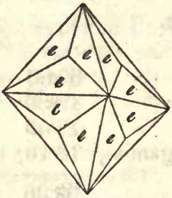
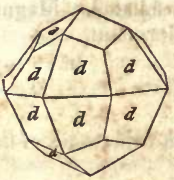
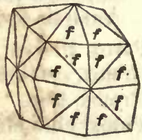


Fig. 541. Franconia, N. H.



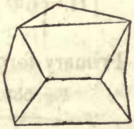
Zillerthal.

Fig. 542.



The faces usually striated parallel to their intersections with *a*. Faces of the galenoid (fig. 540) curved, though smooth. Cleavage octahedral. Fracture conchoidal to uneven. Also, in irregular forms and grains. Lustre metallic; in some varieties imperfect. Color iron-black. Streak black. Opaque. Brittle. Compound varieties. Twin crystals: axis of revolution perpendicular, face of composition, parallel to a face of the octahedron.

Fig. 543.



B. B. infusible; but assumes a brown color. After intense heating, loses its magnetic properties. In the oxydizing flame, with borax, fuses to a dull red glass, which becomes clear on cooling, and afterwards assumes a yellow tint. In the reducing flame, it becomes bottle-green. It is soluble in hot hydrochloric acid. It may be obtained crystallized by fusing it; and crystals are likewise often produced in the process of roasting the ore which contains this mineral; also in pyritous rocks, during spontaneous fermentation, as at Green River, Henderson Co., N. C.

Composition, $\dot{\mathrm{Fe}}\,\dddot{\mathrm{\bar{F}e}}$, or iron 72·4, oxygen 27·6. The *talkeisenstein* of Breithaupt, said to be from Sparta, New Jersey, contains magnesia. Its Gr.=4·41 . . . 4·42.

Occurs in beds in primary rocks, as gneiss, greenstone, talcose and chloritic slate, rarely also in limestone. Immense masses of magnetite exist in Norway, near Arendal, at the Taberg in Smaland in Sweden, at Dannemora in Upland, the island of Utö, near Norberg in Westmanland, Philipotan and Normark (in dodecahedral crystals) in Wermeland, in Lapland, in the Ural in Wissokaja Gora, near Nischne-Tagilsk; in the Hartz, Saxony, Bohemia, Stiria, Moravia, Silesia and Corsica. Magnetite abounds in the northeastern counties of New York, where it exists in beds in granitic gneiss and syenitic granite, as at Crown Point in Essex county; also in Orange (at Monroe in cubes, and other forms), Putnam and Herkimer counties, also in the mountainous districts of New Jersey and Pennsylvania, at Franconia, New Hampshire, likewise in the northern portions of Union, Spartanburg and York districts of South Carolina, and in the contiguous counties of North Carolina. Native magnets of great strength have been found at Suckasunny mine in New Jersey, and near Magnet Cove in Arkansas. The most celebrated native magnets are from Siberia and the Hartz. Large beds of this species abound in Canada West at South Crosby, Marmora and Madre.

This is one of the most valuable of all the ores of iron, for giving (with charcoal) a tough bar-iron, and particularly, one suited to the fabrication of steel.

Sp. 41. Dimagnetite, (*S.*)

[H.=5·5 . . . 6·5. G.=5·0. In slender rhombic prs. of 110 to 115°, one to two inches in length. Black; magnetic.]

Primary form right rhombic prism, as above. Secondary form, the primary, with its obtuse lateral edges bevelled. Fracture subchoncoidal, to even. Lustre feebly shining. Brittle.

B. B. same as magnetite: and composition the same, it being dimorphous with that species.

Found singly and in fascicular groups, on crystals of magnetite, at Monroe, Orange Co. N. Y.

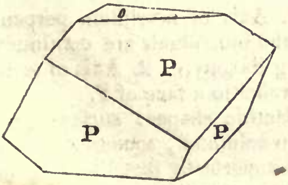
Sp. 42. Hematite; Specular Iron, Iron-glance, Oligiste Iron, Red Iron-ore, Red Hematite, Micaceous Iron-ore, Red Clay Ironstone, Red Ochre, Iron-Foam.

[H.=5.5 . . . 6·5. G.=4·5 . . . 5·3. When in crystals, generally in rhomboids, much modified, often tabular; but mostly massive, granular, micaceous or columnar; when the latter, the color is red, otherwise black. Streak red.]

Primary form, rhomboid. P on P=85° 58′ to 86° 10′.

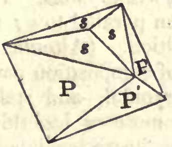
Secondary forms.

Fig. 544.



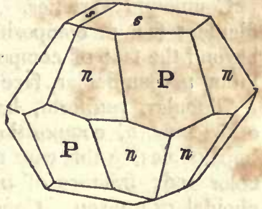
Vesuvius.

Fig. 545.



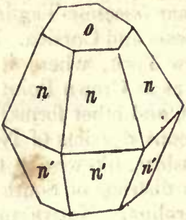
Elba.

Fig. 546.



Framont.

Fig. 547.



Elba.

Fig. 548.

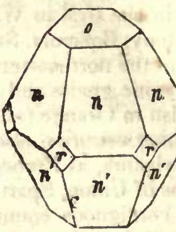
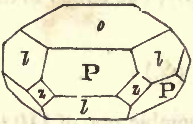
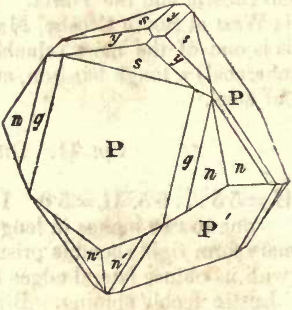


Fig. 549.



Framont.

Fig. 550.



Elba.

Fig. 544. Primary, with summits truncated. P on *o*=122° 40′. Fig. 545. Primary, with the summits replaced by three planes, which if extended, would lead to an obtuse rhomboid. *s* on *s*=142° 56.′ Fig. 546, the same with 545, but having the upper edges of the rhomboid, bevelled by planes *n*. *n* on *n*=128°. Fig. 547, *n* on *o*=119° 34′. Fig. 548. P on *b*=113° 22′, *o* on *z*=90°. Fig. 549, P on *g*=166° 25′.

Cleavage parallel with P and *o*. Fracture conchoidal, uneven. Surface *s* is horizontally streaked, sometimes so deeply that it appears rounded; P is sometimes streaked parallel to the edges of combination with *n*; *y* is uneven and often curved.

Lustre metallic. Color dark steel-gray, iron black. Streak cherry-red, reddish-brown. Surface frequently tarnished; generally with the exception of *o*, which may be useful in finding the position of the crystals when they become complicated. Opaque; very thin laminæ are faintly translucent, and then of a deep blood-red color. Brittle. Sometimes feeble action upon the magnetic needle.

Compound varieties. Twin-crystals. 1. Axis of revolution perpendicular; face of composition parallel to *o*; the individuals are continued beyond the face of composition. (Altenberg Saxony.) 2. Axis of revolution perpendicular, face of composition parallel to a face of P.

Globular, reniform, botryoidal, and stalactitic shapes: surface generally smooth, composition more or less thin columnar, sometimes even, impalpable; in this case the lustre becomes imperfectly metallic, and the color red; fracture of impalpable compound varieties, even, flat conchoidal, or uneven. Compound varieties often join in a second and third composition, which are curved lamellar and granular; the junction of granular masses produces frequently very smooth faces, while the reniform surface of the curved lamellar compositions is rough, and obtained with more difficulty by separating the particles, than the first. Massive: columnar, granular, and often impalpable, when their lustre decreases, their color becomes red and the fracture even, uneven, or flat conchoidal. When the structure is lamellar, and the cohesion among the particles is diminished, it becomes scaly and glimmering; when it is granular, it becomes earthy and dull. Pseudomorphoses in the shape of calcite, fluor and pyrites.

Owing to a want of attention to the simple and compound state of the contents of the present species, arose its subdivision formerly into two species, *specular iron-ore* and *red iron-ore*. Specular iron contained all the simple varieties, and those of the compound ones which had not lost their metallic appearance by the too small size of their component individuals. Those in thin, lamellar compositions were called *micaceous specular iron*, while the rest formed the *common specular iron*. Those varieties which had lost their metallic appearance, were included within the *red iron-ore*, divided into *fibrous* red iron or *red hematite*, which occurs in reniform and other imitative shapes, and consists of columnar particles of composition; into *compact* and *ochrey* red iron, which are massive, and consist of impalpable, granular individuals, more or less firmly connected; and into *scaly* red iron, or *red iron-foam*, consisting of very small scaly particles, which in most cases are but slightly coherent. This variety is in immediate connexion with the micaceous specular iron, between which and the crystallized specular iron, there exists an uninterrupted transition. Among the varieties of *clay iron-ore*, the following may be considered as an appendix to the present species, all of which are of a red color, but more or less impure, and mixed with earthy substances. *Reddle* possesses an earthy, coarse slaty fracture; it soils and writes, and may be used as a drawing material. *Jaspery clay iron-ore* has an even or large flat conchoidal fracture, and a hardness which is considerable, if compared with other minerals of a similar formation. *Columnar* and *lenticular clay iron ore* are, distinguished, the first by the columnar form, the latter by the flattish granular form of its particles of composition.

Infusible before the blow-pipe, but melts with borax, and forms a green or yellow glass, like pure oxide of iron. It is likewise soluble in heated hydrochloric acid.

Analyses.

Analysts.	Varieties and localities.	Ox. of iron.	Ox. mang.	Silica.	Lime.	Alumina.	Water.	Total.
Bucholz.	Micaceous iron ore.	100·00	0·0	0·00	0·0	0·00	0·0	100·00
D'Aubisson.	Red hematite. Framont.	90·00	tr.	2·00	1·0	0·00	3·0	96·00
"	" " "	94·00	tr.	2·00	tr.	0·00	2·0	98·00
Bucholz.	Compact red iron.	100·00	0·0	0·00	0·0	0·00	0·0	100·00
Lampadius.	" " "	65·40	2·7	20·70?	0·0	9·3	0·0	98·10
Bucholz.	Red iron-foam.	100·00	0·0	0·00	0·0	0·0	0·0	100·00
Henry.	" " "	94·50	0·0	4·25?	0·0	1·25	0·0	100·00

The clay iron-ores, being more or less mixed with earthy substances, vary in their contents; and several of their properties are dependent upon the nature of these admixtures. Thus lenticular clay iron-ore is very rich, while the columnar variety contains but little iron, and is produced from nodules of common clay, which have been converted by the influence of heat from burning coal seams, the one into columnar clay iron-ore, the other into porcelain-jasper.

It occurs most commonly in beds and veins in ancient rocks, as gneiss, granite and porphyry. Clay iron-ore forms either by itself beds in secondary mountains, or it is included in beds of clay in the shape of nodules or irregular masses. Specular iron-ore occurs in crystals among the rocks ejected by Vesuvius, and lining the cavities and fissures of lava, where it seems to be a product of sublimation. In beds, it is generally accompanied by other ores of iron, several species of earthy minerals, as epidote, hornblende and pyroxene, calcite and quartz. It occurs moreover as one of the original constituents of mica-slate, or of gneiss rock,—taking the place of mica or of feldspar or even of both; when it sometimes forms more than half the bulk of the formation, and in rare instances, as at the Pilot Knob Mt. in Missouri, it excludes even the quartz, and becomes, over extensive areas, a stratified and regularly jointed hematite-rock.

The most beautiful crystals of the species are fonnd at Elba, along with quartz and pyrites, at St. Gothard, Caravatti in the Grisons, and some other places in the Alps. Other localities are Framont in the Vosges, the vicinity of Vesuvius, the island of Stromboli, Capao in the Brazils, Altenberg in Saxony, Thurnberg in Salzburg, Cumberhead in Lanarkshire. Micaceous iron-ore is very common in beds of chalybite in Stiria and Carinthia; also in the Fichtelgebirge in Hungary, Reichenau in Bohemia, Gölnitz in Hungary, in mica-slate in Brazil, and in Siberia. Red iron ore abounds in Saxony, the Hartz and in Lancashire, England; jaspery clay iron-ore occurs in Lower Austria, the columnar variety in the north of Bohemia, and the lenticular clay iron-ore forms a bed in the transition district of Central Bohemia, in the counties of Pilsen, Beraun, &c.

The iron mountain region of Missouri, situated about fifty miles to the west of the Mississippi River and ninety to the southwest of St. Louis, presents the most remarkable development of the present species, any where known. It here spreads with some interruption, over a space of 10 or 15 miles in extent, situated in a red porphyry formation, through which it rises in almost mountain masses, as in the Pilot Knob, the Iron and the Shepherd Mountain. The former of these elevations is about 600 feet high, while the latter are between 2 and 300 feet. The ore is almost absolutely pure, massive, and iron-black in color A somewhat similar variety occurs in powerful beds in several mountainous counties, upon the borders of North and South Carolina, and in particular near the Cherokee ford, in York and Union districts of the latter state. The micaceous variety is found at Hawley in Mass., at Plymouth, Vt., and Piermont, N. H. Red hematite abounds in the counties of St. Lawrence and Jefferson, N. Y.; while the lenticular argillaceous ore exists extensively in the upper Silurian rocks, in Oneida, Herkimer, Madison and Wayne counties of of the same state, in Michigan near Green Bay, and in Canada West.

On the whole, it may be said to be a species of the highest commercial importance, since it yields a considerable proportion of the iron annually made in different quarters of the globe. The variety with a black color and metallic lustre, requires a greater degree of heat to smelt, than those which are red and dull; but the iron obtained is of good quality. The compact red iron-ore when in powder, is used as a polisher of metals; and a soft variety, much intermixed, with clay, (*reddle*) is employed as a writing material.

Sp. 43. MARTITE, *Breithaupt*.

[H.=6. G.=4·65 . . . 5·33. Xls. modified 8-dra. Iron black.]
Primary form, cube.
Secondary forms.

Fig. 551.

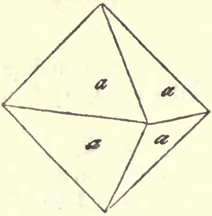


Fig. 552.

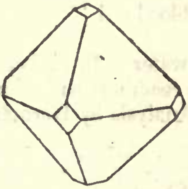
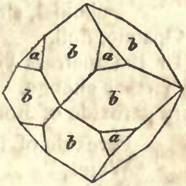


Fig. 553.



Faces *a* striated, parallel to their edges. Cleavage parallel with octahedral faces, indistinct. Color black, sometimes with a bronzed tarnish. Streak purplish brown Fracture uneven to conchoidal. Not magnetic. Opaque.

Composition and behavior before blow pipe, same as hematite

Found in Peru, Brazil, Auvergne, and in the U. S. at Monroe, N. Y., with dark green hornblende, red feldspar and quartz, and at Plymouth, Vt., (imbedded in micaceous hematite).

Sp. 44. FRANKLINITE, *Berthier*.

[H.=5·5 . . . 6·5. G.=5·09. Xls. octahedral, and in irregular forms. Iron-black, metallic. Brittle.]
Primary form, cube.
Secondary form.

Fig. 554.

Cleavage parallel with octahedral faces, but imperfect. Fracture conchoidal. Surface of all its faces smooth. Streak dark brown. Opaque. Acts slightly upon the magnetic needle.

B. B. on charcoal, it presents the appearance of magnetite. With soda, it emits the white smoke of zinc, and becomes green when heated with the same reagent, upon platinum foil, in the oxidation-heat of the instrument. With borax, it gives the reaction of manganese.

Analyses: 1. by Berthier; 2. by Thomson; 3. by Abich.

	1.	2.	3.
Peroxide of iron,	66·	66·10	66·88
Sesquioxide manganese,	16·	14·79	18·17
Protoxide zinc,	17·	17·43	10·81

It is said to occur in a nearly compact state, at Altenberg, near Aix la Chapelle; but its great repository is at Hamburg in New Jersey; at which place it is closely associated with zincite, in a granular limestone formation. Garnet, willemite (troostite,) fowlerite and pyroxene (jeffersonite) also occur sparingly intermingled with the franklinite and zincite, particularly at Stirling Hill, which is in the same neighborhood.

It has been used as an ore of iron.

Section D. *Color red brown.*

Sp. 45. Turgite, *Hermann.*

[H.=5 ... G.=3·5 ... 3·6. Massive; brownish-red; fracture conchoidal, streak blood-red.]

Opaque, dull.

In the matrass yields water B. B. becomes darker, but undergoes no farther change. The reactions with fluxes are the same, as those of pure peroxide of iron. Analysis by Hermann,

Peroxide of iron,	85·34
Water,	5·31
Oxides copper and lead,	1·85
Silica and insoluble matter,	7·50

Occurs in the Turginsk copper mines in the Ural, and in those of Solotuschenskoi in the district of Kolywan in the Altai.

Sp. 46. Limonite, *Beudant;* Limnit, *Glocker;* Brown hematite, Brown iron-ore, Bog iron-ore.

[H.=5·0 ... 5·5. G.=3·4 ... 3·95. Massive, generally in globular and stalactitic shapes which are fibrous within. Color various shades of brown.]

Streak yellowish brown. Brittle. Conducts electricity.

Composition columnar; individuals very delicate, to impalpable. Sometimes the particles are so slightly coherent, that the mass is earthy or dull. Occasionally in pseudomorphoses after calcite, quartz, fluor, blende, pyrites and marcasite. Various names have been applied to the varieties of limonite. Thus, we have *fibrous*, or *brown hematite*, embracing the reniform and stalactitic shapes; *compact brown iron-ore* when the composition is no longer observable; *ochrey* brown iron-ore, or bog-ore when the structure is friable, or earthy; and *granular* and *pisiform clay iron-ores*, when the structure is granular or pea-shaped, owing to the admixture of other minerals with the species.

In the matrass yields water. B. B. becomes black and magnetic. With borax, in the inner flame, melts into a green glass. It is soluble in warm hydrochloric acid, frequently leaving a residue of gelatinous silica.

It consists of peroxide of iron 85·56, water 14·44, usually with a slight admixture of silica and phosphoric acid.

Limonite occurs in beds and veins. When in beds, it is generally accompanied by spathic iron, sometimes also by baryte, calcite, aragonite and quartz. These beds are included both in ancient and in secondary rocks, the latter of which, though very thick, do not extend to a very great distance. When in veins, this species is frequently attended with some of the ores of manganese. Those varieties of clay iron-stone which belong to the present species, either form beds by themselves in secondary rocks, or they are imbedded in strata of clay, in the shape of larger or smaller globular concretions, some of them belonging to the coal formation, others to various kinds of sandstone.

Limonite is very plentiful in some countries. It occurs in beds in gneiss, along with granular limestone, at Friesach, at Hüttenberg, and in the valley of Lavant in Carinthia, at Turrach and Eisenerz in Stiria. Other localities, under similar circumstances, in Europe, are, Torotsko, in Transylvania; Dobschau, Szirk, &c., in Hungary; Schneeberg in Saxony; Kamsdorst and Saalfield, in Thuringia: though at some of these places it is said to occur in newer rocks. It is found in veins in various parts of Saxony, Nassau, the Hartz, &c. Rich varieties of the clay iron-ore occur in Bohemia, in Silesia, at Wehrau in Lusatia, and in Westphalia. The kidney shaped variety is met with, near Teplitz in Bohemia, Tarnowitz in Silesia, in Poland, in several districts of Lower Stiria, &c. The pisiform clay iron-ore is found in Swabia, Franconia, Hessia, and in the district of Ayrshire in Scotland.

Limonite is one of the most widely diffused mineralogical species of the United States. Powerful beds of the fibrous brown hematite, accompanied by the ochery iron-ore, exist at Salisbury and Kent, in Connecticut, contained in mica-slate. In the neighboring towns of Beekman and Amenia, (N. Y.,) similar deposits are met with. Farther north, under the same circumstances, at Richmond and Lenox, (Mass.) the like varieties of the present species occur. The mica-slate, which embraces the foregoing varieties, contains also beds of dolomite. At Hinsdale, the fibrous variety occurs as a cement to a fragmentary quartz rock. The nodular variety occurs at Gill, in the slate of the coal formation; it is also abundant on Nantucket and Martha's Vineyard. Limonite is abundant at Bennington, Monkton, Pittsford, Putney and Ripton, in Vermont; at all of which places, it is more or less associated with ores of manganese. The argillaceous varieties are common in Pennsylvania, near Easton, and throughout the Lehigh range, in Fayette county, at Armstrong, Upper Dublin, and in Washington county. Nodular argillaceous iron, in hollow balls from one inch to one foot in diameter, occur at Bladensburg, (Maryland). Argillaceous iron-ore exists on mount Alto, in the Blue Ridge, at Hugh's mine, in Shenandoah co. (Va.); and in Chatham and Nash counties in North Carolina. Nodular fragments which are perfectly compact and hard, occur disseminated through gravel-hills, near Marietta, in Ohio.

Limonite, when pure, yields an excellent quality of metal; and on the whole, affords a considerable portion of the iron annually produced in the different parts of the globe. The pig-iron, obtained from melting its purer varieties with charcoal, may be easily converted into steel. The hard and compact nodular variety is much esteemed as a burnisher, in the polishing of metallic buttons.

Sp. 47. **Göthite**, *Beudant;* Pyrrhosiderite, *Hausmann;* Onegite, Lepidokrokite, Sammetblende, Stilpnosiderite, Rubinglimmer, Eisenrutil, Chileite.

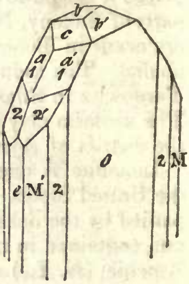
[H.=5· ... 5·5. G.=4·0 ... 4·4. In slender prisms, and fibrous. Color yellowish, reddish, in scales, and blackish brown; blood-red, by transmitted light.]

Primary form, right rhombic prism. M on M = 130° 40′.

Secondary form.

M′ on M over *e*	130° 40′	PHILLIPS.	*c* on M′ -	120° 42′
o on *a*2′ -	135 5		*c* on *b* or *b*′	135 20
o on *b*′ -	121 45		*b* on *a*2 or *b*′ on *a*2′	131 25
o on M′ -	117 50		*a*1 on M -	129 30
a′1 on *a*1 -	125 30		*a*2 on M -	153 25
*a*2 on *a*2′ -	149 24		*a*2 or *a*2′ on *c*	147 00
b on *b*′ -	117 30			

Fig. 555.



The crystals are compressed, parallel with the shorter diagonal of the prism, so as to give an undue extension to the planes *o o* of the above figure. Hence the xls. are often in thin plates. Cleavage, distinct parallel to *o*. Surface deeply striated lengthwise of the prism. Lustre, adamantine. Color yellowish; hair and clove-brown. Streak yellowish brown. Semi-transparent, with a blood-red tint. Massive, reniform and in scales.

In the matrass, yields water and turns red. B. B. in the outer flame, becomes brownish-red; in the inner, black and magnetic. Fusible, with great difficulty. With borax and salt of phosphorus, affords the reaction of iron. It is easily soluble in hydrochloric acid, with a residue of silica. Composition, peroxide of iron 89·89, water 10·11.

The variety called *lepidokrokite* from Oberkirchen is in minute radiating crystals, in thin scales, or feathery groups, upon fibrous hematite with quartz. The *rubinglimmer* of Eiserfeld occurs in the county of Nassau. A capillary variety, *sammetblende* (or *Przibramite,*) is found at Przibram and elsewhere. That called *onegite* occurs at Lake Onega in Siberia, and the chileite is from Chili. The most perfectly crystallized specimens are from Lostwithiel and Botallack in Cornwall. Other localities are near Bristol in England, at Spring Mills in Montgomery Co., Pa., and Greenfield, near Turner's Falls, Mass. At this latter place, it is found in powdery scales, and along with the chalcopyrite in a thin vein, at the junction of the sandstone and trap.

Sp. 48. STILPNOSIDERITE, *Ulmann;* Pitchy iron-ore, Eisenpecherz, Compact brown iron-stone, Iron-stone glance.

[H.=4·5 . . . 5. G.=3·6 . . . 3·8. Compact, in coatings and drops, blackish-brown, pitchy.]

Fracture uneven to splintery; rarely, it possesses an opal-like lustre and fracture. Streak yellowish-brown.

B. B. yields water, and in other respects behaves like peroxide of iron. Composition; the variety from Amberg, according to Kobell, contains

Peroxide of iron, - - - -	86·24
Water, - - - - - -	10·68
Silica, - - - - -	2
Phosphoric acid, - - - -	1·08
	100·00

Found at Salisbury, Conn.

Section E. *Semi-hard and heavy; streak black.*

Sp. 49. Pyrolusite. Gray manganese, Weichmangan, Weichbraunstein.

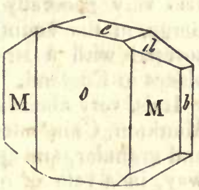
[H.=2·0 ... 2·5. G.=4·8 ... 4·97. Xls. short rhombic prisms; columnar and granular. Black. Streak black.]

Primary form, right rhombic prism, M on M=93° 40′.

Secondary form.

Cleavage parallel to M and *b*. Lustre metallic. Color iron-black; in very delicate columnar compositions, the color becomes bluish, and the lustre imperfectly metallic. Streak black. Opaque. Rather sectile.

Fig. 556



Compound varieties. Reniform coats. Both columnar and granular composition is often met with, particularly the former; the individuals often radiating from common centres. If the individuals are very delicate, the masses will soil the fingers, and write on paper.

B. B. it gives the customary reaction of manganese-ores.

Analysis by *Turner.*

Red oxide of manganese,	85·617
Oxygen,	11·599
Water,	1·566
Silica,	0·553
Baryta,	0·665
Lime,	*trace.*

Pyrolusite is very often the product of decomposition from chalybite,—the carbonate of iron being converted by natural agents, into the hydrate of the peroxide, while the lime, which it occasionally contains, is deposited in the shape of calcite, or aragonite; and the pyrolusite is often found covering the surface of decomposed rhomboids of the original species, in the shape of minute crystals. In this manner, it occurs in the mines of decomposed chalybite, in beds in gneiss, at Huttenberg in Carinthia, at Schwalkalden in Hessia, and other places. It is likewise found in this manner in the counties of Sayn, Siegen, Salm, and Hamm in Prussia, in the veins of chalybite traversing clay slate, which are decomposed in the upper levels, and then contain much limonite. One of the varieties from Horhausen is particularly remarkable for the delicacy of the fibres, which are disposed in small tufts, within the geodes of limonite, and which greatly resemble the fibrous varieties of antimonite. Weyer, in the county of Wied-Runkel, Hirschberg near Ahrensberg, and Beodorf on the Lower Rhine, are likewise quoted as localities of superb specimens of pyrolusite. The finest crystals of pyrolusite, occur at Schimmel and Oslerfreude near Johanngeorgenstadt, and at Hirschberg in Westphalia. These are chiefly short thick prisms, terminated on their extremities in numerous fibres. Large, flattish crystals, of great beauty, terminating in sharp, elongated pyramids, with curved faces, occur at Maeskamezi, near Maggar Lapos, south of Kapnik in Transylvania, in geodes of limonite, and associated with crystals of quartz. Cleavable individuals, of considerable size, are found near Goslar in the Hartz, in a mountain called Gingelsberg imbedded in small veins of quartz and calcite, in clay slate. Distinct, though small crystals, are met with in many of the mines in the west of Germany. A variety occurs at the mine of Antonio Pereira near Villa Ricca in Brazil along with limonite and psilomelane. Small granular pyrolusite occurs in Dalecarlia, Sweden. But the individuals are often much smaller, and appear in the form of a black sooty substance. Such are frequently found in the iron mines of Raschau, and other places in Saxony. The pyrolusite is rarely found without psilomelane; and is also very generally associated with limonite. In some varieties from Berge, in the county of Salm, thin stalactites of limonite are uniformly covered with a stratum of pyrolusite. Pyrolusite occurs at numerous places in England.

It is very abundant in the United States. It occurs at Bennington, Monkton, Chittenden, and various other places in Vermont, crystallized and granular, and associated with psilomelane; in Massachusetts, at Conway, in a vein of quartz; at Winchester, (N. H.); in Connecticut, at Salisbury and Kent, in thin velvety coatings, upon limonite.

Sp. 50. **Manganite,** Gray manganese (in part), Acerdèse, *Beudant;* Newkirkite, *Thomson.*

[H.= 4·0. G. 4·2 . . . 4·4. Xls. elongated, deeply striated (lengthwise) prisms. Lustre metallic; blackish steel-gray.]

Primary form.
Secondary forms.

Fig. 557.

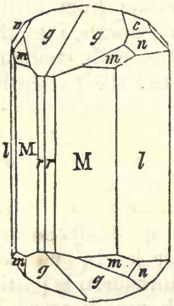


Fig. 558.

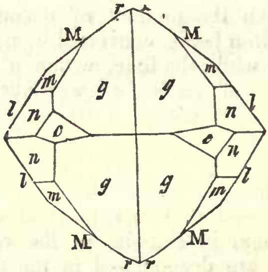


Fig. 559.

g on *g* - -	172° 36′	**Haidinger.**	*m* on *m* - -	112° 35′
c on *c* - -	115 17		*l* on *l* - -	51 18
n on *n* - -	95 4		*r* on *r* - -	134 14

Cleavage parallel with *l*, highly perfect, and easily obtained; with M, also perfect, but less easily obtained; traces of *r*. Fracture uneven, surface of the vertical planes streaked parallel to their common edges of intersection. In general, the faces are smooth, and possess pretty high degrees of lustre.

Lustre imperfectly metallic. Color, dark, brownish black, inclining to iron-black. Streak, reddish brown.* Opaque in large masses; when broken or cleaved in the direction of *l* and exposed to the light of the sun, minute splinters are often observed, which by transmitted light, appear of a bright, brown color. Brittle.

Compound Varieties. Twin-crystals. 1. Face of composition parallel to *l*, axis of revolution perpendicular to it.

Fig. 560.

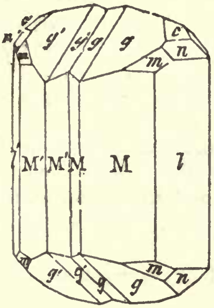
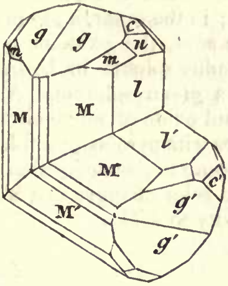


Fig. 561.



A repetition of this law produces thick prisms, terminated perpendicularly upon their axis by a rough face, which consists of the apices of numerous individuals, or rather of numerous particles of two individuals, alternating with each other. 2. Axis of revolution perpendicular, face of composition parallel to a plane of the pyramid.

Massive: composition granular, or columnar,—the latter more frequently.

It is infusible B. B., and colors glass of borax, violet-blue. It is insoluble in nitric acid. In heated sulphuric acid, it disengages chlorine. Also, B. B., or alone, in a strong heat, it gives out oxygen.

Analysis by *Turner.*

Protoxide of manganese, - - -	80·92
Oxygen, - - - - -	8·98
Water, - - - - -	10·10

Manganite occurs in abundance, and great beauty, at Ihlefeld in the Hartz, and at Oehrenstock, near Ilmenau in Thuringia.

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* In the description given above, the streak of the crystals is stated to be reddish brown. It is very often the case however, that crystals are met with, and still more frequently compound varieties, consisting of columnar individuals, which actually afford a black streak. The hardness of these varieties is much inferior to that of the crystals which present a brown streak, being generally between 2·5 and 3·0; and sometimes in fibrous varieties, it is so inconsiderable as to soil the fingers and write upon paper. On the contrary, their specific gravity is higher, and often approaches to 4·7. It is important to observe, that the exterior strata of large crystals sometimes afford a black streak, and show low degrees of hardness, while the interior parts still offer the characters indicated in the preceding description. It would seem, therefore, that the difference in several of these properties, is owing to a change or decomposition of the substance itself, which does not affect the regular form.

Sp. 51. **Crednerite,** *Rammelsberg;* Mangankupferoxyd, *Hausmann;* Mangankupfererz, *Credner.*

[H.=4·5. G.=4·9 ... 5·1. Foliated, Lustre metallic, iron-black. Streak, brownish-black.]

Crystalline. Cleavage very perfect in one direction, and less distinct in two others. Opaque.

In the matrass, exfoliates and loses its lustre. B. B. on charcoal, yields a malleable bead of copper. With borax in the outer flame, forms a violet glass; in the inner, a green one, which at last becomes red and opaque. In nitric acid, the oxide of copper is dissolved, leaving a black residue. It is readily soluble in hydrochloric acid with extrication of chlorine, forming a green solution. Analysis by Credner, gave oxide of copper, 43·85, and oxide of manganese 55·73.

Occurs with pyrolusite and hausmannite at Friedrichsrode in Thuringia. It is prone to decomposition, whereby the cleavages become more distinct, the color changes to a blackish blue, and the hardness falls to 2·5 and gravity to 4·71.

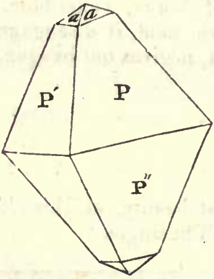
Sp. 52. **Hausmannite,** *Haidinger;* Black manganese, Red oxide manganese.

[H.=5·0 ... 5·5. G.=4·7 ... 4·8. Xls. acute octahedra with square bases; inclination of upper to lower pyramid =117° 30′. Color brown-black; streak, brown.]

Primary form, right square prism.

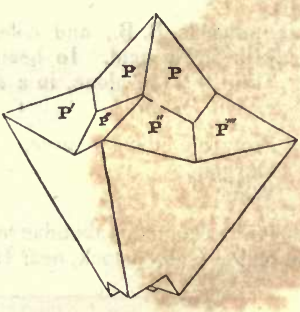
Secondary form.

Fig. 562.



a on *a* = 139° 56′.

Fig. 563.



Cleavage parallel to the base of the primary, perfect; interrupted parallel with P of the figure. Fracture uneven. Lustre imperfectly metallic. Opaque. Twin-crystals. Common octahedral hemitrope; also repeated a second time. Pseudomorphoses, after manganite and calcite. Massive, granular, and firmly connected. Conducts electricity feebly.

B. B. infusible. Imparts the characteristic color of manganese, to borax. Soluble in warm hydrochloric acid, with extrication of chlorine. Concentrated sulphuric acid, to which it has been added in powder, assumes a bright red color. It consists of protoxide manganese 30·89, sesquioxide of manganese 69·02, and oxygen 6·98. Traces of baryta silica and water are also present.

Occurs in porphyry, associated with manganite at Oehrenstock, near Ilmenau in Thuringia, and at Ihlefeld in the Hartz. Said to have been found at Lebanon, Pa.

Sp. 53. PSILOMELANE, *Haidinger;* compact manganese, Black hematite, Schwarzmanganerz, Hartmanganerz.

[H.=5·0 . . . 6·0. G.=3·7 . . . 4·3. Botryoidal, compact, black.]

Massive; fracture even, to sub-conchoidal, with occasional traces of a fibrous structure, as in calcedony. Lustre imperfectly metallic. Color bluish black, greyish black to dark steel-grey. Streak, brownish black, shining. Opaque. Brittle.

B. B. yields water, gives a violet tint to borax, and affords chlorine with hydrochloric acid. Composition rather various, some varieties being nearly anhydrous, while others have 6 p. c. of water, some being destitute of baryta, while others include 16 p. c. of that earth.

Analysis *a* from Ilmenau, by Clausbruch, *b* from Gy, by Ebelmen, and *c* from near Heidelberg, by Rammelsberg.

	a	*b*	*c*
Protox. manganese,			
Oxygen, - -	77·23	70·60	70·17
Potash, - -	15·82	14·18	15·16
Lime, - -	5·29	4·05	2·62
Magnesia, -		1·05	0·21
Baryta, - -	0·12	6·55	8·08
Ox. copper, -	0·40		0·30
Protoxide iron,		0·77	
Ox. cobalt, - -			0·54
Silica, - -	0·52	0·60	0·00
Water, - -		1·67	1·43

Occurs in beds with limonite, pyrolusite and manganite, and in veins with chalybite; likewise in new red sandstone. It is a common ore of manganese, abounding in Devonshire, Cornwall, the northern islands of Scotland, in the Hartz, in Thuringia and Saxony, Silesia and Bohemia. It is abundant throughout the gold region of the southern United States, and exists very commonly with pyrolusite at Bennington, and farther to the north in Vermont, in that part of the Green Mountain range which contains pyrolusite, as at Chittenden and Brandon.

The name is derived from ψιλος, *smooth,* and μελας, *black,*

Sp. 54. BRAUNITE, *Haidinger;* Marceline, Hartbraunstein, *Hausmann.*

[H.=6·0 . . . 6·5. G.=4·81. Xls. very acute 8-dra, and granular; tough. Color dark brownish black.]

Primary form, right square prism.

Secondary forms.

Fig. 564.

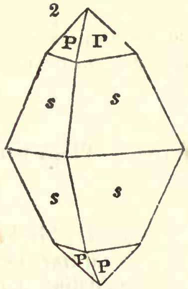


Fig 565

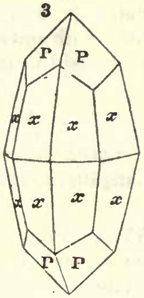
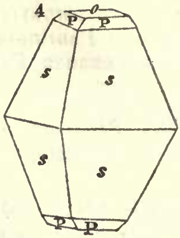


Fig. 566.



Cleavage distinct parallel with P with angles. Fracture uneven. Surface *o*, less lustre than P, and faintly streaked parallel to the edges of combination with P. Faces P often a little rounded ; faces *s* uneven, rough and horizontally streaked ; faces *x* smooth and even. Lustre imperfectly metallic. Streak like color. Individuals strongly coherent in the granular variety.

B. B. alone, infusible. With concentrated hydrochloric acid evolves chlorine, and the variety from St. Marcel, gelatinizes.

Composition, manganese 69·68 oxygen, 38·32. It consists of one atom protoxide and one of binoxide of manganese, with traces of lime, magnesia, baryta, peroxide of iron and silica. The *marceline,* according to Damour, has

Binoxide of manganese, - - -	67·37
Protoxide "	19·17
Lime, - - . - -	1·22
Peroxide iron, - - - -	1·45
Silica, - - - - -	7·71
Gangue, - - - - -	2·72

Found in small attached and imbedded crystals, and in granular masses in porphyry, with other ores of manganese and baryte at Oehrenstock, Eglersburg and Friedrichrode in Thuringia, at Schmalkalde and Leimbach in Mannsfeld, and Streitberg, near Neuenkirchen in Westphalia, and at Mt. Marcel in Piedmont.

Sp. 55. Polianite, *Breithaupt.*

[H.=6·5 . . . 7. G.=4·83 . . . 4·88. Xls. like pyrolusite. Color light steel-grey.]

Primary and secondary forms same as pyrolusite. According to Haidinger, it is pseudomorphous braunite, in the form of that species.

Chemical characters, the same as those of pyrolusite. Analysis, from Maria Theresa mine, near Platten, by Plattner,

Red oxide manganese, - - -	87·27
Oxygen, - - - -	12·11
Red oxide of iron and alumina, - -	0·17
Water, - - - - -	0·32
Silica, - - - - -	0·13

Besides the locality in Bohemia, above cited, it occurs in the Adam Heber mine at Schneeberg, Tannenbaum Stolln, near Johanngeorgenstadt, Spitzleute, near Schneeberg, Hirsch, near Geyer in Saxony, the Eiserne Hartz in Siegen.

APPENDIX TO ORDER ORE.

Azorite, Teschemacher. Pale, yellowish green octahedral xls. (1½ lines in diameter) with the vertical axis somewhat shorter than in the regular octahedron: angle of pyramid (by reflective goneometer) =123° 15′. Basal edges of truncated and prismatic planes inclining to the pyramidal under 133° 40′, (which is near to zircon). Cleavage none. H.=4·0 ... 4·5. Translucent to opaque. Lustre vitreous.

B. B. infusible. Smaller xls. become opaque white; the larger ones reddish, if heated in the outer flame, but light yellow if in the interior flame. With borax, on platinum wire, dissolved with extreme slowness to a transparent globule, sometimes faintly greenish; with more borax, opaque on flaming. With salt of phosphorus dissolves slowly, producing a faint green color. According to A. A. Hayes, it is a columbate of lime; and in composition therefore, approaches microlite. From the Azores; in an albite rock, along with black tourmaline and pyrolusite.

Bodenite, Kerndt. In long prismatic xls. apparently rhombic (of 110° to 112°). H.=6·0 ... 6·5. Brown, reddish brown to black. Lustre somewhat greasy. B. B. glows like gadolinite. In platinum forceps, fuses only on the edges, after long heating, and gives to the flame, the yellow color of soda in the outer flame. Analysis by Kerndt.

Silica,	26·12
Alumina,	10·34
Protox. iron,	12·05
Yttria,	17·43
Oxide cerium,	10·46
Oxide lanthanum,	7·57
Lime,	6·32
Magnesia,	2·34
Protox. Mang.,	1·62
Potash,	1·21
Soda,	0·84
Water,	3·82
	100.00

Occurs with oligoclase, at Boden, near Marienberg, in the Saxon Erzeberge.

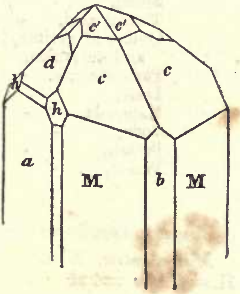
Eumanite, (S.). In very small, thin blackish brown xls., (with color and lustre of cassiterite). Translucent. Color by transmitted light, deep garnet-red. Primary form, right rhombic prism of 123° (or a right rectangular prism).

Secondary form. The crystal figured, weighed less than one grain.

Surface of M rather imperfect and possessed of a high lustre. The other faces very brilliant.

M	on M	=	123°
–	*a*		118° to 118° 30′
–	*c*		136°
c	*c*		151 30
–	*c′*		159 30
–	*d*		127 30
a	*d*		127 40
h	*d*		144 20
a	*h*		128 20
c	*h*		156 30

Fig. 567.



H. = above 6. Only two or three specimens were found; attached to albite at the tourmaline locality in Chesterfield, Mass. It appears to approach mengite more nearly than any other known species. Named from *Eυ* and μανὸς *rare*, from its supposed scarcity.

Kaliphite, Ivanoff. Supposed to be a mixture of limonite, pyrolusite and calamine with lime. From Hungary.

Keilhauite, Erdmann; *Yttrotitanite*, Scheerer. In xls. whose form and angles are almost identical with those of sphene (fig. 488) and in twins. Also massive and highly crystalline, with perfect cleavages in two directions, leading to a prism of about 122° 30′; and traces of a third, oblique to the other two. Lustre on the most perfect cleavage, vitreous. Fracture uneven to small conchoidal, and exhibiting a resinous lustre. Color brownish black; by transmitted light, brownish-red. Streak light greyish brown. H. =6·5. G. =3·69.

B. B. melts easily with ebullition, into a bright black slag. Soluble in borax, to which it imparts the color of iron. In the inner flame, the bead becomes blood-red. With soda, shows the presence of manganese. In fine powder, it is wholly decomposed by hydrochloric acid.

Analyses by Erdmann:—

Silica, - - - - - -	30·00	24·45
Titanic acid, - - - - -	29·01	28·14
Alumina, - - - - - -	6·09	5·90
Peroxide iron, - - - -	6·35	6·48
Oxide manganese, - - -	0·67	0·86
Oxide cerium, - - - -	0·32	0·63
Yttria, - - - - - -	9·62	9·74
Lime - - - - - -	18·92	18·68

Occurs at Buön, not far from Arendal, Norway.

Malacone, Scheerer. Supposed to be altered zircon xls. The faces of the pyramid incline under angles of from 124° 40′ to 124° 57′. H. =6·5. Gr. =3·9...4·04. Brown, lustre vitreous to sub-resinous. Powder red-brown, to uncolored. B. B. like zircon, except it affords moisture. Analyses: *a* from Hitteroe, by Scheerer *b* from Chanteloube, Haute Vienne by Damour; *c* from Ilmen Mts. by Hermann.

	a	*b*	*e*
Silica, - - -	31·31	30-87	31·87
Zirconia, - -	63·40	61·17	59·82
Peroxide iron, - -	0·41	3·67 Protox.	3·11
Yttria, - - -	0·34	——	——
Lime, - - -	0·39	0·08	——
Magnesia, - -	0·11	——	$\dot{\mathrm{Mn}}$ 1·20
Water, - - -	3·03	3·09	4·

Mosandrite, Erdmann. In large flattened prisms, often much elongated; their edges sometimes replaced, but the xls. rather indistinct from partial decomposition. Cleavage in one direction distinct; traces in several others. In thin fragments, translucent. Lustre resinous, on the plane of distinct cleavage, inclining to vitreous. Color dark red-brown; by transmitted light, bright red. Streak, greyish-brown. H. =4. Gr. =2·93.

B. B. melts easily with ebullition into a brownish green, dull bead. Easily soluble in borax, forming a violet bead, which becomes yellow, or nearly colorless, in the inner flame. With soda, yields the reaction of manganese. It is completely decomposed by hydrochloric acid.

Analysis by Berlin:—

Silica, - - - - - - - - -	29·93
Titanic acid, - - - - - - - -	9·90
Oxides of cerium, lanthanum and didymium, - - - -	26·56
Peroxide iron, - - - - - - - -	1·83
Lime, - - - - - - - - -	19·07
Magnesia, - - - - - - - -	0·75
Soda, - - - - - - - - -	2·87
Potash, - - - - - - - -	0·52
Water, - - - - - - - - -	8·90
	100·33

Occurs in syenite on the island of Lamansskäret, near Brevig, Norway.

Muromontite, Kerndt. In pea-sized grains, without apparent crystallization. H. =7. Gr. =4·26. Color black, or slightly greenish by reflection. Lustre vitreous or slightly resinous. Semi-translucent. Streak grey. B. B. it glows, and is slightly fusible on the edges. It is decomposed by acids, leaving a jelly of silica. Analysis by Kerndt:

Silica,	31·09
Alumina,	2·24
Glucina,	5·52
Yttria,	37·14
Protox. iron,	11·23
Protox. mang.,	0·91
Protox. cerium,	5·54
Oxide lanthanum,	3·54
Magnesia,	0·42
Lime,	0·71
Soda,	0·65
Potash,	0·17
Water,	0·85

Found with bodenite in oligoclase at Boden, near Marienberg in Saxony.

Oerstedite, Forchammer. Like calyptolite and malacone, supposed to be altered zircon. It is found at Arendal, Norway. Form of xls., same as zircon. Translucent. Lustre adamantine, inclining to vitreous. Color yellowish brown. H. = 5·5. G. = 23·62. In the matrass, yields water. Infusible. With borax, melts with difficulty to a colorless glass. Analysis by Forchammer:

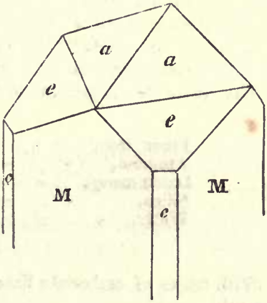
Silica.	19·71
Zirconia and titanic acid,	68·96
Magnesia,	2·05
Lime,	2·61
Protox. iron,	1·14
Water,	5·53

Tachyaphaltite is supposed by Dana to be an altered zircon.

Parathorite, (*S.*). In minute pitchy black xls., having the form of a right square prism, with lateral edges truncated, and a flat four-sided summit.

M on *c*	135°
M on *a*	130
a on *a*	98
a on *e*	160

Fig. 568.



All the faces with the exception of *e*, bright and shining. Cleavage imperfect. Fracture uneven to conchoidal. Lustre resinous. Opaque. H. = 5·0 ... 6·0. Heated B. B in an open tube, it decrepitates slightly, emits abundance of moisture, possessing an acid reaction. Heated in a platinum forceps, it turns brownish red, does not suffer fusion, but presents at the point where most heated, a semi-fused aspect. With borax, it easily fuses to a glass colored by iron. Occurs at Danbury, Conn., in oligoclase, along with danburite. Named in allusion to its supposed resemblance to thorite.

Paracolumbite, (*S.*). Massive; diffused in grains, and short, irregular seams. Color, iron-black, sometimes with a faint tinge of purple. Lustre imperfectly metallic. Fracture sub-conchoidal, opaque, streak black. Hardness about 5·0.

In an open tube, decrepitates slightly, and evolves a little moisture, which possesses a feebly acid reaction; but the heated mineral does not change color. Heated in platinum forceps, or on charcoal, it fuses readily into a black glass, which is not magnetic. With borax, it dissolves rapidly, and yields a glass, which is yellowish-brown while hot, but becomes paler on cooling. When decomposed by sulphuric acid in a glass tube, the glass is corroded by hydrofluoric acid. The mineral is easily attacked by sulphuric acid; and a heavy white precipitate (unmixed with silica) is easily obtained. A portion of its filtered solution was not rendered milky by boiling; nor did the white precipitate evince a tendency to traverse the filter on the affusion of hot water. A portion of the filtered solution was decomposed by ammonia, and the precipitate of mixed oxides of iron and uranium was treated with carbonate of ammonia, which dissolved the latter, and showed its proportion to be small, when compared with the former. From these experiments the mineral seems to be composed of the oxides of iron and uranium, in combination with a metallic acid, which is not the titanic.

Occurs about one mile, in a south-westerly direction from the village of Taunton in Massachusetts; disseminated in exceedingly minute quantities through a very large boulder of granite, lying in a field contiguous to the highway. The granite is almost wholly made up of a peculiar greenish-white feldspar.

Is named from its resemblance to columbite.

Pyrrhite, G. Rose. In octahedral xls. not exceeding three lines in diameter. Cleavage not observable. Color, orange-yellow. Lustre vitreous. Sub-translucent.

B. B. infusible. Small splinters blacken, and color the flame deep yellow. In powder, it dissolves easily in borax or salt of phosphorus; adding largely of the fluxes, it forms a clear glass, which, with still more of the flux, becomes yellowish green, but with less, the glass remains colorless.

Occurs in drusy cavities of feldspar, containing also tables of lithia mica, crystals of albite and white topaz at Alabaschka, near Mursinsk. The name is from *πυϱϱος*, *yellow.*

A similar mineral, found with albite at the Azores, and described by Teschemacher, was discovered by Hayes to consist of columbate of zirconia, colored apparently by oxides of iron, uranium and manganese. ?

Calyptolite, (*S.*). Very minute dark brown xls., having the form of zircon, (fig. 450); but with a rather dull, adamantine lustre. H. =6·5, and Gr. =4·3. Heated in an open tube, they turn pale yellow, yield moisture, exhibit an acid reaction, and with sulphuric acid, slightly corrode the surface of the tube. B. B. it turns nearly white, but does not fuse. With borax, dissolves slowly into a glass which is yellow while hot, but colorless on cooling. It occurs diffused through an aggregate of beryl, chrysoberyl, grey feldspar, quartz, automolite and garnet, at Haddam, Conn.; and probably is an altered zircon, somewhat like malacone and oerstedite.

Tenorite, Semmola. In small hexagonal ? tables $\frac{1}{20}$ to $\frac{1}{8}$ inches in diameter, and scales. Lustre, metallic. Color, dark steel-grey. Streak, black. Thin folia translucent and brown. Composition, copper 79·85, oxygen 19·85. Found on lava, associated with salt, at Vesuvius. It may belong to the species melaeonite; in which case, that species should be removed from ochre to the present order.

Xanthosiderite, Schmid. In fine radiating fibres, or in concentric coats, with a silky lustre and a golden-brown color. H. =2·5. Analysis by Schmid.

	Yellow variety.	Brown.
Perox. iron, - - - -	74·96	75·00
Alumina, - - . - -	1·32	1·51
Oxide mang., - - - -	1·82	1·33
Silica, - - - - -	1·51	5·02
Water, - - - - -	15·67	14·10
	96·28	96·96

With traces of carbonate lime and manganese, alkalies, antimony and lead or bismuth.

Occurs with ores of manganese at Ilmenau.

ORDER XI. METAL.

Sp. 1. MERCURY.

[H.=0. G.=13·5. Amorphous. Liquid. Lustre metallic. Color, tin-white.]

B. B. entirely volatile, wholly taking the form of vapor at 662°: becomes solid at −39°, and crystallizes in 8-drons. Dissolves readily in nitric acid. It is sometimes alloyed with a trace of silver.

Occurs with cinnabar in small drops, at the well known localities of Idria in Carniola, and Almaden in Spain: more rarely also at Wolfstein and Mörsfeld in the Palatinate, and at some places in Carinthia, Hungary, and at Peyrat le Chateau, department of Haute Vienne. It has likewise been observed in California.

Sp. 2. LEAD.

[H.=1·5. G.=11·45. In thin plates and globules.]

Primary form, cube. Massive. Fracture hackly. Color lead-grey. Lustre metallic. Odor disagreeable by friction.

B. B. melts easily, and is gradually dissipated in fumes, leaving a yellow powder upon the charcoal. Soluble in nitric acid, in which sulphuric acid occasions a white precipitate.

Found in thin sheets with minium, near a basaltic dyke in Ireland, in lava at Madeira, in the mines of Carthagena, Spain, at Zomelahuacan in Vera Cruz, in the Altai, in carboniferous limestone near Bristol, England, and at Anglaise river in Michigan in galena, through the joints of which, it is diffused in thin leaves.

Sp. 3. SYLVANITE, *Haidinger*; Graphic Tellurium, Graphic Gold, Schrifterz, Schrift-tellur, Aurotellurite, Mullerite, Weisstellur.

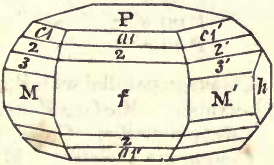
[H.=1·5. G.=5·72...8·2. Mostly in twin-xls, the slender prisms intersecting at 60° and 120°. Lustre metallic; color pure steel-grey.]

Primary form. Right rhombic prism. M on M = 107° 44′.

Secondary form.

P on *a* 1	-	141° 30′	PHILLIPS.
P on *a*2	-	129 12	
P on *c*1 or *c*1′	-	151 40	
P on *c*2 or *c* 2′	-	136 42	
P on *c*3 or *c*3′	-	132 45	
M on *h*	-	126 08	
f on *h*	-	90 00	

Fig 569.



Cleavage parallel with M highly perfect; with P perfect, though not so easily obtained. Fracture uneven. Secondary surfaces of the prism vertically streaked; M fused-like; the remaining faces smooth.

Very sectile. Hardness=1·5 ... 2·0. Sp. gr.=5·723.

Compound varieties. Regular composition of acicular crystals, nearly at angles of 60° and 120°, in one plane; frequently repeated, and imparting to the whole the appearance of certain characters for writing. Massive; composition imperfectly columnar or granular, small, but not impalpable.

The present species presents many varieties of crystalline forms, which being generally very much engaged among themselves, and moreover modified by regular composition, have not yet been satisfactorily developed.

B. B. it melts easily into a dark grey, metallic globule, and covers the charcoal with a white oxide, which changes into a green, or bluish green, when the reduction flame is directed upon it. After having continued the blast for some time, a ductile metallic metal, of a light yellow color, remains.

Composition. Analyses, *a* by Klaproth from Offenbanya, *b* by Petz, in xls., color, white, G.=8·2, *c* do. yellow color, G.=8·3.

	a	*b*	*c*
Tellurium,	60·00	55·39	51·52
Gold,	30·00	24·89	27·10
Silver,	10·00	14·68	7·47
Antimony,		2·50	5·75
Lead,		2·54	8·16

It yet remains to be explained how an amalgam of the above composition should possess a sp. gr. of only 5·723, when the artificial preparation would mount as high as 10.

Graphic gold occurs at Offenbanya in Transylvania, in very narrow, but quite regular veins, which traverse porphyry, several of them at a short distance from each other, and parallel. It is accompanied by gold and quartz; and is occasionally found with nagyagite, at Nagyag in Transylvania. It has been detected, according to Genth, at Gold Hill, Rowan Co., N. Car.

It is a valuable ore, on account of its richness in gold and silver.

Sp. 4. Nagyagite, *Haidinger;* Elasmose, *Beudant;* Black Tellurium, Foliated Tellurium, Tellurium Glance, Blattererz.

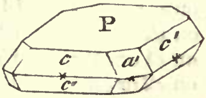
[H.=1·0 ... 1·5. G.=7·08. In highly flexible, thin, black laminæ, also granularly massive.]

Primary form, right square prism.

Secondary form.

x on *x*	90° 00′
x on *x′*	135 00
P on *a*	118 37
P on *c*	111 4

Fig. 570.



Cleavage parallel with P, perfect. Fracture not observable. Surface P smooth.

Lustre metallic. Color, blackish lead-grey. Streak unchanged.

Compound varieties. Massive: composition granular, of various sizes of individuals, sometimes longish.

B. B. upon charcoal, it melts easily, emits white fumes, which are deposited upon the charcoal, and give a metallic globule. With borax, it gives a bead of gold, containing a little silver. It is easily soluble in nitric acid.

Analysis by Klaproth :

Tellurium,	32·20
Lead,	54·00
Gold,	9·00
Silver,	0·50
Copper,	1·30
Sulphur,	3·00

It has been found only in veins with gold, galena, blende and diallogite. Its chief locality is Nagyag in Transylvania, from whence it obtained its old name of *Nagiaker-Erz.* It is found also with sylvanite, at Offenbanya in the same country.

Sp. 5. Tetradymite, Telluric Bismuth, Tellurwismut, Bornite.

[H =1·5 … 2·0. G.=7·2 … 8·4. In small twin-xls. consisting of four individuals in a group, in thin leaves and in granular masses. Lead-grey to reddish steel-grey. Lustre metallic.]

Primary form, rhomboid of 66° 40′, to 68° 10′. Xls. often tabular, with perfect basal cleavage. Not very sectile. Laminæ elastic. Soils paper. Streak unaltered.

In the open tube melts, emits white fumes and deposits a fusible sublimate of tellurous acid, and near to the assay, a red sublimate of selenium, recognisable by the smell. B. B. on charcoal, melts easily into a bright metallic globule, with smell of sulphur and selenium, and imparting a blue color to the flame. Soluble in nitric acid, with the exception of the sulphur.

Analyses; *a* from Schubkau by Berzelius, *b* from Fluvanna Co. Va., by Fisher, *c* from Whitehall, Va., by Jackson, *d* from Davidson Co., N. Car., by Genth, *e* from Brazil, by Damour, *f* from Deutsch-Pilsen, Hungary, by Wehrle.

	a	*b*	*c*	*d*	*e*	*f*
Tellurium,	36·05	35·77	35·05	33·84	15·92	29·74
Bismuth,	58·30	51·65	58·80	61·35	79·15	61·15
Sulphur,	4·32	(Fe 1·25)	3·65	5·27	3·15	2·33
Selenium,		6·81			1·48 (silica)	2·07

The sulphur, selenium and traces of silver, are supposed to be accidental; while the isomorphism of bismuth and tellurium make it probable that they are capable of crystallization together, in many proportions.

Occurs at several gold mines in North Carolina and Virginia, at Tellemark in Norway, and Bastnaes in Sweden, Cumberland England, and numerous other localities.

Sp. 6. Bismuth.

[H.=2·0 … 2·5. G.=9·72. Massive, foliated, dendritic and granular. Color, silver-white, feebly reddish.]

Primary form, rhomboid, 87° 40′.

Cleavage basal, perfect. Lustre metallic. Streak like color. Subject to tarnish. Opaque. Fracture not observable. Sectile.

When heated, it quickly begins to lose its brittleness, and to become slightly malleable. Melts at 264°, frequently with the smell of arsenic. Crystallizes readily from fusion, in forms, scarcely distinguishable from cubes, though they are rhomboids, often with slight truncations of their angles. B. B. on charcoal, deposits a sublimate of oxide, which is yellow while hot. Soluble in nitric acid, the solution letting fall a white precipitate on dilution with water.

Occurs in veins in gneiss and clay-slate, accompanied by various ores of silver, cobalt, tin. Its chief localities are several of the Saxon and Bohemian silver and cobalt mines at Annaberg, Marienberg, Johanngeorgenstadt, Joachimstahl, &c., Modum in Norway, Fahlun, Sweden, the Pyrenees, Wittichen in Baden, Cornwall, Harz, Monroe Conn., Brewer's mine in Chesterfield, S. Car.

Sp. 7. SCHAPBACHITE, *Kenngott;* Bismuthic Silver, Silberwismuthglanz, Wismuthsilbererz.

[Soft. Acicular xls. and massive, amorphous. Tin-white to grey.] Lustre metallic. Subject to tarnish. Fracture uneven; sectile.

B. B. fuses readily to a silver-button, covering the charcoal with the oxides of lead and bismuth, and giving fumes of sulphur. Analyses, *a* by Domeyko, *b* by Klaproth.

	a	*b*
Silver, - - - -	60·1	15·
Bismuth, - - -	10·1	27·
Copper, - - - -	7·8	0·9
Arsenic, - - -	2·8	(sulphur 16·3
Gangue, - - -	19·2	
Lead, - - -		3·3
Iron, - - - -		4·3

Occurs at Schapbach, Baden, Mansfeld, Thuringia, and near Copiapo, Chili.

Sp. 8. PETZITE, *Haidinger;* Hessite, *Fröbel;* Tellurgoldsilber, *Hausmann;* Tilluric Silver, Tellursilber.

[H.=2·0 ... 3·5. G.=8·3 ... 8·9. Massive, granular. Lustre metallic. Color, lead to steel-grey.]

Slightly malleable. Opaque.

B. B. on charcoal, fuses to a black globule. which on cooling, after the action of the reducing flame, presents points of silver on its surface. When heated in a glass tube, it melts and gives a yellow color with glass; with soda, a globule of pure silver is obtained.

Composition, tellurium 37·2, silver 62·8.

The variety from Nagyag, G.=8·7 ... 8·83, yielded to Petz,

Tellurium, - - - -	34 98
Silver, - - - -	46·76
Gold, - - - - -	18·16

with traces of iron, lead and sulphur.

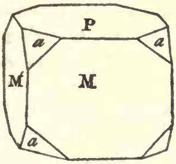
Occurs in the mine of Savodinski in Siberia, in a talcose rock with pyrites, chalcopyrite and blende. Specimens in the Museum of Barnaul on the Ob, measure a cubic foot in dimensions.

Sp. 9. Copper.

[H.=2·5 . . . 3·0 G.=8·9. In xls. cubo-8-dral and massive compact and dendritic, hackly. Copper-red.]

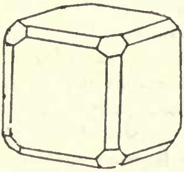
Primary form, cube.
Secondary forms.

Fig. 571.



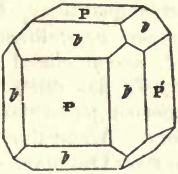
Cornwall.

Fig. 572.



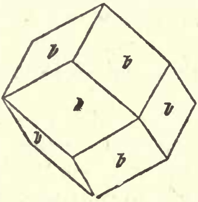
Siberia.

Fig. 573.



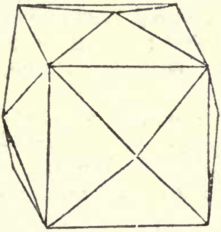
Siberia.

Fig. 574.



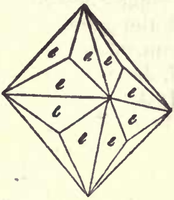
Cornwall.

Fig. 575.



Nelsoe.

Fig 576.



Nelsoe.

Cleavage, none. Fracture hackly. Surface generally not very smooth, but nearly of the same quality in all the forms, excepting the dodecahedron, which is sometimes streaked parallel to its edges of combination with the cube. It is subject to tarnish. Lustre metallic. Color, copper-red. Streak unchanged, shining. Ductile.

Compound varieties. Twin-crystals very frequent, composed parallel to a face of the octahedron. If the form of the individuals is the icositetrahedron, and the compound crystal flattened in the direction of the axis of revolution, isosceles six-sided pyramids are formed, which at first sight appear incapable of derivation from the cube. Small crystals aggregated in rows; arborescent and filiform shapes. Massive: composition not recognizable. Plates often consisting of distinct crystals. Superficial.

B. B. it melts pretty easily, but on cooling is covered with an oxidized coat. It is easily soluble in nitric acid, and yields under the influence of light and air, a blue solution in ammonia. It crystallizes from fusion. Dentiform and capillary crystals are often produced in the vesicular cavities of copper slags.

Composition, copper, with traces of silver, which sometimes amounts to 7 or 8 p. c., particularly at the Lake Superior mines and in Chili.

It is found in beds and veins, and is associated with various other ores of copper, and sometimes with ores of iron; also loose in the soil, and in water-worn fragments.

Copper has been more frequently met with, than any of the other metals in their pure state. It occurs in beds at Herrengrund, Schmölnitz and Göllrietz also at Moldawa, Saska and Orawitza, in the Bannat of Temeswar; probably in the same manner in Siberia, from whence the largest and most distinct crystals of the general shape of the cube have been brought, engaged in granular limestone. It occurs likewise in beds, in bituminous marl-slate, at Kamsdorf in Thuringia, and in the county of Mansfield, and in Chessy near Lyons. In veins, it is met with in considerable quantities, in many of the mines near Redruth in Cornwall. Copper, crystallized in beautiful icositetrahedrons, occurs in amygdaloid, accompanied by chabasite in Nelsoe, one of the Faroe Islands. Copper has often been found in detached masses, throughout North America, particularly in Illinois, Michigan and the North Western Territory. About thirty miles south of Lake Superior, on the west bank of the river Ontonawgaw, near Keweenaw Point, it exists in a trap and sandstone formation, where are found imbedded masses of great size, amounting to hundreds of tons, giving rise to the most profitable mines of copper in the United States. It has particularly abounded throughout the greenstone trap and red sandstone formation of Massachusetts, Connecticut and New Jersey; having been found at Schuyler's mine, (N. Jersey,) at Cheshire, near New Haven, (Conn.) and at Deerfield, (Mass).

What has been called *copper of cementation*, is the metal precipitated from its solution in sulphuric acid, by metallic iron. It is produced at Herrengrund and Schmölnitz in Hungary, and in Cornwall and Wales.

Copper, in its uses, is too well known to require an enumeration of them.

Sp. 10. SILVER.

[H.=2·5 . . . 3·0. G.=10·47. In cubo-8-dral xls., and massive. Hackly; silver white.]

Primary form, cube.

Secondary forms.

Fig. 577.

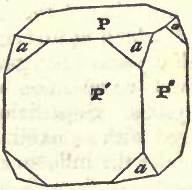
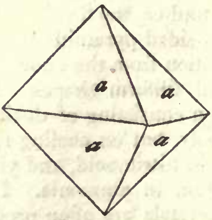
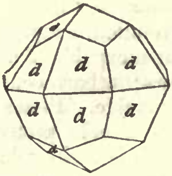


Fig. 578.



Mexico.

Fig. 579.



Kongsberg.

Cleavage, none. Fracture, hackly. Surface, the octahedron striated in a triangular direction, parallel to its edges of combination with the cube. The remaining faces often rough, but even. Lustre metallic. Color, silver-white, more or less subject to tarnish. Streak shining.

Compound varieties. Twin-crystals; compound, parallel to one of the faces of the octahedron. Dentiform, filiform and capillary shapes, also reticulated, arborescent, and in plates. Often the individuals are still discernible, but frequently also their extent can no longer be ascertained. In the latter case, the surface of the dentiform and filiform shapes is longitudinally streaked. Massive: composition rarely observable. fracture hackly. Plates formed in fissures, also superficial coatings.

Fordyce found 28 p. c. gold in one variety; Jahn detected antimony, copper and arsenic in that from Johanngeorgenstadt. The Copiapo silver had 16 p. c. bismuth, and the Kongsberg contains traces of mercury.

Silver has been divided into *common* and *auriferous* native silver. It is at present impossible to decide, whether the latter ought to be united as a variety with the former, or whether it forms a species of its own, as we are not yet sufficiently acquainted with all its physical properties, by which alone this question can be decided. Specific gravity, and the yellowish color form the distinctive marks between them; but as these may arise from the mere juxtaposition of the two metals, they are not alone sufficient for the purpose.

Silver is soluble in cold nitric acid, but in the sulphuric acid, only with the assistance of heat. It crystallizes from fusion before the blowpipe, if the globule is not too large,—forming while crystallizing, a single individual, in which the faces of the octahedron, the cube and the dodecahedron, are distinctly seen.

Silver occurs principally in veins, traversing gneiss, clay-slate, and other primitive and transition rocks. It is accompanied by numerous species of pyrites, glance and blende, as well as by quartz, calcite, &c. The auriferous native silver, though it is found in the same repositories, is far more scarce. The formation of *black silver*, a black friable substance, which is very rich in silver, seems to depend chiefly upon the presence of native silver.

Silver is found in the mining districts of Saxony and Bohemia, also in Norway and Siberia, but particularly in Mexico and Peru; also in Cornwall and in Siberia.

One specimen from Kongsberg Norway, now in the Royal Museum at Copenhagen weighs upwards of 5 cwt., one from Balopilas, Mexico weighs 400 lbs., and another from Huantaya in Southern Peru, exceeded 8 cwt. During the first 18 years of this century, more than 8,180,000 marks of silver were afforded by the mines of Guanaxuato (Mexico) alone.

Found in the U. States at the copper mines of Lake Superior, and at Kings mines, Davidson co. N. Car., where it presents itself in thin leaves and in filiform masses.

The employment of silver in coinage, and in the manufacture of plate and articles of luxury, is well known.

Sp. 11. AMALGAM.

[H.=3·0 ... 3·5. G.=13·75. Xls. from the cube, also massive. Lustre metallic; color, silver-white.]

Primary form, cube.

Secondary forms.

Fig. 580.

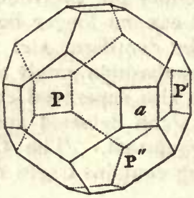


Fig. 581.

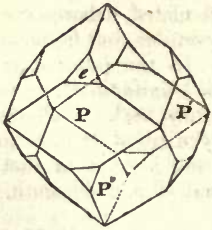


Fig. 582.

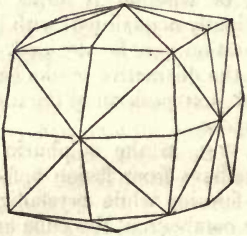
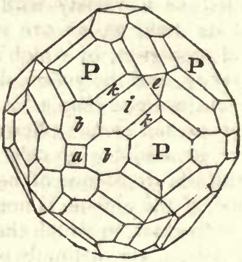


Fig. 583.



P on *a*	135° 00′	PHILLIPS.	P on *k*	160° 40′	PHILLIPS.
P on *b*	154 00	"	*a* on *b*	161 2	"
P on *i*	150 00	"	*i* on *k*	169 5	"

Cleavage, very indistinct traces parallel to the dodecahedron. Fracture conchoidal, uneven. Surface smooth and shining. Lustre metallic. Color, silver-white. Streak unchanged. Brittle; it emits a grating noise when cut with a knife.

Compound varieties. Massive; individuals scarcely discernible, fracture conchoidal, uneven.

Two kinds of amalgam have been distinguished, in reference to the solid or fluid state in which it is found. The fluid varieties must be considered as solutions of the solid ones in fluid mercury.

B. B. the mercury is driven off, and a globule of pure silver is obtained.

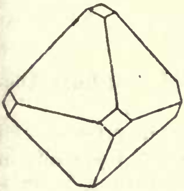
Analysis by	KLAPROTH.	By CORDIER.
Silver,	34·8	27·50
Mercury,	65·2	72·50

It is found accompanied by other ores of silver and mercury, and by pyrites, at Moschellandsberg in the Palatinate, and at Rosenau in Hungary. It is said also to have been met with in France, Spain and Sweden.

Sp. 12. GOLD.

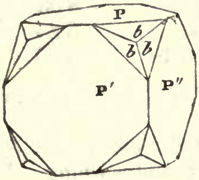
[H.=2·5 . . . 3·0. G.=14·837. Color, gold-yellow.]
Primary form, cube.
Secondary forms.

Fig. 584.



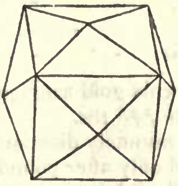
Matto Grosso, Brazil.

Fig. 585.



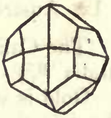
Siebenbergen.

Fig. 586.



Siberia.

Fig. 587.



California.

Cleavage, none. Fracture hackly; the cube often hollow; the octahedrons either rough or smooth, in combinations, generally the latter; the icositetrahedrons streaked parallel to the edges of combination with the cube and the octahedron. These differences in most cases are not distinctly marked. Edges of crystals often salient.

Lustre metallic. Color, various shades of gold-yellow. Streak shining.

Compound varieties. Twin-crystals; face of composition parallel, axis of revolution perpendicular, to a face of the octahedron; pretty frequent, particularly in the icositetrahedrons, as represented in fig. 588.

Fig. 588.

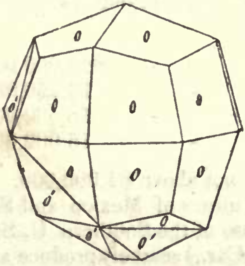
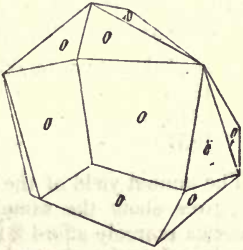


Fig. 589.



If this variety (fig. 588) be compressed in the direction of the axis of revolution, fig. 589 is formed. Filiform, capillary, reticulated and arborescent shapes; also leaves and membranes. Sometimes the individuals are still discernible. Surface drusy, striated or smooth. Massive: composition not observable, fracture hackly. Plates, superficial coatings, rolled masses.

Analyses of gold:—1, by Rose; 2, by Boussingault; 3, by Awdejew; 4, by Boussingault; 5, by Rose; 6, by Rose; 7, by Hunt; 8, by Rose; 9, by Rivot; 10, by Rose; 11 by Darcet; 12, by Kerl.

	Gold.	Silver.	Copper.	Iron.
1. Altai, - -	60·08	39·38	0·33	
2. Columbia, (G=12·6)	73·45	26·48		
3. Katherinenb'g (G=16·)	79·69	19·47	Co, Fe and loss	0·8
4. Trinidad, -	82·40	17·60		
5. Nischne Tagilisk,	83·85	16·15		
6. Near Miask, - -	87·40	12·07		
7. Chaudière, Canada,	86·73	13·27		
8. Near Miask, -	89·35	10·65		

	Gold.	Silver.	Copper.	Iron.
9. California, (G.=14·6)	90·7	8·80		0·38
10. Beresof, - -	91·8	8·03	0·02	
11. Brazil, - -	94·	5·85		
12. Australia, - -	95·48	3·59		

The California gold averages $\frac{875}{1000}$ to $\frac{885}{1000}$ths in gold, that from Australia $\frac{960}{1000}$ to $\frac{966}{1000}$ths.

Gold is so minutely disseminated in several rocks, that its presence can be discovered only after pounding and washing. It occurs frequently in beds, in small nodules imbedded in quartz, along with pyrites, antimonite and wolfram: rarely also, it is found in crystals in these situations: in veins also, with the same minerals, and with blende, calcite, silver, &c. Gold is often found in the sand of rivers, in valleys and plains, into which it has been carried from its original repositories, in the shape of larger or smaller, generally flat pebbles, often mixed with quartz.

The great sources of gold are California, Asiatic Russia, Australia, Brazil, the southeastern United States, Africa, the East India Islands, and Bohemia and Transylvania in Europe. It also occurs in the sands of the Rhine, on the southern slope of the Pennine Alps, in Piedmont, Spain, Wales, Scotland, and at Wicklow in Ireland, in Canada, Cuba, Mexico and Peru.

The Russian mines yielded between the years 1725 and 1841, 30,000 lbs. troy of the precious metal. In 1842, they gave 42,000 lbs. troy, half of which was from Siberia, east of the Urals.

In 1843 they gave 60,000 lbs., - - -		$13,000,000
1845, - - - - -		13,250,000
1846, - - -	76,353 lbs. - -	16,500,000
1851, - - - - -		15,000,000

The annual yield of the rest of Europe is not above $1,000,000. Africa gives about the same quantity. The mines of Mexico and South America scarcely afford $10,000,000. Those of the Southern U. States (the best deposits of which are in S. and N. Car.,) scarcely produce above $1,000,000 annually; but those of California probably do not fall short of $60,000,000: while Australia is said to give for the two first quarters of the present year, at the rate of $100,000,000. It is probable that the gold produce of the globe now reaches $200,000,000 per year.

Among the large lumps of gold which have been noticed, may be mentioned the following: one from Cabarras Co., N. C., weighing 37 lbs.; one from California of 20 lbs.; one from Paraguay of 50 lbs.; one from Taschku Targanka in the Urals, (and now preserved in the Mining School of St. Petersburg) of 100 lbs., and finally the enormous mass of 134 lbs. 7 oz., lately found in Australia, and which sold for £5,532.

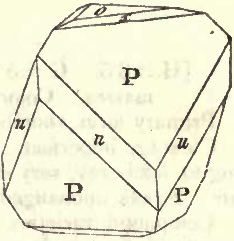
Sp. 13. ANTIMONY, Spiesglas, *Werner*.

[H.=3 . . . 3·5. G.=6·6 . . . 7·0. Massive, granular, individuals easily separated.]

Primary form, rhomboid of 117° 15′.

Secondary form.

Fig. 590.



Cleavage parallel with *o* highly perfect, and possessing a strong lustre; parallel with P distinct, and easily obtained, but showing a less degree of lustre; parallel with *x*, obtained with difficulty, and interrupted; faint traces parallel with *u*. The surface of *o* is triangularly streaked, of P in a horizontal direction, and parallel with its edges. Fracture not observable. Lustre metallic. Color, tin-white. Streak unchanged.

Compound varieties. Reniform; surface reniform or uneven; composition of flat grains, collected into curved or lamellar. Massive; composition granular, of various sizes of individuals, easily separated; faces of composition striated agreeably to the faces of cleavage.

B. B. it melts quickly into a globule, and continues to burn when heated to redness, even if the blast is suspended. It emits copious white fumes, which are deposited round the globule; first yellowish-white octahedrons, probably of antimonious acid, are formed, and then snow-white prismatic crystals of oxide of antimony, with which at last the whole globule is covered. Some of the varieties leave a globule of silver when the contents of antimony have been entirely volatilized. It crystallizes readily from fusion.

Analysis by Klaproth.

Antimony, - - - - -	98·00
Silver, - - - - - -	1·00
Iron, - - - - - -	0·25

Antimony is found in veins traversing ancient rocks, and is principally accompanied by other species that contain antimony. The valentinite, which occurs with it, seems to be the product of decomposition.

The present species was first discovered at Suhlberg, near Sahla in Sweden, and afterwards at Allemont in Dauphiny, (where it occurs in curved lamellar, compound varieties, which consist of granular ones,) and at Andreasberg in the Hartz. It is likewise found in primitive mountains, attended by antimonite and galena; at San Han Huetamo, and Cuencamé in Mexico.

Sp. 14. ALLEMONITE, Arsenical Antimony, Arsenikantimon, Antimonarsen, *Naumann*.

[H.=3·5. G.=6·1 . . . 6·2. Massive, granular. Color tin-white to red-grey.]

In reniform masses. Structure curved lamellar. Lustre metallic, or occasionally splendent, sometimes dull. Often tarnished brownish-black.

B. B. emits fumes of arsenic and antimony, and fuses to a metallic globule, which takes fire and burns away, leaving oxide of antimony on the charcoal.

Analysis by Rammelsberg, arsenic 62·15, antimony 37·85.

Occurs at Allemont in Dauphiny, also at Przibram in Bohemia, where it is associated with blende, antimony and chalybite: likewise at Schladming in Styria and Andreasberg in the Hartz.

Sp. 15. ARSENIC.

[H.=3·5. G.=5·7 . . . 5·8. Rarely in xls.: massive in reniform masses. Color, tarnished dark grey.]

Primary form, rhomboid of 114° 26′.

Cleavage imperfect. Lustre metallic. Color tin-white, a little inclining to lead-grey, very soon tarnished dark-grey on being exposed to the air. Streak unchanged, rather shining.

Compound varieties. Reticulated, reniform and stalactitic shapes; composition granular, small and often impalpable; it is sometimes columnar, forming a second curved lamellar composition; the individuals being generally impalpable, and the faces of the second composition reniform or uneven. In columnar particles of composition, a cleavage in a direction perpendicular to the axis of the individuals, is observed.

Upon ignited charcoal, or before the blowpipe, it emits a strong smell of garlic, and copious white fumes: and at last disappears altogether. It is the volatilized metal, and not the white fumes of arsenious acid, which possess the odor of garlic.

Analysis by Jahn.

Arsenic,	96·00	97·00
Antimony,	3·00	2·00
Oxide of iron and water,	1·00	1·00

It is not uncommon in several of the mines of Annaberg, Schneeberg, Marienberg and Freiberg in Saxony; also at Joachimsthal in Bohemia, at Andreasberg in the Hartz, in the Black Forest, in Alsace, at Allemont in Dauphiny, in Kongsberg in Norway, at Kapnik in Transylvania, and in beds at Orawitza in the Bannat of Temeswar.

It is variously employed in metallurgical processes: it enters into the composition of certain kinds of glass, and of many colors; and has been introduced even among the pharmaceutical preparations. It is a violent poison.

Sp. 16. ALTAITE, *Haidinger;* Tellurblei.

[H.=3·0 . . . 3·5. G.=8·15. Rarely in cubes: usually massive. Color like antimony, with a yellow tarnish.]

Primary form, cube. Cleavage cubic. Lustre metallic. Color, tin-white. Sectile. B. B. volatilizes in the reducing flame, excepting a minute bead of silver. Colors the flame blue. Soluble in nitric acid. Composition Pb Te. Analysis by Rose; tellurium 38·37, lead 60·35, silver 1·28.

Occurs with petzite at Savodinsky, in the Altai.

Sp. 17. DISCRASITE, *Frobel;* Antimonial silver, Silber-Spiesglanz.

[H.=3·5. G.=9·4 . . . 9·8. Mostly granular; silver-white.]

Primary form, right rhombic prism of 120°.

Secondary form.

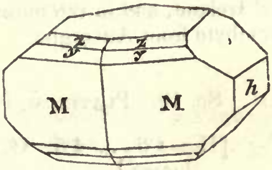


Fig. 591.

Cleavage parallel to *o* and P distinct; cleavage parallel to M imperfect. Fracture uneven. Surface in general, smooth. Lustre metallic. Color silver-white, inclining to tin-white. Streak unchanged.

Compound varieties. Twin-crystals like those of aragonite and cerussite. Massive: composition granular, individuals of various sizes, and easily separated.

Pseudomorphic six-sided prisms.

B. B. it yields a globule of silver, while the antimony is driven off.

Silver, - - - - -	76·5
Antimony, - - - -	23·5

It is found accompanied by silver, arsenic, galena and various other species. Its localities are Altwolfach in Furstenberg, and Andreasberg in the Hartz.

The *arsenical silver* is considered as a more or less intimate mechanical mixture of arsenic, or of mispickel, with discrasite. It possesses the color of silver, but is commonly tarnished externally, of a blackish color. It occurs in small, curved lamellar compositions, consisting of very thin crystalline coats. It is harder than discrasite. B. B. the arsenic and antimony are for the most part, volatilized, leaving a globule of impure silver, surrounded by a slag. A specimen from Andreasberg afforded Klaproth,

Arsenic, - - - - -	35·00
Antimony, - - - -	4·00
Silver, - - - - -	12·75
Iron, - - - -	44·25

Its localities are the same as those mentioned for discrasite, and in addition, it comes from Guadalcaual in Estremadura in Spain.

It is valuable for the extraction of silver.

Sp. 18. Iron (exclusive of meteoric iron).

[H=4·5. G. 7·3...7·8. Massive, granular, usually fine-granular. Color steel-grey to iron-black. Magnetic.]

Fracture hackly. It is almost pure iron, or only contains a small admixture of other metals, but always without nickel. Sometimes carbon is present, in which case it confers upon the iron a steel-like property of brittleness. It has been found in a thin vein at Oulle near Allemont in Dauphiné, at Vesuvius and Graveneire in Auvergne, in thin flexible leaves. In the iron-stone conglomerate near Itabira do Matto Dentro in the Brazils. A mass described by Klaproth, was found with magnetite at Gross Kamsdorf near Saalfeld in Thuringia, in which he found iron 93·5, lead 6·0, copper, 1·5: and according to Dr. Andrews of Belfast, it is a common constituent of many igneous and of some metamorphic rocks, being diffused through them, in exceedingly minute quantity. To detect its presence, the rock is moistened with a solution of acid sulphate of copper, when a film of metallic copper is deposited. He found the largest indications of iron in a glassy basalt, which forms the entire mass of Slieve

Mish in Antrim. It occurs however, in other basaltic rocks in the north of Ireland, and in the indurated lias of Port Rush, also in a specimen of trachyte from Auvergne.

Sp. 19. Platinum, Platin, *Haidinger* ; Polyxen, *Hausmann*.

[H.=4·0 ... 4·5. G.=16·0 ... 19·0. In grains and irregular lumps.]

Primary form, cube. Mostly in irregular forms and grains. Cleavage none. Fracture hackly. Lustre metallic. Color, perfect steel-grey. Streak unchanged, shining.

It is very refractory, and soluble only in nitro-muriatic acid.

Analysis by Berzelius.

	Fr. Nischne-Tagilsk.		Fr. Goroblagodat.	Fr. the Ural.
Platinum, - -	78·94	73·58	86·50	84·30
Iridium, - -	4·77	2·35	0·00	1·46
Rhodium, - -	0·86	1·15	1·15	3·46
Palladium, -	0·28	0·30	1·10	1·06
Iron, - -	11·04	12·98	8·32	5·31
Copper, - -	0·70	5·20	0·45	0·74
Osmium and iridium,	1·96	2·30	1·40	1·03 osmium.
Earthy substances,	0·00		0·00	0·72

The original repositories of platinum are not known, it having hitherto been found only in pebbles and grains, generally small, but sometimes upwards of a pound and a half in weight. It is accompanied by zircon and some other gems; also by magnetite, gold, iridium and palladium.

It has been chiefly brought from the provinces of Choco and Barbacoas in South America, also from Matto-Grosso in Brazil. It has likewise been found in St. Domingo, and in Siberia. In the mine of Nischne-Tagilsk, (which is also rich in gold, iridosmine, rutile, and even contains diamonds,) several large masses of platinum have been found, weighing from seven to fifteen pounds. M. Schwetzaw describes two varieties in the Russian platina from Nignotaguilsk in the government of Perme. 1. *Common platinum.* Color platinum-grey. Grains angular and bristled, seldom blunt-edged; also in cubical crystals and grouped. Hardness = hornblende. Malleable. Sp. gr.=17 ... 17·6. 2. *Ferruginous platinum.* Color darker than the preceding. Surface tarnished, sometimes like meteoric iron. Grains and crystals have the same form as common platinum. Hardness = feldspar, and rather higher. Less malleable than the first. Sp. gr. 14·6 ... 15·7. It is magnetic, and in some grains not only attracts, but repels. It contains a large proportion of iron.

Russia affords an annual produce of about half a ton of platinum, which is ten times the amount obtained from all other localities. It is found also in Borneo, the sands of the Rhine, the county of Wicklow, Ireland, in the gold region of North Carolina and California, and at St. Francois Beauce in Canada East.

The refractory powers of this metal when heated, and the circumstance that it is not acted upon by the greater part of the chemical reagents, render it extremely valuable in the construction of philosophical and chemical apparatus. It is used also for covering other metals, for painting on porcelain, for coin; and like gold and silver, for various other purposes.

Sp. 20. PALLADIUM.

[H.=4·5 ... 5·0. G.=11·8 ... 12·44. In minute 8-drons and in grains, sometimes made up of diverging fibres.]

Primary form, cube.

Secondary form, minute octahedrons. Lustre metallic. Color steel-grey to silver-white. Opaque.

Alone B. B. infusible; but melts easily, when sulphur is added. By continuing the heat, the sulphur is driven off, and a globule of palladium obtained. Composition, palladium alloyed with a little platinum and iridium.

Occurs with platinum in Brazil. It has been employed, when purified, in the manufacture of balances, mathematical and surgical instruments.

Sp. 21. IRIDOSMINE, Native Iridium, Osmium, Iridium, Neujanskite, *Haidinger;* Sisserskite, *Haidinger.*

[H.=6·0 ... 7·0. G.=19·3 ... 21·12. In irregular, flattened grains, rarely in 6-sided prisms.]

Lustre metallic. Color tin-white to light steel-grey. Opaque. Malleable with difficulty.

Analysis *a* from Katharinenburg by Berzelius, *b* from Nischne-Tagilsk by Rose.

	a	*b*
Iridium,	46·77	19·86
Osmium,	49·35	80·24
Iron,	0·74	
Rhodium,	3·15	

a had a H.=7. G.=19·38 and a tin-white color. It is the Neujanskite of Haidinger. *b* had a H.=7 and a G.=21·11, and is the sisserskite of the same author. At a high temperature, the latter gives out osmium, undergoing no further change. The neujanskite does not emit the odor of osmium, unless heated with nitre; when a mass soluble in water is obtained, from which nitric acid throws down a green precipitate. It is frequent in the gold formation of California, and has been detected in the gold-washings of the rivers du Loup and des Plantes in Canada.

Sp. 22. SVANBERGITE (*S.*), Platiniridium, *Svanberg;* Native Iridium.

[H.=6·0 ... 7·0. G.=22·6 ... 23·1. In small grains and rarely in what appear to be cubes, with truncated angles. Color, white.]

Analysis by Svanberg.

	Irid.	Plat.	Pallad.	Rhod.	Fe	Cu
1. N. Tagilsk,	76·80	19·64	0·89			1·78
2. Brazil,	27·79	55·44	0·49	6·86	4·14	3·30

It is brought of late, in considerable quantity, from California, mixed with the fine gold.

APPENDIX TO ORDER METAL.

Arquerite, Berthier, is an amalgam of silver from the mines of Arqueros near Coquimbo. Crystallized, and according to Domeyko, has the composition, of silver 86·49, mercury 13·51.

Bismuthaurite, or *Bismuthic Gold* (*S.*). In grains, the largest not weighing above $\frac{9}{10}$ths of a grain. Structure hackly, or sub-fibrous. H.=2·5..3·0. G.=12·44..12·9. Color that of palladium. Malleable, but when thinned out under the hammer, it becomes brittle. Scarcely acted upon by nitric acid, or by hydrochloric alone; but in the two, slowly dissolves save traces of a heavy white precipitate. Heated B. B. on charcoal, it melts as soon as touched by the flame, into a globule which gives off a white smoke, at the same time coloring the support of a bright yellow, while the charcoal remains hot, but turning white, when cold. If allowed to cool, the globule crystallizes beautifully, with a coarsely indented surface, and has its color changed from greyish white, to a distinct golden yellow tinge. By continuing the heat, the globule gradually wastes away to less than half its original bulk, crystallizes less distinctly, grows less fusible, and finally puts on the appearance of pure gold.

Elektrum, the name sometimes given to gold, when it contains above 20 p. c. of silver.

Gold Amalgam, Schneider. In small white grains, as large as a pea. Fragile. Composition, mercury 57·40, gold 38·39, silver 5·0. Occurs in the platinum region of Columbia, along with platinum. It is said also to exist near Mariposa in California.

Iron-Platinum, Eisenplatin of Svanberg. The platinum from Nischne-Tagilsk, having a H.=6 and a G.=14·6 to 15·8, and which contains 12 p. c. iron, has received this name.

Porpezite, Palladium gold. From Porpez in Brazil. It afforded Berzelins, gold 85·98, palladium and silver, 4·17.

Rhodium-gold has G.=15·5 . . . 16·8. Brittle, and contains, according to Del Rio, 34 to 43 p. c. of rhodium. Mexico.

Tin, reported as found in small, greyish white, metallic grains, along with gold from Siberia. Composition, according to Hermann, tin with some lead.

ORDER XII. PYRITES.

Sp. 1. **BORNITE**, *Haidinger;* Purple Copper, *Phillips;* Variegated Copper-ore; Buntkupfererz, *Hausmann;* Purple Copper; Erubescite, *Dana.*

[H.=3. G.=4·4...5·0. Crystallizations imperfect. Color pinchbeck-brown to copper-red; highly prone to assume a purplish tarnish.]

Primary form, cube.
Secondary forms.

Fig. 592.

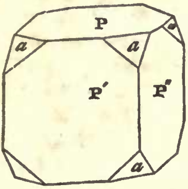
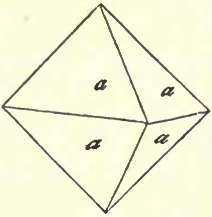
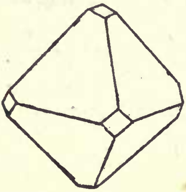


Fig. 593.



Bristol, Conn.

Fig. 594.



Bristol, Conn.

a on *a* = 70° 32′
P on *a* = 54 44

Cleavage, traces, parallel with P. Fracture small conchoidal, uneven. Surface, generally rough, particularly P, and often curved. Much subject to tarnish. Lustre metallic. Streak pale grayish black, a little shining. Rather sectile. Often in twins. Massive, composition fine granular, strongly connected. Fracture conchoidal and uneven. Brittle. Acquires, when exposed to a moist atmosphere, an iridescent tarnish, in which purple tints prevail.

Heated in the open tube, yields sulphurous acid, but no sublimate. B. B. on charcoal, turns black, and after cooling, red. After long exposure to the flame, fuses into a steel-gray, brittle, magnetic globule. With borax and soda, yields a globule of copper. After roasting, shows with fluxes, the reactions of oxides of copper and iron. Partially soluble in concentrated hydrochloric acid, leaving the greater part of the sulphur.

Composition, (Fe €u) S, or sulphur 23·7, copper 62·5, iron 13·8. Analyses:—

	S	Cu	Fe		
1. Siberia,	21·65	61·63	12·75	quartz 3·5	Brandes.
2. Cornwall (xls.)	28·24	56·76	14·84		Plattner.
3. Redruth (xls.)	26·84	57·89	14·94		Chodnew.
4. Bristol, Conn.,	25·70	62·73	11·64		Bodemann.

The massive varieties often contain a mechanical mixture of chalcopyrite.

Occurs in beds and veins in granite, gneiss, and in new red sandstone. The chief localities are Orawitza in the Banat, Arendal Norway, in bituminous marl-slate at Saalfeld and Kamsdorf in Thuringia, in veins in iron-stone in Siegen, in gneiss at Annaberg and Freiberg in Saxony, in veins in granite near Redruth and St. Day in Cornwall, where it is sometimes called "horse-flesh-ore" by the miners; but the finest specimens, both massive and crystallized, have been afforded by the Bristol, Conn. mine. It also occurs (cubic xls.) in the Connecticut river sandstone, at Cheshire, Conn., associated with malachite, redruthite, and baryte. It is a valuable ore of copper.

Sp. 2. CHALCOPYRITE, *Beudant;* Copper Pyrites, Yellow Copper Pyrites, Kupferkies, Towanite, *Brooke and Miller.*

[H.=3·5 . . . 4·0. G.=4·1 . . . 4·3. Generally massive. Color brass-yellow. Streak greenish black.]

Primary form, right square prism.

Secondary form.

Fig. 595.

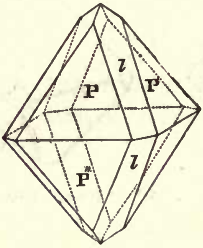
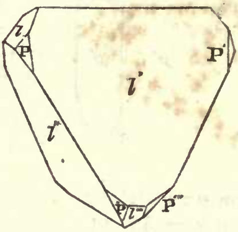


Fig. 596.



P on *l*	- - - -	141° 15′	*Phillips.*
l on *l*	- - - -	110 00	"
l′ on *l*′′′	- - - -	71 10	"
P on P″	- - - -	125 30	"

Fracture conchoidal, more or less perfect. Surface, P streaked, parallel with the base; the alternating faces enlarged, faces of *l* are irregularly streaked. The remaining faces are almost all smooth, and often possess a high lustre. Lustre metallic. Color brass-yellow. Streak greenish-black, a little shining. Rather sectile.

Compound varieties. Twin-crystals: face of composition perpendicular to a face of P, similar to the common hemitrope in the regular octahedron. Globular, reniform, botryoidal, stalactitic, and other imitative shapes: surface generally rough, sometimes also smooth, composition impalpable, fracture flat conchoidal. Massive: composition granular, of various sizes of individuals, often impalpable, and strongly coherent, fracture uneven or flat conchoidal.

Upon charcoal, B. B. it becomes black, but turns red on cooling. It melts into a globule, which becomes magnetic if kept in the blast for some time. With borax, it yields a globule of copper. It is partly soluble in dilute nitric acid; the solution is green, and the undissolved part consists of sulphur. Composition, $\text{Ꞓu}\,S + Fe^2\,S^3$, or sulphur 34·9, copper 34·6, iron 30·5; but these proportions are liable to vary from admixture of pyrites. Analysis by Rose, sulphur 35·37, iron 29·82, copper 34·81.

Found in veins and beds, and is attended by other ores of copper, blende, galena and chalybite. It is the principal ore of the Cornish mines, which yield it annually to the amount of 160,000 tons. It exists abundantly in Wales at Anglesea, in Ireland at the Wicklow mines, at Fahlun in Sweden, in the Hartz, at Freiberg, in Thuringia, Hungary, in Tuscany, and in South Australia. The best mines of chalcopyrite in the United States are those of Bristol, Conn., the Hiawassee mines of Tennessee, and the Maculloch mines near Greensboro', N. Carolina. It exists also in promising quantity in the Canton mine in Cherokee Co., Ga. in the extensive system of mineral veins near N. Hampton, Mass., where the primitive meets the secondary rocks of the Connecticut valley, as at Greenfield (Turner's falls), Leverett, and Southampton, and again at Middletown and Bristol, Conn.; other deposits exist at Phenixville, Pa., at Stafford and Schrewsbury in Vermont, in numerous gold mines in Cabarras and Rowan counties in North Carolina, and particularly at Gold Hill. The probability is strong that many of the pyritic veins at present yielding gold, will, when worked in depth, turn into valuable deposits of the present species.

It is a very valuable ore for the production of metallic copper; and is said to afford from 10 to 12,000 tons of this metal annually. Much of the ore of the Cornish mines is so largely intermixed with pyrites that it yields only 5 to 7 p. c. of metallic copper. The copper-ores of all kinds smelted in Great Britain during 1855, yielded copper, worth £2,867,207.

Sp. 3. Millerite, *Haidinger;* Native Nickel, *Phillips;* Haarkies, *Mohs;* Nickelkies, *Hausmann.*

[H.=3·5. G.=5·2 . . . 5·3. In delicate brass-yellow acicular xls.]

Primary form, rhomboid, 144° 8′.

Cleavage rhombohedral, perfect. Lustre metallic. Color brass-yellow, inclining to bronze-yellow, with a gray iridescent tarnish. Streak bright. Brittle.

In the open tube, yields sulphurous acid. B. B. melts readily to a black magnetic globule. With borax, gives the characteristic reaction of nickel. With aqua regia, yields a green colored solution. Analyses, *a* by Rammelsberg, *b* by Arfvedson.

	a	*b*
Sulphur,	34·26	35·79
Nickel,	64·35	61·34
Copper,		1·14
Iron,		1·73

Occurs in cavities among crystals of other species at Joachimstahl in Bohemia, Johanngeorgenstadt, Przibram, Riechelsdorf, Andreasberg, Cornwall in Wales, Stirling iron-mine Antwerp, N. Y., and in the chalybite of the coal slate at Scranton, Lackawana valley, Pa.

Sp. 4. Nicopyrite, (*S.*) Eisennickelkies, *Scheerer.*

[H.=3·5 . . . 4·0 G.=4·6. Massive. Pinckbeck-brown.]

Primary form, cube.

Cleavage apparently 8-dral. Fracture uneven. Lustre metallic. Brittle. Streak rather darker than color. Brittle. Opaque. Not magnetic.

B. B. like pyrites, except that when fused with borax in the inner flame, after being well roasted, the bead becomes black and opaque, in consequence of the reduction of the nickel.

Composition, $2\mathrm{Fe\,S} + \mathrm{Ni\,S}$ = iron 41·04, nickel 22·11, sulphur 35·95. Analysis by Scheerer:—

Iron,	40·21
Nickel,	21·07
Copper,	1·78
Sulphur,	36·64

Occurs in greenish black hornblende with chalcopyrite, near Lillehammer in Norway, and at Argyleshire in Scotland, where it exists along with pyrrhotine.

Sp. 5. **Domeykite**, *Haidinger;* Condurrite, *Faraday;* Arsenious copper, Cuivre arsenical, *Dufrénoy;* Weisskupfer, *Hausmann.*

[H.=3·5. G.=4·7...5·0. Massive, reniform and botryoidal. Color yellowish tin-white, also soft, blackish, and without metallic lustre.]

Lustre metallic, sometimes with a yellowish iridescent tarnish. Fracture uneven, to flat conchoidal. Also black and soft; when impure, soiling the fingers. (In the latter case, it is mixed with cuprite and arsenite.)

Melts easily B. B. evolving a strong arsenical odor.

Analyses; *a* from Chili by Domeyko, *b* from Cornwall by Rammelsberg, *c* do. by Faraday.

	a	*b*	*c*
Arsenic,	28·36	18·70	29·88
Copper,	71·64	70·51	70·11

Occurs near Coquimbo and at Copiapo in Chili, at the Condurrow mine near Helstone, at Huel Druid mine at Corn Brae near Redruth, Cornwall.

Sp. 6. **Stannine**, *Beudant;* Tin Pyrites, Zinnkies.

[H.=4·0. G.=4·47...4·51. Massive, granular, color steel-gray inclining to yellow.]

Primary form, right square prism.?

Fracture uneven, imperfectly conchoidal. Lustre metallic, sometimes a bluish tarnish. Brittle. Streak black. Opaque.

Heated in an open tube, gives the smell of sulphurous acid. B. B. on charcoal, melts, depositing a non volatile white powder and leaving a brittle metallic globule, which on being moistened with hydrochloric acid and exposed to the flame of a lamp, tinges it a beautiful blue. The mineral being treated with fluxes, gives the reactions of copper and iron.

Composition, $\bar{\mathrm{C}}\mathrm{u\,S}\,(\mathrm{Sn}^2\,\mathrm{S}^3\,\mathrm{Fe}^2\,\mathrm{S}^3)$ = sulphur 30, tin 27, copper 29·7, iron 13·1, which almost exactly coincides with analyses made by Klaproth, Rammelsberg, Johnston, and Mallet.

Occurs with pyrites and blende at Huel Rock, parish of St. Agnes, Cornwall, also in granite at St. Michael's Mount, and at Zinnwald in the the Erzgebirge with blende and galena.

Sp. 7. PYRRHOTINE, *Breithaupt;* Magnetic Iron Pyrites, Magnetkies.

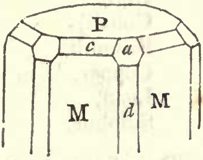
[H.=3·5...4·5. G.=4·4...4·7. Mostly massive. Color bronze-yellow to copper-red. Streak grayish black; tarnishes speedily.]

Primary form, rhomboid.

Secondary form.

M on M′	120° 00′	*Bournon.*
M on *d*	150 00	
P on *a*	135 00	
P on *c*	102 13	

Fig. 597.



Cleavage parallel with P, perfect; less so with M. Fracture small and imperfectly conchoidal in xls., otherwise, structure foliated or fine granular. Lustre metallic. Slightly attracted by the magnet. Brittle. Opaque.

Heated in the open tube, it yields sulphurous acid. B. B. on charcoal, in the exterior flame, it is converted into peroxide of iron; in the interior flame, it melts into a globule which continues to glow a few moments after it is withdrawn from the fire, when it becomes an uneven black mass. When broken, the fracture is crystalline, the color yellowish grey, and the lustre metallic.

Composition, $\mathrm{Fe\,S}$=sulphur 36·4, iron 63·6. Analyses by Rose and by Schaffgotsch.

Sulphur,	38·78	39·41
Iron,	60·52	60·59

A nickeliferous variety (1) from Kleva by Berzelius, and one (2) from Lancaster Co., Pa., by Boyé, gave,

	S	Fe	Ni	Co	Mn	Cu	Gangue
(1.)	38·08	57·64	3·04	0·09	0·22	0·44	0·46
(2.)	24·84	41·34	4·55	Pb 0·27	——	1·30	27·16

Occurs in beds with other ores of iron, as well as with blende, chalcopyrite, and sometimes with iolite. It forms an accidental ingredient of several rocks, and sometimes crystallizes in their fissures. It is also common in meteorites. Small crystals are found at Andreasberg in the Hartz, in connection with the massive variety. It is abundant at Bodenmais in Bavaria, where it is sometimes broadly foliated and attended by iolite. A similar variety is found at Trumbull, Conn., in conjunction with topaz and fluor. The uncleavable variety is common at Bernardstown in Mass., at Stafford, Cornish, and Schrewsbury, Vt., as well as at numerous other places in the U. S. It is employed in the manufacture of copperas and sulphuric acid.

Sp. 8. GRÜNAUITE, *Nicol;* Saynite, Wismutnickelkies, *Kobell;* Nickelwismutglanz; Bismuth Nickel.

[H.=4·5. G.=5·13. In small 8-dral xls. and massive granular. Color steel-gray, liable to a yellowish gray tarnish.]

Primary form, cube.

Secondary form.

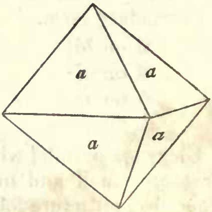
Cleavage parallel with *a*. Lustre metallic. Streak dark grey. Brittle. Opaque.

B. B. melts into a gray brittle, magnetic bead, depositing a greenish yellow sublimate on the charcoal. Dissolves in nitric acid, leaving a residue of sulphur. The solution is green; when neutral, it yields a precipitate on the addition of water.

Analyses; *a* by v. Kobell, *b* and *c* by Schnabel.

	a	*b*	*c*
Nickel,	40·65	22·03	22·78
Iron,	3·48	5·55	6·06
Cobalt,	0·28	11·24	11·73
Bismuth,	14·11	10·49	10·41
Copper,	1·68	11·59	11·56
Lead,	1·58	7·11	4·36
Sulphur,	38·64	31·99	33·10

Fig. 598.



Found at Grünau in Sayn Altenkirchen, with quartz and chalcopyrite.

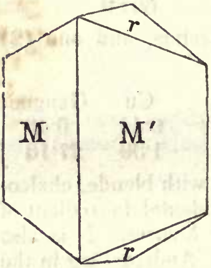
Sp. 9. Mispickel; Arsenical Iron, Danaite, *Hayes;* Plinian, *Breithaupt;* Arsenopyrite, *Glocker.*

[H.=5·5...6·0. G.=6·0...6·3. In short rhombic prisms (111° 53′) striated vertically, and massive, fine granular to compact. Color silver white to steel-grey.]

Primary form, right rhombic prism, M on M′=111° 53′.

Secondary forms.

Fig. 599.



Fig, 600.

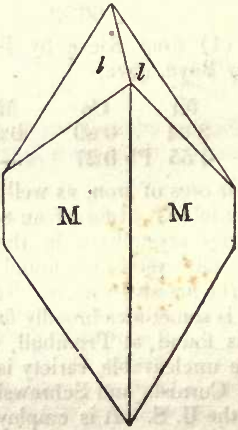


Fig. 601.

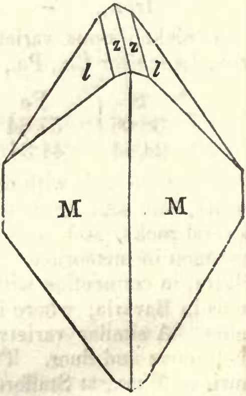


Fig. 602.

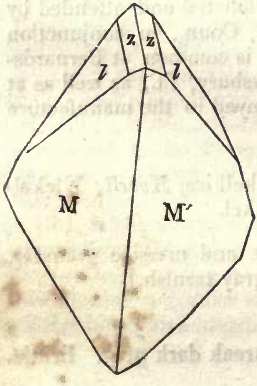


Fig. 603.

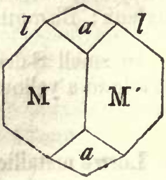
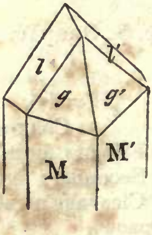
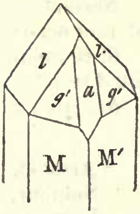


Fig. 604.



r on *r*	145° 26′
l on *l*	80 8
z on *z*	118 32
l on *z*	160 49
a on *a* (fig. 308)	121 52
M on *a*	136 20
g on *g*	118 32
g on *l*	131 48
g on *a*	149 16

Fig. 605.



Cleavage, parallel with M and M′ very perfect; traces, parallel with P. Surface, *r* deeply streaked parallel to its own edges; *g* sometimes rough, or striated in the direction of its edges of combination with *l*: the remaining faces are smooth. Lustre metallic. Color silver-white, inclining to steel-grey. Streak dark greyish-black. Brittle.

Compound varieties. Twin-crystals: face of composition parallel, axis of revolution pendicular to a face of M; the composition often taking place parallel to both faces, or being repeated in parallel layers. Massive: composition columnar, individuals of various sizes, generally straight and divergent, or irregular. The faces of composition are irregularly streaked. Individuals joined in a granular composition are often very small, or even impalpable and strongly connected; the fracture is uneven.

B. B. on charcoal, it emits copious arsenical fumes, and melts into a globule, which is nearly pure sulphuret of iron. It is soluble in nitric acid, with the exception of a whitish residue.

Composition, $Fe\,S^2+Fe\,As$=iron 34·37, sulphur 19·64, arsenic 45·99. In one variety, the danaite, part of the iron is replaced by cobalt; others contain traces of silver or gold. Analyses, *a* by Stromeyer, *b* by Plattner (the plinian), *c* by Scheerer (the danaite from Skutterud), *d* by Hayes (the danaite from Franconia, N. H.).

	a	*b*	*c*	*d*
Iron,	30·04	34·46	26·54	33·28
Sulphur,	21·08	20·07	17·57	18·02
Arsenic,	42·80	45·46	47·55	41·86
Cobalt,	——	——	8·31	6·52

Found in imbedded and attached xls.; also in beds and veins, accompanied by ores of lead, cobalt, nickel, silver, tin and zinc. It is common in the mining districts of Saxony, in the tin veins of Bohemia, in the Hartz, in Cornwall, and at Tunaberg in Sweden. It exists in distinct veins at Chatham and Derby, Conn., in a bed at Worcester, Mass., in thin seams in gneiss at Franconia, N. H., at the lead and copper mine of Canton, Ga., and at many other places in the United States.

Found at Harzgerode in the Hartz, at Schladming in Stiria, Kamsdorf, Lobenstein in Thuringia, near Loos in Sweden, Prakendorf in Hungary, in Spain and in the Brazils.

Sp. 10. CHATHAMITE (*S.*).

[H.=3·5 … 6·0. G. not determined with accuracy, but supposed to be near that of mispickel. Massive; fine granular. Lustre metallic. Color, white, but quickly tarnishing to a dull steel-grey.]

Primary form, right rhombic prism.

Secondary form near to fig. 602. The xls. attached, minute, and of rare occurrence.

B. B. affords copious arsenical fumes: and after roasting the semi-fused residue, it ultimately affords with borax, the reaction of cobalt.

Analyses *a* and *b* by Genth, *c* by the author.

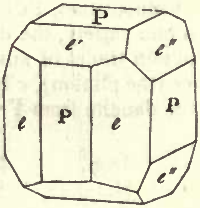
	a	*b*	*c*
Arsenic, - -	70·11	67·46	70·00
Sulphur, - - -	4·78	5·62	17·70
Iron, - - -	11·85	12·92	
Nickel, - - -	9·44	10·17	12·16
Cobalt, - -	3·82	3·85	1·35

Occurs disseminated in thin seams in an interlamenated vein, three feet wide, between layers of micaceous gneiss at Chatham, Conn. It is generally associated with black hornblende, garnet and quartz, and more rarely with breithauptite, pyrrhotine and sphene.

Sp. 11. **Gersdorffite,** *Haidinger;* Nickel-Glance, Nickelarsenkies, Nickelarsenikglanz, Amoibite, *Kobell;* Tombazite. Disomose, *Beudant.*

[H.=5·5. G=5·6 . . . 6·9. In cubo 8-dral xls, and massive; lamellar or granular. Color light lead-grey, with a greyish black tarnish.]

Fig. 606.



Primary form, cube.

Secondary forms.

Cleavage cubic, tolerably perfect. Fracture uneven. Lustre metallic. Opaque. Streak greyish black.

Decrepitates in the matrass. In the open tube, yields a yellowish brown sublimate of sulphide of arsenic. The reactions of the residue are the same as those of nickelin. B. B. on charcoal, deposits a white sublimate, and fuses into a black, brittle globule, which imparts a green color to borax. Partially soluble in nitric acid, with a residue of sulphur and arsenious acid.

Composition $NiS^2 + Ni\,As^2$. Analyses; *a* from Loos by Berzelius, *b* from Haueisen near Lobenstein by Rammelsberg, *c* from Harzgerode by Rammelsberg, *d* in xls. from Schladming, the mean of three analyses by Löwe, *e* from Prakendorf by Löwe, *f* from Müsen by Schnabel, *g* variety *amoibite* (G.=6·08) from Lichtenberg near Steben in Fichtelgebirge by Kobell.

	a	*b*	*c*	*d*	*e*	*f*	*g*
Nickel,	30·21	31·82	30·30	26·14	28·75	32·66	37·34
Iron,	4·15		6·01	9·55	8·90	2·38	2·50
Cobalt,	0·92	(antimony	0·86)				trace
Arsenic,	45·78	48·02	44·01	49·83	46·10	46·02	45·34
Sulphur,	19·51	20·16	18·83	14·13	16·25	18·94	14·

An arsenical nickel from near Tanne in the Hartz gave Hoffmann, nickel 30·02, cobalt 0·56, iron 3·29, arsenic 53·00, sulphur 11·05.

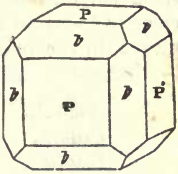
Sp. 12. CHLOANTHITE, *Breithaupt;* Rammelsbergite, *Haidinger;* Weissnickelerz, (in part) *Hausmann.*

[H.=5·5. G.=6·4 . . . 6·7. Xls. cubic; massive, granular. Lustre metallic, tin-white.]

Primary form, cube.

Secondary form.

Fig. 607.



Traces of cleavage. Fracture uneven. Opaque. Acquires first a greyish, and afterwards a blackish tarnish, by exposure to the atmosphere.

Emits a smell of arsenic when broken. In the matrass, yields a smell of arsenic, leaving a copper-red residuum. In the open tube, affords arsenic and arsenious acid. Melts readily B. B., emits fumes and continues to glow after removal from the flame, depositing xls. of arsenious acid, and at last, leaves a brittle, metallic globule. Soluble in nitric acid and in aqua regia, forming a green solution, which on cooling, deposits xls. of arsenious acid.

Composition, Ni As = nickel 28·27, arsenic 71·73. Analyses;—*a* from Reichelsdorf by Booth, *b* and *c* from Kamsdorf and *d* from Allemont, by Rammelsberg.

	a	*b*	*c*	*d*
Nickel,	20·74	28·40	29·50	18·71
Iron,	3·25	traces.	traces.	6·82
Cobalt,	3·37		sulphur.	2·29
Arsenic,	72·64	70·34	70·93	71·11

Found at Schneeberg in Saxony, and the other places above mentioned.

Sp. 13. RAMMELSBERGITE, *Dana;* Chloanthite, *Haidinger;* Weissnickelkies (in part.)

[H.=5·25 . . . 5·75. G.=7·0 . . . 7·18. Xls. prismatic, otherwise like chloanthite.]

Twin-xls. somewhat analogous to those of harmotome. Color, tin-white, inclining to red on surfaces of recent fracture.

B. B. and composition, the same as chloanthite. Analysis from Schneeberg, by Hoffmann.

Nickel,	28·14
Bismuth,	2·19
Copper,	5.00
Arsenic,	71·30
Sulphur,	0·14

Found at Schneeberg and Reichelsdorf, and first separated from chloanthite by Breithaupt.

Sp. 14. PLACODINE, *Breithaupt.*

[H.=5·0 . . . 5·5. G.=7·9 . . . 8·06. In attached tabular xls. Color between bronze-yellow and copper-red. Lustre metallic. Streak black.]

Primary form, right rhombic prism. M on M=115° 28′.

Secondary form.

Fig. 608.

M on M	115° 28′	*c* on *a*	133° 18′
c on *c*	93 4	*v* on *a*	115 4
M on *c*	122 16		

Cleavages M, *a* and *v*, in traces. Brittle. Opaque.

In open tube, yields a sublimate of arsenious acid, and some sulphurous acid. Fuses readily B. B., imparting a blue color to borax in the inner flame, and the red-brown color of nickel, in the outer flame. Soluble in nitric acid. Analysis by Plattner.

Nickel,	57·04
Cobalt,	0·91
Copper,	0·86
Iron,	trace.
Arsenic,	39·71
Sulphur,	0·62

Occurs with chalybite and gersdorffite at Müsen in Siegen.

Sp. 15. **Ullmannite**, ***Frobel;*** Nickel Stibine, Nickeliferous Grey Antimony, Nickelspiesglanzerz, Antimonnickelglanz, Nickelantimonglanz.

[H.=5·0 . . . 5·5. G.=6·2 . . . 6·51. In cubo-8-dral xls., and massive, granular. Steel-grey. Lustre metallic.]

Primary form, cube.

Secondary forms. (Fig. 607.) (Fig. 609.) (Fig. 610.)

Cleavage parallel with P, perfect. Color sometimes inclining to silver-white; acquires a greyish black or variegated tarnish, by exposure. Streak greyish-black. Brittle.

In an open tube, yields sulphurous acid, and a sublimate of oxide of antimony. B. B. on charcoal, fumes strongly, and emits a faint smell of arsenic, melting at the same time into a brittle metallic globule, which often tinges borax, blue. Decomposed by strong nitric acid, leaving a residue of sulphur, oxide of antimony and arsenious acid. With aqua regia, affords a green solution.

Composition $\mathrm{Ni\,Sb}+\mathrm{Ni\,S}^2$ = nickel 26·84, antimony 58·62, sulphur 14·54, a portion of the antimony being sometimes replaced by arsenic.

Analyses ;—*a* from Eisern by Ullmann, *b* from Freusberg by Klaproth, *c* from Landskrone by Rose, *d* from Harzgerode by Rammelsberg.

	a	*b*	*c*	*d*
Nickel,	26·10	25·25	28·04	29·43
Iron,				1·83
Antimony,	47·56	47·75	54·47	50·84
Arsenic,	9·94	11·75		2·65
Sulphur,	16·40	15·25	15·55	17·38

Found in iron-stone veins containing ores of copper and lead ; with pyrites, chalcopyrite, galena, smaltine, cuprite, malachite and chalybite, near Eisern, Brandenberg, Landskrone near Willesdorf, at Freusberg, (Duchy of Nassau,) and near Harsgerode.

Sp. 16. **Linnæite**, *Haidinger;* Cobalt pyrites, Kobaltkies, Kobaldine, *Beudant;* Carrollite, *Faber;* Siegenite, Kobalt-Nickelkies, *Rammelsberg*.

[H.=5·5. G.=4·8 . . . 5·0. In cubo-8-dral xls., and massive. Color silver-white, inclining to steel-grey, with a yellowish or copper-red tarnish; streak blackish-grey.]

Primary form, cube.

Secondary forms. (Fig. 609.) (Fig. 610.) (Fig. 611.)

Cleavage, P, imperfect. Fracture conchoidal to uneven. Surface smooth. Opaque. Lustre metallic. Brittle.

B. B. yields sulphurous acid, and melts in the inner flame to a grey magnetic globule. the interior of which is bronze-yellow. Colors borax blue; and is partially soluble in warm nitric acid, with a residue of sulphur.

Composition, $CoS+Co^2S^3$=sulphur 42·0, cobalt 58·0. Cobalt is sometimes replaced by copper or nickel. Analyses: *a* from Riddarhyttan by Hisinger, *b* from Müsen by Wernekink, *c* from Carroll co., Md., by Smith and Brush, *d* from Siegen by Schnabel.

	a	*b*	*c*	*d*
Sulphur, - -	28·50	41·0	41·93	41·98
Cobalt, - -	43·20	43·86	37·25	22·09
Copper, - -	14·40	4·10	17·48	
Iron, - -	3·53	5·31	1·26	2·29
Nickel, - -			1·54	33·64

Found in gneiss with chalcopyrite at Bastnaes, near Riddarhyttan, Sweden; at Müsen near Siegen in Prussia, with barytes and chalybite; at Mine La Motte, Mo., with galena; and at Finksburg, Carroll co., Md., with chalcopyrite.

Sp. 17. **Cobaltine**, *Beudant;* Cobalt glance, Kobalt-glanz, *Werner;* Cobalt-gris, *Haüy;* Silver-white Cobalt, Bright-white Cobalt, Stahlkobalt, Ferrocobaltine.

[H.=5·5. G.=6·0 . . . 6·3. In cubo-8-dral xls., and massive, granular. Color silver-white, inclining to red. Streak greyish-black.]

Primary form, cube.

Secondary forms.

Fig. 609.

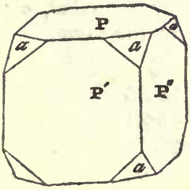


Fig. 610.

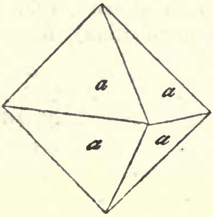


Fig. 611.

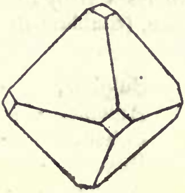


Fig. 612.

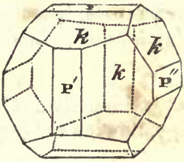


Fig. 613.

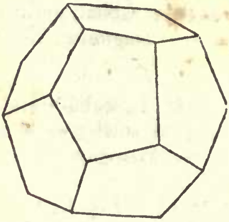


Fig. 614.

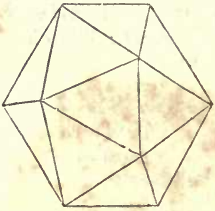


Fig. 615.

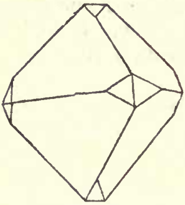


Fig. 616.

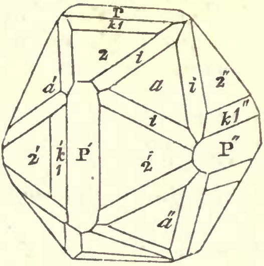


Fig. 615 differs from fig. 612 by the reduction of the irregularly six-sided planes *k*, to small triangles.

P on P′ or P″ - - - -	90°	00′	00″	00‴	H.
a on *a*′ or *a*″ - - -	109	28	16	00	P.
P′ or P″ on *a* - - -	125	15	52	00	P.
P on *k*1, P′ on *k*1′, or P″ on *k*2″	166	30	00	00	P.
P on *k*2, P′ on *k*2′, or P″ on *k*2″	153	26	5	30	H.
a or *a*′ on *k*2 - - -	140	46	17	00	P.
a on *i* - - - -	163	27	00	00	P.
*k*2′ on *k*2′ - - -	126	52	11	00	H.

The above crystals, all from Tunaberg, Sweden.

Cleavage parallel with P, perfect. Fracture imperfectly conchoidal, uneven. Surface, the faces of the cube streaked in three directions perpendicular to each other. The remaining faces smooth. Lustre metallic.

B. B. on charcoal, gives a large quantity of arsenical fumes, and melts only, after having been roasted. It imparts a blue color to borax and other fluxes. It affords a pink solution with nitric acid, leaving a white residue of arsenious acid, which is itself dissolved on farther digestion, Composition, $CoS^2+Co\,As^2$=sulphur 19·3, arsenic 45·2, cobalt 35·5. Analyses *a* by Stromeyer, *b* massive, from Siegen by Schnabel, *c* plumose, (Stahlkobalt or Ferrocobaltine), from Siegen by the same.

	a	*b*	*c*
Sulphur, - - -	20·08	19·35	19·98
Arsenic, - - -	43·46	45·31	42·53
Cobalt, - - -	33·10	33·71	8·67
Iron, - - -	3·23	1·62	25·98
Antimony, - - -			2·84

Occurs in beds and veins, in primitive rocks, accompanied by pyrites, mispickel and chalcopyrite; also associated with magnetite, pyroxene, and hornblende; rarely in veins, with calcite and barytes. The xls. found in beds are terminated on all sides. Found at Modum in Norway, Tunaberg in Südermanland in Sweden, at Querbach, in Siberia, Siegen in Westphalia, and at Orawitza in the Banat. It is a valuable ore of cobalt.

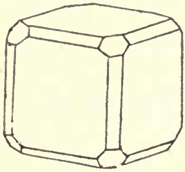
Sp. 18. **Smaltine**, *Beudant;* Grey Cobalt, Tesseralkies, *Breithaupt;* Tin-white Cobalt, *Jameson;* Weisser-Speiskobold, *Werner;* Speisskobalt, *Hausmann.*

[H.=5·5 ... 6·0. G.=6·4 ... 6·8. In cubic and dodecahedral xls. mostly; also massive, reticulated and granular. Color, tin-white to steel-grey. Streak greyish-black.]

Primary form, cube.

Secondary forms.

Fig. 617.



Schneeberg.

Fig. 618.

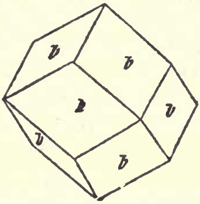


Fig. 619.

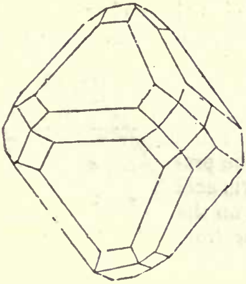
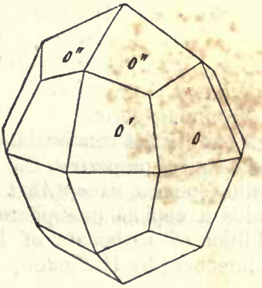


Fig. 620.



Cleavage, traces parallel with the faces of the cube, the octahedron and the dodecahedron; the first a little the most distinct. Fracture uneven. Surface generally pretty smooth; those of the primary, often curved. Subject to tarnish. Brittle. Botryoidal, stalactitic and amorphous.

Heated in an open tube, it emits a good deal of arsenious acid. B. B. on charcoal, gives a strong odor of arsenic, and melts into a greyish-black magnetic pearl. With borax and salt of phosphorus, produces a sapphire-blue glass. In powder, with concentrated nitric acid, it immediately develops red fumes, attended with effervescence and the extrication of heat.

Composition, Co As=cobalt 28·23, arsenic 71·77. It often contains equal parts of nickel and iron, and then is supposed to have the formula (Co, Fe, Ni) As^2. Rose thinks it is never without nickel. Analyses, *a* from Riechelsdorf (in cubes) by Rammelsberg, *b* from Tunaberg by Varrentrapp.

	a	*b*
Arsenic, - - -	60·42	69·46
Cobalt, - - -	10·80	23·44
Iron, - - -	0·80	4·95
Copper, - -		
Nickel, - - -	25·87	
Sulphur, - -	2·11	0·90

Occurs for the most part, in veins, traversing rocks of various ages; more rarely in beds; and is attended by ores of silver, copper and nickel. It is found in veins in primitive rocks at Schneeberg and Annaberg in Saxony; also at Freiberg and Marienberg; at Joachimstahl in Bohemia: and in veins in killas at Wheal Sparnon in Cornwall. The veins of the counties of Sayn and Siegn which contain it, are included in greywacke; and those of Thuringia and Mansfeld, and of Riechlesdorf in Hessia, are in cupriferous slate. Other localities are Schladming, Orawitza Banat and Dobschau, Hungary.

It is a valuable ore for giving origin to the blue enamel colors, and particularly for smalt.

*SAFFLORITE, *Haidinger;* Eisenkobaltkies, *Köbell;* Eisenkotalterz, *Hausmann.*

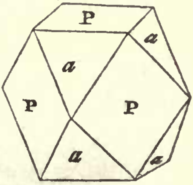
[H.=5·5. G.=6·9 . . . 3·7. In small cubic xls. and massive, reniform, columnar and compact. Tin-white, with a dark grey or iridescent tarnish.]

Primary form, cube.

Secondary form.

Fracture flat conchoidal to uneven.

Fig. 621.



Chemical properties, the same as those of the preceding species, except that the solution in nitric acid yields a copious precipitate of oxide of iron, on the addition of carbonate of lime. Analyses, *a* from Schneeberg by Hoffmann, *b* by Kobell.

	a	*b*
Cobalt, - - -	13·95	9·44
Iron, - - - -	11·71	18·48
Nickel, - - -	1·79	
Copper, - - -	1·39	trace.
Bismuth, - - -	0·01	1·00
Arsenic, - - -	70·37	71·08
Sulphur, - - -	0·66	trace.

Found at Schneeberg in Saxony.

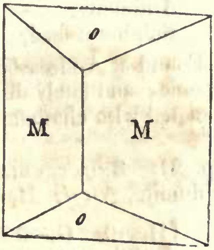
Sp. 19. **Leucopyrite,** (*S.*) ; Lölingite, *Haidinger ;* Mohsine, *Chapman ;* Arseneisen Arsenikeisen, Arsenikalkies, Glanzarsenikkies.

[H.=5·0 . . . 5·5. G.=7·22 . . . 7·33. Right rh. prs. of 122° 26′, and massive, columnar and granular. Color, silver-white to steel-grey.]

Primary form, as above.

Secondary form.

Fig. 622.



o on o	51° 30′
M on o	146

Cleavage perfect, parallel to the longer diagonal, less distinct parallel with two faces on the acute lateral edges, inclining under 86° 10′ ; traces parallel with M. Fracture uneven. Surface faintly streaked, parallel to the common edges of combination, frequently smooth. Lustre metallic. Acquires a dark tarnish by exposure. Streak greyish-black. Faces of composition in the massive varieties, irregularly streaked. Opaque.

In the matrass, yields a sublimate of metallic arsenic. B. B. on charcoal, in the inner flame, emits arsenical fumes and melts into a black magnetic globule. Partially soluble in nitric acid, leaving a residue of arsenious acid. Composition, Fe^4As^3=iron 33·26, arsenic 66·74. Analyses, *a* from Reichenstein by Karsten, *b* by Hoffmann, *c* by Meyer, *d* from Schladming by Scheerer, *e* from Sätersberg near Fossum in Norway (G.=7·09) by Scheerer.

	a	*b*	*c*	*d*	*e*
Iron, - -	32·35	28·70	31·36	13·49	27·39
Arsenic, -	65·88	67·49	65·51	60·14	70·22
Sulphur, - -	1·77	1·98	1·69	5·20	1·28
Nickel, -				13·37	
Cobalt, - -				5·10	

The sulphur is probably derived from a mixture of pyrrhotine and mispickel.

Found in xls., and disseminated in granular and columnar masses in veins in clay-slate, with arsenic, pyrargyrite and discrasite, at Andreasberg ; in beds of chalybite at Löling, near Hüttenberg in Carinthia, and Schladming in Stiria, and in serpentine at Reichenstein in Silesia.

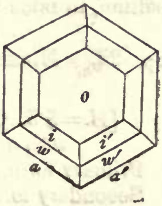
Sp. 20. **Breithauptite,** *Haidinger ;* Antimonnickel.

[H.=5·0. G.=7·2 . . . 7·54. In thin, tabular 6-sided xls., massive, dendritic. Color, light copper-red, acquires a violet tarnish. Streak reddish-brown.]

Primary, rhomboid.

Secondary form.

Fig. 623.



a on *o*	90° 0′	*i* on *i′*	154° 20′
a on *a′*	120 0	*w* on *o*	123 55
i on *o*	153 38	*w* on *w′*	130 56

Fracture uneven to conchoidal. Opaque. Lustre metallic. Brittle.

When heated in the open tube, a little antimony sublimes. B. B. on charcoal, deposits a copious sublimate of oxide of antimony, leaving a residue of nickel, fusible with great difficulty. Easily dissolved in aqua regia. Composition $Ni^2 Sb$,=nickel 31·43, antimony 68·57. Analyses by Stromeyer.

Nickel, - - -	28·95	27·05
Iron, - - - -	·87	0·84
Antimony, - - -	63·73	59·71
Sulphuret lead, - - -	6·44	12·36

Found at Andreasberg with smaltine, galena, blende, pyrargyrite and arsenic; and lately discovered by Dr. Francfort at Chatham, Conn., associated with chathamite.

Sp. 21. **Skutterudite**, *Haidinger;* Tesseralkies, *Breithaupt;* Modumite, *Nicol;* Hartkobaltkies, Hartkobalterz, Arsenikkobaltkies.

[H.=6. G.=6·74 . . . 6·84. In cubo-8-dral xls. and granular. Tin-white to lead-grey, sometimes with a blue tarnish.]

Primary form, cube.

Secondary forms.

Fig. 624.

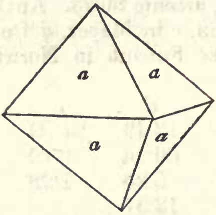
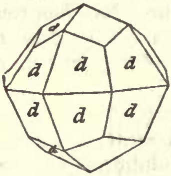


Fig. 625.

(Fig. 618.)

Fig. 626.



Cleavage parallel with P distinct; with *b*, in traces. Fracture flat conchoidal. Opaque. Lustre metallic.

In the matrass, yields a sublimate of arsenic; in the open tube, a copious one of arsenious acid, leaving a rose-red powder. B. B. same as smaltine.

Composition, $Co^2 As^3$=cobalt 20·77, arsenic 79·24. Analyses: *a* by Scheerer, *b* by Wöhler.

	a	*b*
Cobalt, - - -	20·01	19·5
Iron, - - - -	1·51	1·4
Arsenic, - - -	77·84	79·
Sulphur, - - -	0·69	

Found in xls. and granular masses, sometimes attached to xls. of cobaltine, in mica slate, at Skutterud, in the parish of Modum in Norway.

Sp. 22. **Nickelin**, *Haidinger;* Copper Nickel, *Phillips;* Kupfernickel.

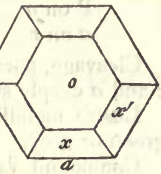
[H.=5·5. G.=7·2 . . . 7·8 Massive, nearly compact, copper-red, with a greyish tarnish.]

Primary form, rhomboid.

Secondary form.

a on o	90°	
a on a′	120	
x on o	136	35
x on a	133	15
x on x′	138	48
x on x″	107	

Fig. 627.



Lustre metallic. Opaque. Streak brownish-black. Brittle.

In the matrass, yields no sublimate. B. B. on charcoal, melts with evolution of arsenical vapor, into a brittle, white metallic globule. In an open tube, yields arsenious acid and changes gradually into a green, earthy mass, which fuses with soda and a little borax, into a white magnetic, metallic globule. With aqua regia, affords a green solution.

Composition, $Ni^2 As$ = nickel 44·02, arsenic 55·98. Analysis by Stromeyer.

Nickel,	44·21
Arsenic,	54·73
Iron,	0·34
Lead,	0·32
Sulphur,	0·40

Occurs chiefly in veins, in various classes of rocks, associated with smaltine, various ores of silver and lead, bismuth, barytes, calcite, &c. Found at Schneeberg, Annaberg, Marienberg, Freiberg, Gersdorf and other places in Saxony; at Joachimsthal in Bohemia, at Saalfield in Thuringia; at Riegelsdorf in Hessia; in the Hartz, at Allemont in Dauphiny, Schladming in Stiria, Orawitza Banat, in Cornwall, Leadhills, and in small quantity with chathamite and breithauptite, at Chatham, Conn.

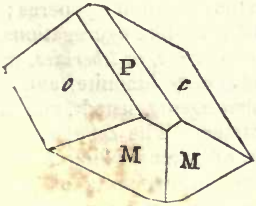
Sp. 23. **Marcasite**, ***Haidinger;*** White Iron Pyrites, ***Phillips;*** Spear-pyrites, Speerkies, Spärkies, Strahlkies, Kammkies, Hepatic Pyrites, Leberkies, Zellkies.

[H.=6·0 ... 6·5. G.=4·67 ... 4·84. In short prismatic xls. and massive, globular, reniform, with a radiating, columnar structure. Color, light brass-yellow, inclining to green and grey.]

Primary form, right rhombic prism, M on M=106° 2′.

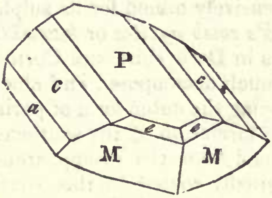
Secondary forms.

Fig. 628.



Cornwall.

Fig. 629.



Warwick, N. J.

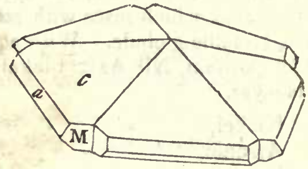
P on *c*	160° 48′
P on *a*	130 00
a on *c*	141 30

Cleavage, parallel with M rather perfect. Fracture uneven. Surface *c* and *a* deeply streaked, parallel to their edges of combination with P.

Lustre metallic. Color, pale bronze-yellow, sometimes inclining to green or grey. Streak greyish-black, or brownish-black.

Compound varieties. Twin-crystals: 1. Face of composition parallel, axis of revolution perpendicular to a face of M. This composition is generally repeated, as in the annexed figure, where a group of five individuals is formed, having much the appearance of a five-sided pyramid with truncated apices, each of the five solid angles at the base, presenting a re-entering angle. 2. Face of composition parallel, axis of revolution perpendicular to *a* and *c*. This composition takes place in varieties, already compounded by the first law. They assume a grooved appearance. The re-entering angle formed by the faces M=114° 16′. Globular, reniform, stalactitic and other imitative shapes: surface drusy; composition columnar, individuals straight, and generally small, or even impalpable. There is sometimes a second curved lamellar, or granular composition, the faces of composition being uneven or rough. Massive: composition, as in the imitative shapes; fracture even, flat conchoidal, uneven. Pseudomorphoses in low, nearly regular, six-sided prisms. Cellular.

Fig. 630.



B. B. on charcoal, it becomes red, burning with a blue flame, attended by a sulphurous odor; and melts in the inner flame into a blackish magnetic globule, which imparts a bottle-green color to borax. It is partly soluble in nitric acid, leaving a residue of sulphur.

Composition $Fe S^2$=iron 46·7, sulphur 53·33 Analysis by Berzelius,

Iron,	45·07
Sulphur,	53·35
Manganese,	0·70
Silica,	0·80

It is dimorphous with pyrites.

It is less abundant than pyrites, and occurs most frequently in beds of coal and in metalliferous veins with ores of silver, lead and copper. The variety called *spear-pyrites*, consisting of macled xls., is abundant in the plastic clay of the brown coal-formation near Carlsbad, Bohemia, and is extensively mined for its sulphur and the manufacture of copperas; the *cock's comb pyrites* or *kammkies*, consisting of crest-like aggregations, occurs in Derbyshire and Cornwall; the *hepatic pyrites*, or *leberkies*, which is much decomposed and chiefly in the condition of limonite, and often copying the cubic form of pyrites, exists at Johanngeorgenstadt, and in the gold-formation of the southeastern United States. The *cellular pyrites*, formed from the disappearance of cubic xls. of galena which had been originally coated by this species, abounds in various parts of Saxony. Marcasite is of frequent occurrence in the great coal regions of the United States.

Sp. 24. **Pyrites**, *Haidinger;* Iron Pyrites, *Phillips;* Schwefelkies, *Hausmann.*

[H.=6·0 . . . 6·5. G.=4·9 . . . 5·1. In cubo-8-dral xls. and massive. Color, bronze-yellow. Streak dark-grey.]

Primary form, cube.

Secondary forms.

Fig. 631.

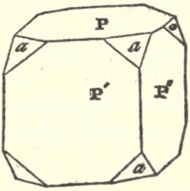


Fig. 632.

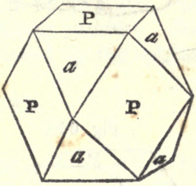


Fig. 633.

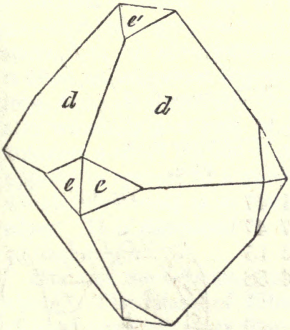


Fig. 634.

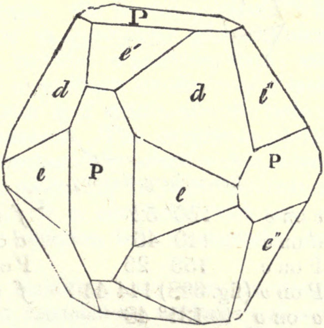


Fig. 635.

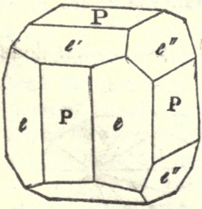


Fig. 636.

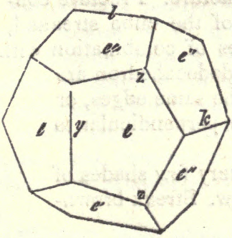


Fig. 637.

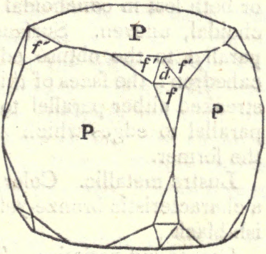


Fig. 638.

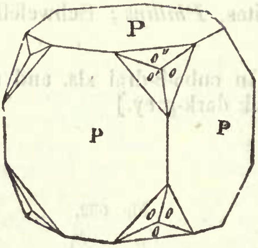


Fig. 639.

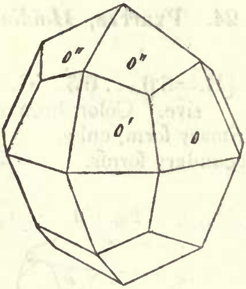
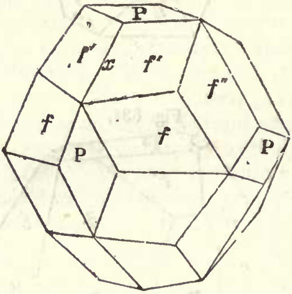
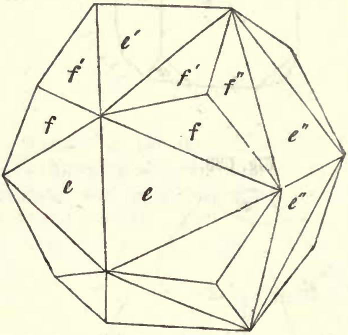


Fig. 640.



Schneeberg, Saxony.

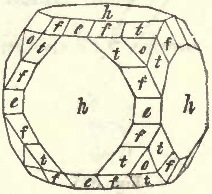
Fig. 641.



Elba.

e on *e*	126° 52′	*f* on *f*	141 47
d on *e*	140 46	*d* on *f*	157 47
P on *e*	153 26	P on *d*	152 15
P on *o* (fig. 638)	144 44	*f* on *e*	162 58
o on *o*	131° 48′		

Fig. 642.



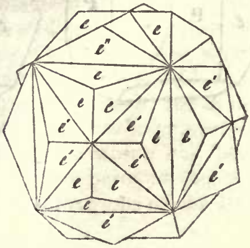
Valley of Planen, near Dresden.

Cleavage, parallel with the cube and octahedron, in various degrees of perfection; sometimes highly perfect; often one of them more distinct, or both lost in conchoidal fracture. Fracture conchoidal, uneven. Surface of the cube streaked, parallel to the obtuse edges of combination with the pentagonal dodecahedron: the faces of this dodecahedron are streaked either parallel to the same edges, or parallel to edges which are perpendicular to the former.

Lustre metallic. Color, very few shades of a characteristic bronze-yellow. Streak brownish-black.

Compound varieties. Twin-crystals: face of composition parallel, axis of revolution perpendicular to a face of the dodecahedron. The individuals continued beyond the face of

Fig. 643.



Schoharie, N. Y.

composition, by which the compound group takes a cruciform appearance. The composition frequently repeated.

Imbedded and implanted globules; surface drusy; composition indistinctly columnar. Massive; composition granular, sometimes even impalpable, strongly coherent; fracture uneven, or on a large scale, flat conchoidal. Cellular.

B. B. in the oxidating flame, pyrites becomes red upon charcoal, the sulphur is expelled, and oxide of iron remains. At a high temperature, in the interior flame, it melts into a globule, which continues red-hot for a short time, when removed from the blast; and possesses, after cooling, a crystalline fracture and metallic appearance. In heated nitric acid, it is partly soluble, and leaves a whitish residue. Some varieties are subject to decomposition, when exposed to the action of the atmosphere.

Composition FeS^2=iron 46·67, sulphur 53·33.

Analysis by Hatchett.

Iron, - - -	47·30	47·85
Sulphur, - -	52·70	52·15

Pyrites is one of the most common and widely diffused species among the ores; and occurs in very various repositories. It is engaged in imbedded crystals, and in massive nodules; the former particularly in clay-slate and greywacke-slate, the latter in greenstone, granular limestone, &c. It even forms beds by itself, included in primitive slate; and is often an important ingredient of those beds which contain ores of lead, iron, &c. It frequently occurs mixed with coal seams, and the beds of clay which form a part of the coal measures. The *auriferous pyrites* contains a small portion of native gold, mechanically mixed with it, which appears to operate by a galvanic effect, in producing the decomposition, to which this variety is so generally subject. It is also found with ores of silver. It is contained in many organic remains, both of vegetable and animal origin.

Some of the crystals, along with their localities, have been mentioned above. The Island of Elba is the most conspicuous for large and well defined crystals: very fine crystals are found in Piedmont, at Freiberg, Johanngeorgenstadt, &c. in Saxony, in Bohemia, in Hungary, in the Hartz, at Kongsberg in Norway, at Fahlun in Sweden, in Derbyshire and Cornwall.

Some of the most perfect and interesting xls. of pyrites have been found in the lead mine of Rossie, N. Y., at Scoharie, N. Y., at Shoreham and Hartford, Vt., at the Canton mine in Ga., at the Middletown, (Ct.) lead mine, where besides presenting the modification in fig. 631, they present an elongated prismatic figure, and are curiously arranged into twins like staurotide; at Haddam, Ct. in very large cubes: also abundant throughout the gold and coal formations of the United States, besides forming extensive beds in the primary rocks in Vermont, Massachusetts and Connecticut.

Pyrites affords to commerce, large quantities of sulphur, copperas and sulphuric acid.

APPENDIX TO ORDER PYRITES.

Barnhardtite, Genth. Massive. Color pale bronze-yellow, tarnishing readily, to pinchbeck and pavonine tints. Cleavage not observable. Streak black, slightly shining. B. B. gives sulphur fumes, and fuses to an iron-black, magnetic globule. With the fluxes, gives reactions of iron, copper and sulphur. Composition $2\text{Ȼu}\,\text{S}+\text{Fe}^2\,\text{S}^3$. Analysis by Taylor, sulphur 29·4, copper 47·61, iron 22·23, silver, a trace. From Cabarras and Mecklenburg counties, North Carolina.

Cuban, Breithaupt. In cubes and massive. Color bronze- to brass-yellow. Streak dark reddish black. H.=4. G.=4·02 . . . 4·16. B. B. fuses easily, giving off fumes of sulphur, but no arsenic. Analysis by Booth, sulphur 39·01, copper 19·80, iron 38·01, silica 2·3, which gave the formula $\text{CuS}+\text{Fe}^2\,\text{S}^3$. From Barracanao, Cuba.

Glaucodote, Breithaupt. In short, right rhombic prisms, M on M=112° 36′, having the lateral angles (each) deeply replaced by three planes, so as to convert the figure, if placed on end, into a 12-sided prism with di-hedral summits;—a form much like that of mispickel. Cleavage parallel with P perfect, with M less distinct. It is also found massive. Color greyish tin-white. Lustre metallic. Streak black. H.=5·0. G.=5·9 . . . 6·0. Composition, $\text{R}\,\text{S}^2+\text{R}\,\text{As}$, where R is Co and Fe. Analysis by Plattner,

Cobalt, with a trace of nickel,	24·77
Iron,	11·90
Arsenic,	43·20
Sulphur,	20·21

Found in veins in chloritic slate with cobaltine, chalcopyrite, axinite, and quartz, near Huasko in Chili.

Kyrosite, arsenid of copper, weisskupfererz of Werner, is from the mine Briccius near Annaberg; also from Chili and from Siberia. H.=5·5. G.=4·7 . . . 5.0. Color whitish brass-yellow. The variety from Chili, according to Plattner, has 12·9 p. c. of copper, besides iron and sulphur, but no arsenic.

Lonchidite, Breithaupt, *Kausimkies*. Has very nearly the angles of marcasite, M on M being 104° 24′. H.=6·5. G.=4·9 . . . 5. Color tin-white, sometimes greenish, or greyish. Streak black. Analysis by Plattner, sulphur 49·61, arsenic 4·40, iron 44·23, cobalt 0·35, copper 0·75, lead 0·20. Occurs at Freiberg and Cornwall.

Syepoorite, Nicol. *Graucobalterz*. Massive, in grains and seams. G.=5·45. Color steel-grey, inclining to yellow. Composition, $\text{Co}\,\text{S}=$ sulphur 35·2, cobalt 64·8. Analyses by Middleton, sulphur 35·36, cobalt 64·64. Occurs in primitive slate-rock with pyrrohotine at Syepoor, near Rajpootanah in India. It is employed by the native jewelers, to give a rose-color to gold.

Wasserkies, *Hydrous pyrites*. H.=3·0 . . . 4·0. G.=3·3 . . . 3·5. According to Glocker, contains water in chemical combination. From Moravia, and Upper Silesia.

ORDER XIII. GLANCE.

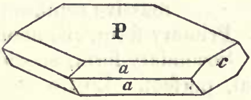
Sp. 1. **STERNBERGITE,** *Haidinger;* Flexible Silver, *Bournon.*

[H.=1·0 . . . 1·5. G.=4·2. In thin, nearly hexagonal tables; globular and rose-like aggregates and massive, with a granular structure. Pinchbeck-brown. Thin laminæ flexible.]

Primary form, right rhombic prism. M on M 119° 30′.

Secondary form.

Fig. 644.



P on *c* - 90°
P on *a* - 121

Cleavage, highly perfect, parallel to P: the laminæ may be torn asunder like thin sheet-lead. Lustre metallic. Streak black. Tarnish, often violet-blue. Very sectile: leaves traces on paper, like plumbago.

B. B., on charcoal, burns with a blue flame, and smells of burning sulphur, finally melting into a magnetic globule, covered with silver. With borax, yields a globule of silver, and a glass, colored by iron. It is decomposed by aqua regia, leaving sulphur and chloride of silver. Composition $AgS+2Fe^2S^3$= sulphur 33·7, silver 32·5, iron 33·7. Analysis by Zippe, sulphur 30, silver 33·2, iron 36.

Occurs in attached xls., in fan-shaped and globular aggregations and columnar masses, in veins, with pyrargyrite and argentite at Joachimsthal in Bohemia, and at Schneeberg and Johanngeorgenstadt in Saxony.

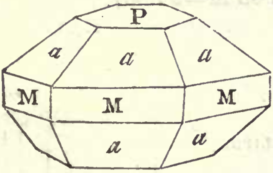
Sp. 2. **MOLYBDENITE,** (*S.*) Molybdène, *Hauy;* Molybdänit, *Haidinger;* Molybdänglanz, *Hausmann.*

[H.=1·0 . . . 1·5. G.=4·59. Mostly massive, foliated or granular. Color, pure lead-grey. Thin laminæ highly flexible. Very sectile.]

Primary form, rhomboid.

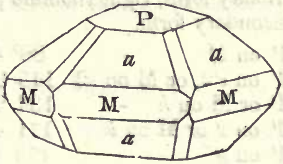
Secondary forms.

Fig. 645.



Haddam, Ct.

Fig. 646.



Shutesbury, Mass.

Cleavage, parallel with P, highly perfect. Fracture not observable. Surface P smooth; the remaining planes horizontally streaked. Lustre metallic. Streak unchanged. Gives a grey trace on paper, and a greenish one, on porcelain.

B. B. infusible, but emits sulphurous fumes. In the forceps, it tinges the flame green. It gives a dull brown pearl with borax, if nitre be added. Dissolves in nitric acid, excepting a greyish-white residue.

Composition, $MoS^2 =$ sulphur 41·0, molybdenum 59. Analysis by Brandes. Molybdenum 59·6, sulphur 40·4.

Found imbedded in gneiss and granite; sometimes attended by cassiterite and wolfram. Occurs at Altenberg in Saxony, and at Schlaggenwald and Zinnwald in Bohemia; also in Cornwall, Norway, Sweden and Scotland. The chief localities in the United States are Haddam, Conn., Shutesbury, Mass., and Westmoreland, New Hampshire.

Sp. 3. **Covelline**, *Beudant;* Indigo Copper, Blue Copper, Kupferindig, *Hausmann.*

[H.=1·5 ... 2·0. G.=3·8 ... 3·82. In hexagonal plates, double 6-sided pyramids and spheroidal masses with crystalline surfaces; massive reniform and in coats. Indigo-blue.]

Primary form, rhomboid.

Secondary form, six-sided plates and double pyramids. Cleavage basal, perfect. Lustre sub-metallic, somewhat greasy, slightly pearly on cleavage faces. Streak black. Opaque. Sectile. In thin leaves, flexible.

B. B. burns with a blue flame, melting with ebullition into a globule, which with soda, yields a bead of copper. Soluble in nitric acid. Composition, $CoS^2 =$ sulphur 33·5, copper 65·5. Analysis, *a* from Badenweiler by Walchner, *b* from Vesuvius by Covelli, *c* from Leogang.

	a	*b*	*c*
Sulphur, - - -	32·64	32·0	34·30
Copper, - -	64·77	66·	64·56
Iron, - - -	0·46		1·14
Lead, - - -	1·04		

Occurs with other copper ores in Salzberg, Poland, Thuringia, and at Vesuvius.

Sp. 4. **Antimonite**, *Haidinger;* Grey Antimony; Antimonglanz.

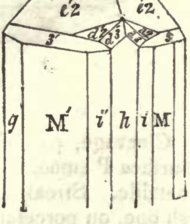
[H.=2·0. G.=4·51 ... 4·6. In rhombic prs. of 90° 45′ and massive, in long, thin columnar individuals, rarely granular. Color, lead-grey. Lustre metallic.]

Primary form, right rhombic prism. M on M=90° 45′.

Secondary form.

M′ on M -	88° 40′	Phillips.
M′ on *e*′2, or M on *e*2	145 30	
M′ or M on *h* -	134 20	
M′ on *i*′ or M on *i*	171 40	
M′ on *g* -	173 00	
e′2 on *e*2 -	108 30	
h on *e*′2 or *e*2 -	125 30	
h on *i*′ or *i* -	161 30	

Fig. 647.



Cleavage, highly perfect in the direction of *h*, or the shorter diagonal of the prism; much less distinct, parallel with M. Fracture small conchoidal, rather imperfect. Surface, the vertical planes deeply striated, parallel to their own intersections, and rough. The remaining faces generally smooth. Subject to tarnish.

Lustre metallic. Color, lead-grey, inclining to steel-grey. Streak unchanged. Sectile. Thin laminæ are a little flexible. Crystals sometimes bent.

Compound varieties Massive; composition columnar, of various sizes of individuals, sometimes very thin, but not impalpable. They are long and straight, either parallel or divergent from several common centres, and aggregated in a second angulo-granular composition. The faces of composition are irregularly streaked in a longitudinal direction. Sometimes the composition is granular, and then the individuals often become impalpable, but are generally very strongly connected; the fracture becomes even or uneven. Capillary crystals often form a tissue resembling wool, or felt.

Very fusible B. B., and is absorbed by the charcoal. By a continued blast, it may be volatilized, without leaving any considerable residue. When pure, soluble in hydrochloric acid. Composition, Sb^2S^3 = sulphur 27·12, antimony 72·88.

Analysis, *a* by Proust, *b* by Thomson.

	a	*b*
Antimony, - - -	75·00	73·77
Sulphur, - - -	25·00	26·23

Occurs in veins and beds; in the latter case, with chalybite. It is frequently associated with barytes, blende and quartz. Its decomposition produces the valentinite, with which it is often invested.

Veins, consisting almost entirely of the present species, have been discovered at Pösing near Presburg in Hungary, and at Wolfsthal in the county of Stollberg in the Hartz; also such as contain it in considerable quantities, associated with other minerals, at Felsobanya in Upper Hungary, at Cremnitz, Schemnitz, and other places in Lower Hungary, and in France. Other localities are Bräunsdorf near Freiberg in Saxony, Neudorf in Anhalt, Cornwall and Scotland. The fibrous variety occurs at Loben in the valley of the Levant in Carinthia, and the compact at Magurka in Hungary.

It is abundant in Borneo. It has been found at Carmel, Penobscot Co., Me., at Cornish and Lyme, N. H., and at Soldier's Delight, Md.

It is used for extracting the crude antimony of commerce, which is so largely employed in the manufacture of several alloys (particularly of type-metal), and in medicines.

Sp. 5. Eucairite, *Berzelius;* Selenkupfersilber.

[H.= soft. In cleavable grains. Lustre metallic. Color, lead-grey. Streak shining. Opaque.]

In black metallic films, staining the calcite in which it is contained.

In the matrass, yields a sublimate of selenium and selenic acid. B. B. emits the odor of selenium, and melts easily into a grey, metallic globule. With borax and salt of phosphorus, yields the reaction of copper, leaving a grey, brittle globule of seleniuret of silver. Soluble in hot nitric acid.

Composition, $Cu^2Se+Ag\,Se$=silver 43·08, copper 25·29, selenium 31·63. Analysis by Berzelius:

Silver,	38·93
Copper,	23·05
Selenium,	26·00
Earthy matter,	8·90

Found in an abandoned copper-mine at Strickerum in the parish of Tryserum in Smaland, Sweden.

Sp. 6. BERZELINE, *Beudant;* Selenkupfer, *v. Leonhard;* Selenid of copper.

Crystalline. Lustre metallic. Silver-white. Streak shining. Soft and malleable. When isolated and rubbed, acquires resinous electricity.

In an open tube, selenium and selenic acid sublime, leaving a residue of copper. B. B. gives the odor of selenium and fuses to a grey bead. After long continued roasting with soda, yields a globule of copper. Composition, Cu^2Se=copper 61·52, selenium 38·48. Analysis by Berzelius; copper 64, selenium 40.

Found in a thin dendritic coating on calcite, in the copper-mine of Skrickerum in Smaland, Sweden.

Sp. 7. NAUMANNITE, *Haidinger;* Selensilber, *Rose.*

[H.=2·5. G.=8·0. In cubic xls., in thin plates and granular; lustre splendent, metallic.]

Primary form, cube.

Streak, iron-black.

B. B. on charcoal, it melts easily in the outer flame. With soda and borax, it yields a bead of silver

Occurs at Tilkerode in the Hartz.

*RIOLITE, *Fröbel.*

In hexagonal tables with rounded edges and angles: malleable: color lead-grey. Composition, $Ag\ Se^2$. Analysis by Del Rio, silver 57·66, selenium 42·34.

Occurs at Tasco in Mexico.

*ONOFRITE, *Haidinger;* Merkurglanz, *Breithaupt;* Selenid of Mercury, Selenquecksilber.

[H.=2·5 G.=7·37. Massive, granular; steel- to blackish lead-grey. Lustre metallic; streak shining.]

Sectile. B. B. emits the smell of sulphurous acid: with soda, yields metallic mercury.

Composition, H^2Se, HgS, a mixture of selenide and sulphide of mercury. Analysis by Rose.

Mercury,	81·33
Sulphur,	10·30
Selenium,	6·49

Said to occur in veins with mercury, quartz, calcite and barytes, at San Onofre in Mexico.

Sp. 8. **Argentite**, *Haidinger;* Vitreous Silver, Silberglanz, Glaserz, *Hausmann;* Argyrose, *Beudant.*

[H.=2·0 . . . 2·5. G.=7·19 . . . 7·36. In cubo-8-dral xls., reticulated, filiform and capillary shapes, and massive in plates, coatings and compact. Color, blackish lead-grey.]

Primary form, cube.

Secondary forms.

Fig. 648.

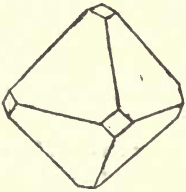


Fig. 649.

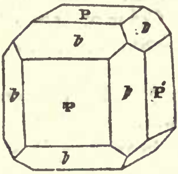
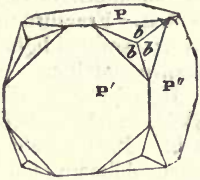


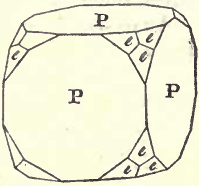
Fig. 650.



Freiberg.

P on *b*	- -	135°
b on *b*	(fig. 649.)	120
b on *b*	(fig. 650.)	146 27
P on *d*	(fig. 650.)	144 44

Fig. 651.



Cleavage, sometimes traces, parallel to *b*, (fig. 649). Fracture imperfect and small conchoidal, uneven. Surface, nearly of the same description in all its forms, often uneven, and possessing low degrees of lustre. Subject to tarnish. Streak shining.

B. B. on charcoal, intumesces, melts with odor of sulphurous acid, and at last yields a globule of silver. Soluble in nitric acid, leaving some of the sulphur behind. Composition, AgS=silver 87·05, sulphur 12·95. Analysis by Klaproth; silver 86·50, sulphur 13·50.

Found almost exclusively in veins with ores of lead, silver and antimony, and attended by blende, quartz and calcite. The rock adjoining the veins is often impregnated with it, and covered with the same, in a state of partial decomposition, forming a black powder. It occurs at Freiberg, Marienberg, Annaberg, Schneeberg and Johanngeorgenstadt in Saxony; in Bohemia, Hungary, Siberia, Mexico, Peru, in the Hartz and at Cornwall.

It is a valuable ore for the extraction of silver.

Sp. 9. **Akanthite**, *Kenngott.*

[H.=2·5. G.=7·31 . . . 7·36. In slender, acute, double 6-sided pyramids.]

Primary form, right rhombic prism.

Secondary form, as above.

Cleavage indistinct. Fracture uneven; lustre shining. Other properties like argentite, with which species it is dimorphic.

Occurs at Joachimsthal, with granular pyrites, argentite and calcite. It is named from αχανθα, a thorn, in allusion to the sharp pointed forms of its crystals.

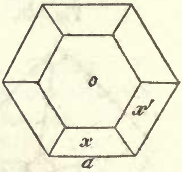
Sp. 10. Polybasite, *Rose;* Eugenglanz.

[H.=2·0 ... 3·0. G.=6·21. In thin hexahedral xls. and massive. Color and streak iron-black.]

Primary form, rhomboid.

Secondary form.

Fig. 652.



x on *o* 121° 30′
x on *x′* 129 32

Terminal planes (*o*) striated triangularly, parallel to the alternate terminal edges. Cleavage, parallel with *o*. Fracture uneven. Color of thin tabular xls. by transmitted light, cherry-red; otherwise, opaque. Lustre metallic.

Decrepitates, when heated. In the open tube, yields a white sublimate and a smell of sulphurous acid. B. B. on charcoal, melts very easily, and deposits a sublimate of oxide of antimony upon the support. With borax, yields a bead of silver, containing copper, and imparts a bluish-green color to borax. Composition, (Ag, Ȼu) $S+\frac{1}{9}(Sb, As)^2S^3=$ with silver alone, sulphur 14·9, antimony 9·9, silver 75·2.

Analysis, *a* from Guarisamey, *b* from Schemnitz, *c* from Freiberg by Rose.

	a	*b*	*c*
Silver,	64·29	72·43	69·99
Copper,	9·93	3·04	4·11
Iron,	0·06	0·33	0·29
Zinc,	——	0·59	——
Arsenic,	3·74	6·23	1·17
Antimony,	5·09	0·25	8·39
Sulphur,	17·04	16·83	16·35

Found in veins in primitive slate, in transition rocks, and in trachyte, with stephanite, pyrargyrite, blende, chalcodite, pyrites, quartz and calcite, in Saxony, Bohemia, Hungary and Mexico.

Named from πολυς, *many*, and βασις, *base*, in allusion to the large amount of the base, sulphide of silver, as compared with those of arsenic and antimony.

Sp. 11. Clausthalite, *Haidinger;* Tilkerodite, *Haidinger;* Raphanosmite, *Kobell;* Zorgite, *Brooke* and *Miller;* Selenblei, Selenkupferblei.

[H.=2·5 ... 3·0. G.=7·0 ... 8·8. Massive, fine granular. Resembles galena. Lustre metallic. Color, bluish or yellowish lead-grey.]

Primary form, cube.

Cleavage, cubic. Acquires a bluish tarnish. Streak greyish black. Rather sectile.

B. B. on charcoal, gives the odor of horse-radish, and deposits a reddish-brown coating. Heated in an open tube, the selenium sublimes, forming a red ring; and on heating the tube to redness, the ore fuses and the red ring partially disappears, giving place to a white crystalline deposit. Some of the varieties give a copper reaction.

Composition, $PbSe$= selenium 27·6, lead 72·4, with part of the lead often replaced by silver. Analyses, *a* from Tilkerode by Rose, *b* from Clausthal by Stromeyer, *c* from Tilkerode by Rammelsberg, *d* from Clausthal (*selenkobaltblei*) by Rose, *e* from Tilkerode (*selenbleikupfer*) by Rose, *f* from Tilkerode (*selenkupferblei*) by Rose.

	a	*b*	*c*	*d*	*e*	*f*
Selenium, -	27·59	28·11	26·52	31·42	34·26	29·96
Lead, -	71·81	70·98	60·15	63·92	47·43	59·67
Cobalt, -	0·83	——	——	3·14	——	——
Copper, -	——	——	——	——	15·15	7·86
Silver, -	——	——	11·67	——	1·29	——
Iron, -	——	——	——	0·45	2·08	0·33

d is the *tilkerodite* of Haidinger, *e* and *f* are the *raphanosmite* of Kobell, and the *zorgite* of Brooke and Miller.

Found in a vein of hematite in the Hartz, and at Reinsberg and Freiberg in Saxony.

*LEHRBACHITE, *Brooke* and *Miller;* Selenquecksilberblei.

Soft. G.=7·3. Granular with a cubic cleavage. Lead-grey to steel-grey and iron-black. Lustre metallic. Streak black. Sectile. Opaque.

Decrepitates when heated. In the matrass, yields a grey sublimate of selenide of mercury; with soda, a sublimate of mercury. In the open tube, gives a liquid sublimate of selenate of mercury. Composition, a mixture of $PbSe$ and $HgSe$ in variable proportions. Analysis from Tilkerode by Rose.

Lead, - - - -	55·84	27·33
Mercury, - - -	16·94	44·69
Selenium, - - - -	24·97	27·98

Found at Lehrbach and Tilkerode in the Hartz.

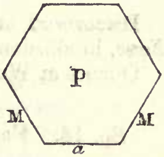
Sp. 12. JAMESONITE, *Haidinger;* Bleischimmer.

[H.=2·0 ... 2·5. G.=5·56 ... 5·61. In acicular xls. and fibrous, (parallel or diverging) masses. Color and streak, steel-grey.]

Primary form, right rhombic prism. M on M=101° 20.

Secondary form.

Fig. 653.



P on M 90
M on *a* 129 20
M on M 101 20

Cleavage, parallel with P very perfect, M and *a*, less so. Lustre metallic. Sectile.

In the open tube, affords dense white fumes of the oxide of antimony. B. B. on charcoal, decrepitates when heated, melts easily, deposits a sublimate of oxide of lead and antimony; and after the lead and antimony are driven off, leaves a slag, which usually affords the reactions of copper and iron. With soda, yields a globule of lead.

Composition, $PbS+\frac{2}{3}Sb^2S^2$= sulphur 20·2, antimony 36·2, lead 43·6. Analyses, *a* from Cornwall by Rose, *b* from Estremadura by Schaffgotsch, *c* from Tuscany by Becchi.

	a	b	c
Sulphur, - -	22·15	21·78	20·53
Antimony, - -	34·40	32·62	32·16
Lead, - -	40·75	30·97	43·38
Iron, - - -	2·30	3·63	0·94
Copper, - - -	0·13	0·94	1·25
Bismuth, - -		1·06	——
Zinc, - -		0·42	1·74

Occurs principally in Cornwall, associated with quartz and small xls. of bournonite; also found in Siberia, Spain, Hungary and Brazil.

Sp. 13. Plagionite, *Rose*.

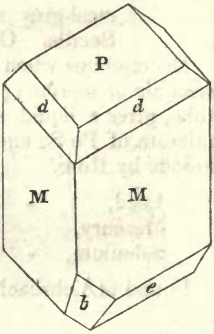
[H.=2·5. G.=5·4. In short, oblique rhombic prisms of 120° 49′ in geodes and druses; also granular. Color and streak, blackish lead-grey. Lustre metallic.]

Primary form, oblique rhombic prism. M on M=120° 49′, P on M=138° 52′.

Secondary form.

P on *d*	-	154° 20′
" *e*	-	149
" *b*	-	107 22
d on *d*	-	142 3

Fig. 654.



Xls. somewhat tabular; the plane P shining and smooth; others striated. Cleavage, perfect parallel with M, but seldom affording smooth surfaces. Fracture imperfectly conchoidal. Opaque. Brittle.

Decrepitates violently when heated. In the open tube, emits fumes of antimony and sulphurous acid. B. B. on charcoal, melts very easily, sinks into the support, and finally yields a globule of lead.

Composition $PbS+\frac{3}{4}Sb^2S^3$= sulphur 26·6, antimony 38·3, lead 41·1. Analysis by Rose.

Sulphur, - - - - -	21·53
Antimony, - - - -	37·34
Lead, - - - - - -	40·52

Discovered at Wolfsberg by Zinken, and named from πλαγιος, *oblique*, in allusion to its unusually oblique axis.

Occurs at Wolfsberg.

Sp. 14. Frieslebenite, *Haidinger;* Schilfglaserz, Freisleben.

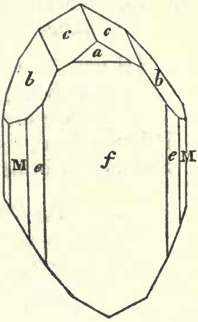
[H.=2·0 . . . 2·5. G.=6·0 . . . 6·4. In short, oblique rhombic prs.; striated lengthwise, and massive. Color and streak steel-grey. Lustre metallic. Brittle.]

Primary form, oblique rhombic prism. M on M=119° 12′.

Secondary form.

e on *e* - 132 48

Fig. 655.



Cleavage, parallel with M, also with *e*. Fracture conchoidal to uneven. Opaque. Brittle. Often in twins.

B. B. on charcoal, deposits a sublimate of oxides of lead and antimony, and yields a globule of silver, which sometimes imparts the color of copper to borax.

Composition, (Pb, Ag) $S + \frac{3}{7} Sb^2S^2$. Analysis by Wöhler.

Silver,	22·18
Lead,	30·
Iron,	0·11
Copper,	1·22
Antimony,	27·72
Sulphur,	18·77

Found in veins in gneiss with galena, antimonite, pyrargyrite, pyrites, chalybite, calcite and quartz, in the Himmelsfürst and some other mines near Freiberg in Saxony. It is said to have been found at Kapnik in Transylvania, and (a variety containing bismuth) at Ratieborzitz in Bohemia. It is a very scarce mineral.

Sp. 15. ZINKENITE, *Rose.*

[H.=3·0 ... 3·5. G.=5·3 ... 5·35. In twin xls. which are hexagonal prisms vertically striated, with low hexagonal pyramids at summit; in radiating groups and columnar masses. Color and streak dark steel-grey, to lead-grey, sometimes iridescent.]

Primary form, right rhombic prism, M on M 120° 39′.

Fracture uneven. Opaque. Lustre metallic. Slightly brittle.

In the open tube, yields a white sublimate of oxide of antimony and antimonite of lead. B. B. on charcoal, decrepitates, melts and deposits a yellow sublimate of oxide of lead, surrounded by a ring of oxide of antimony, leaving a very small bead containing copper. With soda, yields a globule of lead. Decomposed by warm hydrochloric acid, forming chloride of lead. Composition, $PbS + Sb^2S^3 =$ sulphur 21·6, antimony 43·5, lead 34·9. Analysis by Rose.

Lead,	31·84
Copper,	0·42
Antimony,	44·39
Sulphur,	22·58

Found with antimonite and quartz, at Wolfsberg in the Hartz, and near Trudpert in the Black Forest. Named in honor of M. Zinken, director of the Anhalt mines.

Sp. 16. STEPHANITE, *Haidinger;* Sprödglaserz, *Hausmann;* Melanglanz, *Breithaupt;* Brittle Sulphuret Silver, *Phillips.*

[H.=2·5. G.=6·2 ... 6·3, In tabular xls. (often twins) and massive, granular and compact. Color and streak, iron-black Lustre metallic.]

Primary form, right rhombic prism, M on M=115° 39′.
Secondary forms.

Fig. 656.

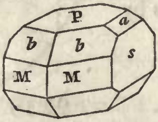
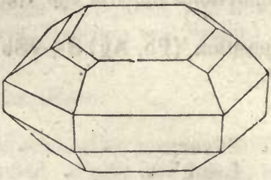


Fig. 657.



b on *b* - - - - -	130° 16′
M on *s* - - - - - -	122 10
a on *s* - - - - -	143 54
M on *b* - - - - - -	142 9

Cleavage, parallel with *a* and *s*, imperfect. Faces M and *s* striated parallel to their intersections with each other. Its other faces, smooth. Xls. often in twins; M, the face of composition; forms like aragonite, common. Fracture conchoidal to uneven. Sectile.

In the open tube, yields a sublimate of oxide of antimony: many varieties yield arsenious acid. B. B. on charcoal, melts into a dark grey bead, which with soda or borax, in the inner flame, yields a globule of silver. Soluble in dilute, heated nitric acid, sulphur and oxide of antimony being deposited.

Composition, $AgS+\frac{1}{6}Sb^2S^3=$ sulphur 15·6, antimony 14, silver 70·4. Analysis by Rose, from Schemnitz.

Sulphur, - - - - -	16·42
Antimony, - - - - -	14·68
Silver, - - - - -	68·54
Copper, - - - - - -	0·64

Occurs in veins with other silver ores in slate, transition, and trachytic rocks, in the mining districts of Saxony, Bohemia, Hungary, Hartz and Mexico.

Sp. 17. KOBELLITE, *Satterberg.*

[Soft. G.=6·29 ... 6·32. Resembles antimonite, radiating, columnar and fibrous. Lustre metallic. Color, dark lead-grey. Streak black.]

In the open tube, yields sulphurous acid and oxide of antimony. B. B. melts with ebullition, depositing upon the charcoal, a white and yellow sublimate, and leaving a white metallic bead. Soluble in hydrochloric acid, with extrication of sulphuretted hydrogen.

Analysis by Sätterberg.

Lead, - - - - - -	40·12
Bismuth, - - - - -	27·05
Iron, - - - - - -	2·96
Copper, - - - - -	0·80

Antimony,	9·25
Sulphur,	17·86
Earthy matter,	1·45

Found in the cobalt mine of Hvena, in the province of Nerike in Sweden, accompanied by cobaltine, mispickel and chalcopyrite.

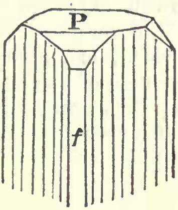
Sp. 18. **Bismuthine**, *Beudant;* Wismuthglanz,

[H=2·0 ... 2·5. G.=6·4 ... 6·5. In prismatic xls. and massive, with a granular, foliated structure. Color and streak, lead-grey, with a yellowish tarnish.]

Primary form, right rhombic prism, M on M =91°, nearly.

Secondary form.

Fig. 658.



The lines parallel to the plane *f*, represent the striæ, constantly observed on the xls., but which in reality are a series of planes. Cleavage, parallel to P and *f;* most perfect, parallel with the latter, and at right angles to *f*, affording the measurement of 90° by the reflective goniometer. Fracture scarcely observable. Opaque.

In the open tube, boils, yields a sublimate of sulphur, with extrication of sulphurous acid. Melts in the flame of a candle. B. B. on charcoal, in the inner flame, melts readily, yielding a yellow sublimate, and a globule of bismuth. Partially soluble in nitric acid, leaving a residue of sulphur; the clear solution gives a white precipitate, on dilution with water. Composition, Bi^2S^3= sulphur 18·4, bismuth 81·6. Analysis by Rose, sulphur 18·72, bismuth 80·98.

Found with bismuth in veins and beds. Its localities are Altenberg, Schneeberg, Joachimsthal, Cornwall, Riddarhyttan Sweden, Beresof Siberia, Drammen Norway, Caldbeckfell Cumberland and Haddam, Conn.

Sp. 19. **Aikinite**, *Chapman;* Aciculite, *Nicol;* Needle ore, *Jameson;* Nadelerz, *Hausmann;* Belonite, *Glocker;* Patrinite, *Haidinger.*

[H.=2·0 ... 2·5. G.=6·75. In long slender, 4 and 6-sided prisms, striated lengthwise. Color and streak, dark lead-grey. Acquires a brown tarnish.]

Primary form, right rhombic prism. M on M = nearly 110°.

Cleavage in one direction, parallel with the prismatic axis. Fracture uneven. Massive, rarely impalpable.

In the open tube, yields sulphurous acid, and a white vapor, part of which condenses in transparent drops. B. B. on charcoal, melts very easily, emits fumes, and deposits a white and yellow sublimate, leaving a bead, which with soda, yields a globule of copper. Partially soluble in nitric acid, leaving sulphate of lead and sulphur. Composition, $(Co, Pb) S+\frac{1}{8}Bi^2S^3$=16·7, bismuth 36·2, lead 36·1, copper 11. Supposed to be isomorphous, with bournonite. Analysis, from Beresof, by Frick:

Sulphur, - - - - -	16·05
Bismuth, - - - - -	34·62
Lead, - - - - -	35·69
Copper, - - - - -	11·79

Found imbedded in white quartz, with gold, malachite and galena, at Beresof, near Ckatherinenberg in Siberia.

Sp. 21. Berthierite, *Haidinger*.

[H.=2·0 ... 3·0. G=4·0 ... 4·3. In slender xls. and massive, columnar, plumose, rarely granular. Dark steel-grey to pinchbeck-brown.]

Cleavage indistinct. Fracture uneven. Lustre metallic; liable to tarnish. Opaque.

B. B. on charcoal, melts readily, yields fumes of antimony, and leaves a black, magnetic slag. Dissolves readily in hydrochloric acid, with evolution of sulphuretted hydrogen Composition, $Fe\,S+Sb^2S^3$= sulphur 28·9, antimony 58·4, iron 12·7. Analysis, *a* from Braunsdorf by Rammelsberg, *b* from Arany Idka, Hungary, by Pettko, *c* near Freiberg, by v. Hauer.

	a	*b*	*c*
Sulphur, - -	30·575	29·27	30·53
Iron, - - -	11·96	12·85	10·16
Antimony, - -	54·33	57·88	59·30
Manganese, - -	0·45	——	——

Found in gneiss near Chazelles in Auvergne, Anglar in the department of la Creuse, at Braunsdorf near Freiberg, and in Hungary.

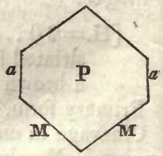
Sp. 21. Geocronite, *Svanberg*; Kilbrickenite, *Apjohn*; Schulzite.

[H. =2·5 ... 3·0. G.=5·80 ... 6·54. In right rhombic prisms; mostly massive, granular and earthy. Color and streak, light lead-grey.]

Primary form, right rhombic prism. M on M=119° 44′.
Secondary form.

P on M -	90 1°
M on *a* -	120 8

Fig. 659.



Cleavage, parallel with M. Fracture conchoidal to even. Lustre metallic. Opaque. Brittle.

B. B. on charcoal, fuses easily, emitting fumes of antimony and sulphur, and staining the support yellow. Composition, $PbS+\frac{1}{5}(Sb\,As)^2S^3$= sulphur 16·2, antimony 16·7, lead 66·8. Analysis, *a* from Sahla by Svanberg, *b* from Merido by Sauvage, *c* from Ireland (the *kilbrickenite*) by Apjohn.

	a	*b*	*c*
Sulphur, - -	12·26	16·90	16·36
Antimony, -	9·58	16.	14·39
Lead, - -	66·45	64·89	68·87

Arsenic,	4·69	——	——
Copper,	1·51	1·60	0·38
Iron,	0·42	——	——
Zinc,	0·11	——	——

Found at Merido, in Spain, at Val di Castello in Tuscany, at Sahla Sweden, and at Kilbricken, county of Clare, Ireland.

Sp. 22. Plumosite, *Haidinger ;* Heteromorphite, ***Rammelsberg ;*** Federerz, Feather-ore.

[H.=1·0 . . . 3·0. G.=5·6 . . . 5·9. In flexible, capillary xls., also massive. Color, dark steel-grey, sometimes iridescent. Lustre dull metallic.]

B. B. on charcoal, melts easily, is volatilized, except a small slag-like residue, the oxides of lead and antimony, being deposited upon the support. With soda, yields a globule of lead.

Composition, $PbS+\frac{1}{2}Sb^2S^3=$ sulphur 19·2, antimony 31·0, lead 49·8. Analysis, *a* plumose from Wolfsberg by Rose, *b* massive from Wolfsberg by Poselger, *c* acicular xls. from Tuscany by Becchi.

	a	*b*	*c*
Sulphur,	19·72	20·32	18·39
Antimony,	31·04	32·98	30·19
Lead,	46·87	48·48	47·68
Iron,	1·30	——	0·16
Zinc,	0·08	——	1·08
Copper,	——	——	1·11

Occurs in the Hartz, at Freiberg and Schemnitz, in the Anhalt at Pfaffenburg and Meiseberg, and near Bottino in Tuscany.

Sp. 23. Boulangerite, ***Thaulow ;*** Plumbostite, ***Breithaupt ;*** Embrithite, ***Breithaupt ;*** Schwefelantimonblei.

[H.=2·5 . . . 3·0. G.=5·75 . . . 6·0. Plumose, granular and compact. Bluish lead-grey, with yellow rust-spots.]

Lustre somewhat silky. Streak darker than color. Slightly brittle.

B. B. melts easily, emits fumes of sulphur and antimony, depositing oxide of lead upon the support. Soluble in warm hydrochloric acid, with evolution of sulphuretted hydrogen. Composition, $PbS+\frac{1}{3}Sb^2S^3=$ sulphur 17·9, antimony 24·1, lead 58·0. Analysis, *a* from Nasafjeld by Thaulow, *b* from Molieres by Boulanger, *c* from Wolfsberg by Rammelsberg, *d* from Tuscany by Becchi.

	a	*b*	*c*	*d*
Sulphur,	18·86	18·5	18·91	17·99
Antimony,	24·60	25·5	25·94	26·08
Lead,	55·57	53·89	55·15	53·15
Iron,	——	1·2	——	1·24
Copper,	——	0·9	——	0·35
Zinc,				1·41

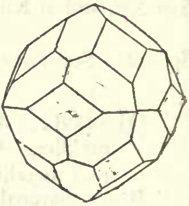
Abundant at Moliéres, department of Gard, in France ; also at Nasafjeld in Lapland, at Nertschinsh, at Wolfsberg, and near Bottino in Tuscany.

Sp. 24. DUFRÉNOYSITE, *Damour*; Gotthardite, *Rammelsberg*.

[H.=5·5. G.=5·54. In dodecahedral xls. and massive. Lustre metallic. Color, steel-grey. Streak red-brown.]

Primary form, cube.
Secondary forms.
Cleavage indistinct. Brittle.

Fig. 660.



Heated in a matrass, affords a red sublimate of sulphide of arsenic. B. B. fuses easily, giving off fumes of sulphur and arsenic; and leaving behind a globule of lead. Dissolved by hot nitric acid. Composition, $Pb+\frac{1}{2}As^2S^3$= sulphur 22·1, arsenic 20·7, lead 57·2. Analysis by Damour.

Sulphur,	22·49
Arsenic,	20·69
Lead,	55·40
Silver,	0·21
Copper,	0·31
Iron,	0·44

Occurs disseminated in narrow seams and nests in dolomite, with realgar, orpiment, blende and pyrites, at St. Gothard.

Sp. 25. GALENA, *Bleiglanz*.

[H.=2.5. G.=7·4 . . 7·6. Cubo-8-dral xls. and massive. Color and streak, lead-grey. Lustre metallic. Cubical cleavage perfect.]

Primary form, cube.
Socondary forms.

Fig. 661.

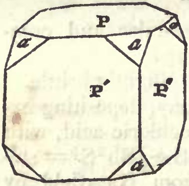


Fig. 662

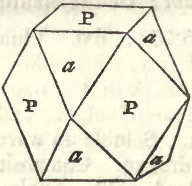


Fig. 663.

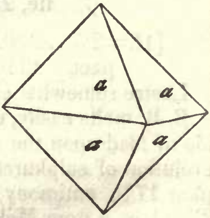


Fig. 664.

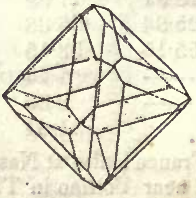


Fig. 665.

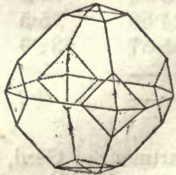


Fig. 666.

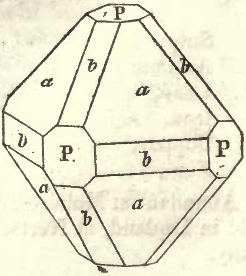
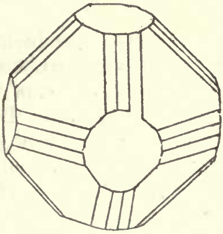


Fig. 667.



Feistrix, Stiria.

Fig. 668.

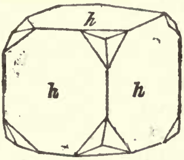
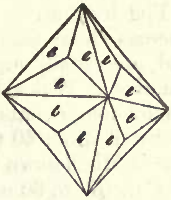


Fig. 669



Cleavage parallel with the cube, perfect. Fracture rarely discernible. Surface, the cube and the galenoid (fig. 669) streaked parallel to the edges of combination with the octahedron. Sometimes subject to tarnish. Rather sectile.

Compound varieties. Twin-crystals; face of composition parallel, axis of revolution perpendicular to a face of the octahedron.

Reticulated, tabular, and some other imitative shapes, the individuals of which are often still observable. Massive; composition granular, of various sizes of individuals, sometimes impalpable. In this case the color becomes pale, or whitish lead-grey, the fracture even, or flat conchoidal, and the streak shining. The granular particles of composition sometimes become elongated, or compressed in one direction, and then approach to lamellar or columnar ones. Pseudomorphoses of pyromorphite. Plates, &c.

B. B. on charcoal, at first decrepitates, but if heated with caution, soon fuses with strong fumes of sulphur; and at last gives a globule of lead. Composition, PbS = sulphur 13·4, lead 86·6. It sometimes contains traces of zinc, antimony and copper; and is rarely destitute of silver. This latter metal is sometimes present in a proportion as high as 0·5 p. c. and very rarely as 1·0, though it usually varies between 0·01 to 0·03. If it be in a proportion as high as 70 oz. to the ton, it is called a rich argentiferous galena. It does not generally pay for separating if it falls below 10 or 15 oz.

Galena is frequently found in veins, but also in great quantity in beds, particularly in limestone. Thus it occurs in Carinthia, at Deutsch-Bleiberg, Windisch-Bleiberg, Windisch Kappel, Ebriach, and other places,—in England in the counties of Derbyshire, Durham, Northumberland and Cumberland,*—and in the United States, in the States of Missouri, Illinois, Iowa and Michigan. The mines of Missouri are chiefly in the counties of Washington, Jefferson and Madison; those of the other States are distributed over 80 townships, a region 87 miles from east to west by 54 in breadth, comprising 62 towns in Wisconsin, 8 in Iowa, and 10 in Illinois. Throughout this entire region, it is said, that galena may be found upon every square mile of surface. From a single spot, not exceeding 50 yards square, 3,000,000 lbs of lead have been obtained. The mines of the lead district above indicated, afforded in 1847, 77,000 pigs

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* Mr. Beaumont, a single proprietor of lands and mines in these three, last counties, annually raises $\frac{1}{10}$th of the lead, produced in the world.

of lead, (weighing 70 lbs. each,) and in 1850, 570,000 pigs; those of Missouri, 150,000 pigs. The lead-produce of England in 1855 was valued at £1.692,055.

The lead mines situated in limestone, are rarely silver producing; whereas those found in other formations, while they are less prolific in lead, are usually argentiferous. It is thus found in slate in most of the counties of Wales, in granite in Aberdeenshire, at Beer-Alston in Devonshire (often containing from 80 to 120 oz. silver to the ton of lead,) in Cornwall (from 40 to 70 oz.,) in Cardiganshire (80 oz.,) in altered mica-slate at Middletown Conn. (56 oz.,) at the Washington mine, Davidson Co. N. Car. (50 to 60 oz.,) at Wheatley's mine at Phœnixville, Pa., (25 oz.,) and from the Morgan mine, Spartanburg, S. Car., (23 to 30 oz.). Other valuable lead regions in the primary rocks within the U. States, exist at Rossie, N. Y., at Lubec, Me., at Southampton, Amherst and Leverett, Mass., at Eaton, N. Hamp., Thetford, Vt. in the counties of Wythe and Louisa, Va., &c. &c.

Sp. 26. Hessite, *Fröbel;* Petzite, *Haidinger;* Tellursilber, *Rose;* Telluric Silver.

[H.=2·0 . . . 3·5. G.=8·3 . . . 8·9. Massive, granular. Lead-grey. Slightly malleable.]

Primary form, right rhombic prism?

Fracture even. Streak, same as color.

In the open tube, melts and yields a slight sublimate of tellurous acid. B. B. on charcoal, at a white heat, is volatilized, leaving a brittle globule of silver. In the matrass, with soda and powdered charcoal, at a red heat, yields telluride of sodium, which with water forms a yellow solution.

Composition, $Ag\,Te$ = tellurium 37·2, silver 62·8. Analyses, *a* from Savodinsky Altai by Rose, *b* from Nagyag by Petz, *c* from Retzbanya by Retz.

	a	*b*	*c*
Tellurium,	36·96	37·76	27·96
Silver,	62·42	61·55	59·67
Iron,	0·24	——	——
Gold,	——	0·69	——
Iron, lead and sulphur,	——	traces	——
Foreign substances,	——	——	15·25

Found in Siberia and Transylvania.

Sp. 27. Redruthite, *Nicol;* Vitreous Copper, *Phillips;* Copper-glance; Kupferglanz; Chalkosine, *Beudant.*

[H.=2·5 . . . 3·0. G.=5·5 . . . 5·8. In low hexagonal pyramids and prisms, mostly twins; and massive, compact. Color and streak blackish lead-grey.]

Primary form, right rhombic prism, M on M=119° 35′.

Secondary forms.

Fig. 670.

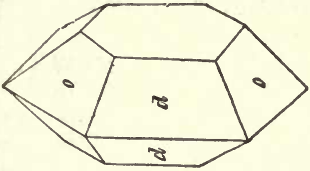
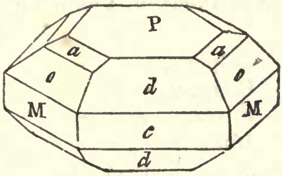


Fig. 671.



o on *o* - - - - - -	126° 52′
d on *d* - - - - - -	63 00
o on *o* over *d* - - . -	80 6

Fig. 672.

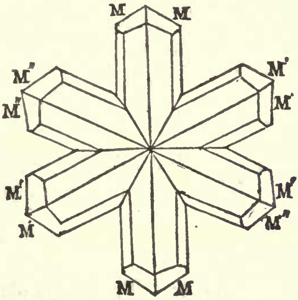
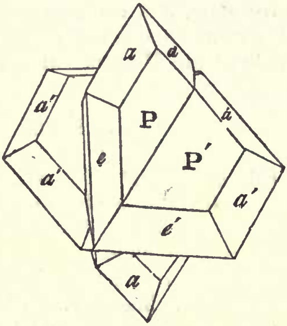


Fig. 673.



Cleavage, traces of M, very imperfect. Fracture conchoidal. Surface, most of the faces smooth, only the faces at right angles to the axis, and particularly *c*, are streaked horizontally. Lustre metallic. Color blackish lead-grey. Streak unchanged, sometimes shining. Compound varieties. Twin-crystals: 1. Axis of revolution perpendicular to one or both faces of M; face of composition parallel to it, as in figure 673, only that the re-entering angles are filled up. 2. Axis of revolution perpendicular, face of composition parallel to a face of *a*; the individuals being continued beyond the face of composition.

The inclination of P to P′ is equal to that of the acute terminal edge of *a* on *a*′ on one side, and of 91° 51′ on the other; the respective inclinations of *a* on *a*′ are =153° 37′, and =157° 19′. Massive; composition granular, of various sizes of individuals, generally small, and often impalpable; in the last case, the fracture becomes uneven, even or flat conchoidal. Plates.

B. B. in the oxidating flame, it melts and emits glowing globules, attended with some noise. In the reducing flame, it becomes covered with a coat, and does not melt. When the sulphur is driven off, a globule of copper remains. If the mineral be treated with nitric acid, the copper is dissolved, forming a green solution; but the sulphur remains undissolved.

Composition, Cu^2S= sulphur 20·2, copper 79·8. Analyses, *a* from Siegen by Ullmann, *b* from Tellemark, Norway, by Scheerer.

	a	*b*
Sulphur, - - - -	19.0	20·43
Copper, - - - - -	79·50	78·76
Silver, - - - -	1·00	——
Iron, - - - - - -	·75	0·91

Occurs in single xls. in druses and implanted, often covering broad surfaces of the massive variety, or the containing rock, in splendid crystallizations; the most remarkable of which have been obtained at the Bristol copper mine in Conn., where all the forms above given, and many other modifications, abundantly occurred, a few years since; but of late this locality has wholly ceased to afford them. The principal locality at present, of the crystallized variety, is Redruth in Cornwall. In the massive state, it is common in the bituminous copper-slate in Hessia, in the Hartz mountains in Sweden, Norway, Siberia, the Banat of Temeswar, Peru and Mexico. It is always a most valuable ore of copper.

Sp. 28. HARRISITE, (*S.*)

[H.=2·5...3·0. G.=4·5. Massive in large individuals, perfectly cleavable, with a cubic cleavage. Color and streak dark lead-grey to iron-black.]

Primary form, cube.

Secondary forms. (See figs. 648 and 661.)

Surface sometimes tarnished of a deep blue color. The large cleavage individuals much cracked and partially coated by a blue or black powder. The color of the species is analogous to that of psilomelane; and its cleavages are more easily affected than those of galena, which at first view it strikingly resembles, except in color. The laminæ besides being cracked, are often a little curved.

B. B. on charcoal, smells feebly of sulphurous acid, fuses easily, boils and throws off melted globules; a crust forms on the globule, which finally gives place to a button of pure copper.

Composition, Cu^2S= sulphur 22·2, copper 79·8. It is dimorphous with redruthite; and much resembles the artificially prepared compound, from fusing together a mixture of copper and sulphur in the above proportions, or by melting the redruthite.

Occurs in short interrupted seams in a vein by itself, associated with quartz and staurotide, in the Canton (Georgia) copper and lead mine. It is named after the Messrs. Harris, brothers, to whose skill and enterprize, the discovery, and opening of the mine are due.

Sp. 29. BOURNONITE, *Phillips;* Endellionite, *Bournon;* Wheel-Ore; Radelerz.

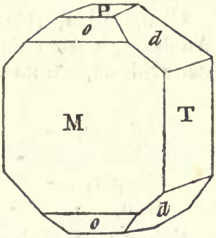
[H.=2·5...3·0. G.=5·76. In low prismatic (mostly twin) xls.; massive and granular. Color and streak, blackish-grey.]

Primary form, right rectangular prism.

Secondary form.

P on *o* = - - - -	138° 15′
P on *d* - - - -	136 26
T on *d* - - -	133 34
M on *o* - - - -	131 45

Fig. 674.



Cleavage distinct, parallel with M and T, and with both diagonals of the prism. Fracture conchoidal, uneven. Surface nearly equal, often highly smooth and splendent: longitudinal striæ sometimes visible on the secondary planes, which replace the lateral edges of the prism. Lustre metallic. Brittle. In the twin-xls., the axis of revolution is perpendicular, and face of composition parallel to M, or the broader face of the primary form. The individuals are generally continued beyond the face of composition. The axes of the individuals cross each other at angles of 93° 40′ and 86° 20′. When granular, the individuals are closely connected.

Decrepitates when heated. In the open tube, evolves sulphurous acid, deposits oxide antimony in the upper part of the tube, and on the lower, a non-volatile coating of antimonite of lead. B. B. on charcoal, melts, with fumes of sulphurous acid and oxide of antimony, depositing a yellow coating of oxide of lead; and after the lead has been expelled and soda added, leaves a globule of copper. Partially soluble in nitric acid, forming a blue solution, and leaving a residue of oxide of antimony and sulphur.

Composition, (Ȼu, Pb)S$+\frac{1}{3}$Sb^{2}S^3= sulphur 19·4, antimony 26·0, lead 41·8, copper 12·8. Analyses, *a* from Pfaffenberg by Rose, *b* from Mexico by Dufrénoy, *c* from Wolfsberg by Rammelsberg.

	a	*b*	*c*
Sulphur, - - -	20·31	19·4	19·76
Antimony, - -	26·28	28·3	24·34
Lead, - - -	40·84	40·2	42·88
Copper, - -	12·65	13·3	13·06

Occurs in xls. an inch or more in diameter, at Neudorf in the Hartz; at Kapnik, Transylvania; at Servoz in Piedmont: and in Saxony, Cornwall, Devonshire and Chili.

Sp. 30. STROMEYERITE, *Haidinger;* Stromeyerine, *Beudaut;* Silberkupferglanz.

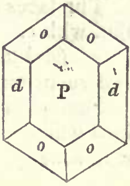
[H.=2·5 . . . 3·0. G.=6·25. In xls., isomorphous with redruthite, and massive, compact. Color and streak, blackish lead-grey. Perfectly sectile.]

Primary form, right rhombic prism. M on M=119° 35′.

Secondary form.

P on *d* -	154° 7′
P on *o* -	154 26
d on *d* -	128 14

Fig. 675.



Fracture conchoidal. Lustre metallic. Opaque.

B. B. fuses readily into a grey metallic globule, which with fluxes affords the reaction of copper, and by cupellation, a globule of silver. Partially soluble in nitric acid, the solution yielding copper on an immersed iron plate, and silver upon one of copper.

Composition, $(Cu, Ag)S$= sulphur 15·8, silver 53·1, copper 31·1. Analyses, *a* from Schlangenberg Siberia by Stromeyer, *b* from Rudelstadt Silesia, *c* from Chili by Domeyko.

	a	*b*	*c*
Sulphur, - - -	15·782	15·92	17·83
Silver, - -	52·272	52·71	28·79
Copper, - - -	30·478	30·95	53·28
Iron, - - -	0·333	0·14	——

Found with chalcopyrite in Siberia, Silesia, Peru and Chili.

Sp. 31. Wolchite, *Haidinger;* Antimonkupferglanz, *Breithaupt;* Antimonial Copper-Glance.

[H.=3·0. G.=5·7 ... 5·8. In short rhombic prisms and massive. Color and streak, blackish lead-grey.]

Cleavage parallel with the shorter diagonal, imperfect. Fracture conchoidal to uneven.

B. B on charcoal, fuses with ebullition, depositing first a white then a yellow sublimate, and yielding a lead-grey metallic globule, which after long roasting, yields with soda, a globule of copper. Analysis by Schrötter.

Lead, - - - - -	29·90
Copper, - - - -	17·35
Zinc, - - - - -	2·40
Antimony, - - - -	16·65
Arsenic, - - - -	6·04
Sulphur, - - - .	28·60

Found in a bed of chalybite with pyrites, antimonite and galena, at St. Gertrand in the Lavantthal, Carinthia.

Sp. 32. Wolfsbergite, *Nicol;* Antimonial Copper, Kupferantimonglanz, *Zinken;* Chalcostibites, *Glocker.*

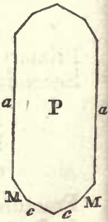
[H.=3·0 ... 4·0. G.=4·748. In nests or geodes of small tabular prs. Color, lead to iron-grey. Streak black, Lustre metallic.]

Primary form, right rhombic prism. M on M =101°.

Secondary form.

c on *c*	- -	135° 12′
M on *c*	-	112 24
M on *a*	-	129 30

Fig. 676.



The faces *a* large and striated, parallel with their intersection with *c*. Cleavage *a* very perfect. P less so. Fracture conchoidal to uneven. Opaque. Faces sometimes exhibit an iridescent tarnish.

Decrepitates when heated. B. B. melts easily, and deposits a white sublimate, leaving a hard, metallic globule, which with soda, yields a bead of copper.

Composition, $CoS + Sb^2S^3$ = sulphur 25·0, antimony 50·2, copper 24·8. Analysis, by Rose.

Copper,	24·46
Iron,	1·39
Lead,	0·56
Antimony,	46·81
Sulphur,	26·34

Found with chalcopyrite, zinkenite, antimonite and quartz, at Wolfsberg in the Hartz.

Sp. 33. **Tetrahedrite**, *Haidinger;* Grey Copper, *Phillips;* Fahlerz, Schwarzerz, Kupferfahlerz, Weisigiltigerz, Schwarzgiltigerz, Graugiltigerz, Panabase, *Beudant;* Polytelite, *Glocker;* Aphthonite, *Svanberg;* Aftonite, Quecksilberfahlerz, or Spaniolite, *Kobell;* Freibergite, or Argentiferous Tetrahedrite.

[H.=3·0 ... 4·0. G.=4·5 ... 52.. In tetrahedral xls., (often twins); massive, compact. Color, blackish lead-grey to iron-black. Streak, dark reddish-grey.]

Primary form, cube.
Secondary forms.

Fig. 677.

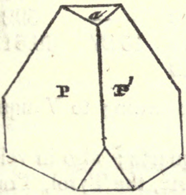


Fig. 678.

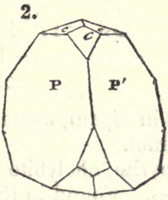


Fig. 679.

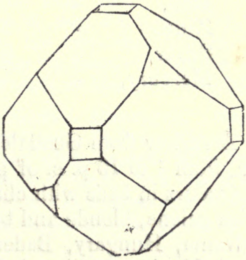


Fig. 680.

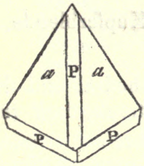


Fig. 681.

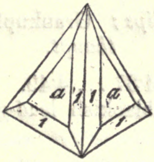
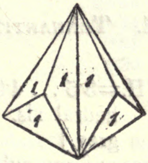


Fig. 682.



1 on *a* - 160° 32′ P on *a* - 115 16

Cleavage, not visible, except traces of the octahedron. Fracture conchoidal, of different degrees of perfection. Surface, the tetrahedron and the trigonal dodecahedron generally streaked irregularly, parallel to their common edges of combination, not rough; the dodecahedron sometimes a little rough. Some varieties are subject to tarnish.

Compound varieties. Twin-crystals: face of composition parallel to a face of the octahedron; the individuals continued beyond the face of composition.

Massive: composition granular, of various sizes of individuals, strongly connected, and often impalpable; fracture uneven.

In the open tube, yields fumes of antimony, sulphur and arsenic. B. B., on charcoal, decrepitates, emits the smell of sulphur, deposits a coating on the support, and melts easily with slight ebullition into a steel-grey slag, which is usually magnetic; but which on the addition of borax, melts into a grey metallic bead, and on the farther addition of soda, affords a globule of copper. The powder is decomposed by nitric acid, with separation of oxide of antimony, arsenious acid and sulphur. The powder is also partially decomposed by caustic potash, which dissolves out the sulphides of antimony and arsenic; the alkaline solution yielding an orange-red, or lemon-yellow precipitate, on the addition of an acid. Composition, $(Co, Ag, Fe, Zn)\,S+(SbAS_{\frac{1}{4}})^2S^3$. Analysis, *a* from Kapnik by Rose, *b* from Clausthal by Rose, *c* from Wolfach by Rose, *d* from Wermland (var. *aphthonite*) by Svanberg, *e* from Schwatz Tyrol (var. *spaniolite*) by Weidenbusch, *f* from Freiberg (var. *Weissgiltigerz*) G.=5·4 by Rammelsberg.

		a	*b*	*c*	*d*	*e*	*f*
Sulphur,	-	25·77	24·73	23·52	30·05	22·96	22·53
Antimony,	-	23·74	28·24	26·63	24·77	21·31	22·39
Arsenic,	-	2·88	——	——	trace	——	——
Copper,	-	37·98	34·48	25·23	32·91	34.51	0·19
Iron,	-	0·86	2·27	3·72	1·31	2·24	3·72
Zinc,	-	7·29	5·55	3·10	6·40	1·34	3·15
Silver,	-	0·02	4·97	17·71	3·09	——	592
Mercury,	-	——	——	——	lead ·04 cobalt ·49	15·27	36.51

A variety from Guadalcanal in Spain, contains, according to Vauquelin, from 1 to 10 p. c. of platinum.

Occurs in beds with chalcopyrite, chalybite and quartz; also in veins with galena, blende and barytes. Found in the Hartz, the Tyrol, Transylvania, Hungary, Baden, Bohemia, Saxony, Siberia, Cornwall, Scotland, Mexico, Chili and Peru.

Sp. 34. Tennantite, *Phillips;* Graukupfererz, Kupferblende, *Breithaupt.*

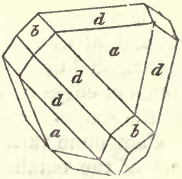
[H.=3·5 ... 4·0. G.=4·37 ... 4·49. In tetrahedral and dodecahedral xls. Color, blackish lead-grey. Streak, dark reddish-grey.]

Primary form, cube.

Secondary forms. (See Figs. 680 and 682.)

Cleavage dodecahedral, imperfect.

Fig. 683.



Fracture uneven. *b* striated parallel to intersections with *a*. Twins. Twin-face *a*. Opaque. Brittle.

B. B., decrepitates, emits arsenical fumes, and melts into a black, magnetic globule. Composition, *a* from Trevisane, Cornwall, by Phillips, *b* from Skutterud, Norway, by Fearnley, *c* from Freiberg (*kupferblende*), by Plattner.

a on *d* - 160° 32 *b* on *c* - 144 44.

	a	*b*	*c*
Sulphur,	30·25	29·18	28·11
Arsenic,	12·46	19·01	18·87
Copper,	47·70	42·60	41·07
Iron,	9·75	9·21	2·21
Zinc,	——	——	8·89
Lead,	——	——	0·34
Silver and antimony,	——	——	traces.

Found in small attached xls., rarely massive, on other ores of copper, near Redruth, and St. Day in Cornwall; also in Norway and Algeria.

APPENDIX TO ORDER GLANCE.

Binnite, Heusser. In striated prs. Color dark steel-gray, streak dark red. Very brittle. Fracture conchoidal. Found with dufrénoysite at St. Gothard.

Bismuth Silver, Wismuthsilbererz, *Wismuthbleierz,* Hausmann, Silberwismuthglanz.

In acicular xls. and amorphous. Soft. Lustre metallic. Color tin-white or greyish,—liable to tarnish. Fracture uneven. Sectile. Opaque.

B. B. fuses readily to a silver button, giving sulphur fumes, and covering the charcoal with the oxides of lead and bismuth. Soluble in nitric acid.

Analysis by Klaproth—bismuth 27, lead 33, silver 15, iron 4·3, copper 0·9, sulphur 16·3. A specimen analyzed by Domeyko, from the mine San Antonio near Copiapo, Chili, afforded, silver 60·1, bismuth 10·1, copper 7·8, arsenic 2·8 gangue 19·2.

Found at Schapbach in Baden, and in the cupreous shale of Mansfeld, Thuringia.

Brongniardite, Damour. H. above 3. G.=5·95. Massive. Cleavage not observable. Lustre like that of bournonite. Streak greyish-black. B. B. on charcoal, decrepitates, fuses easily, giving off an odor of sulphur and white vapors. After roasting, yields a globule of silver, surrounded with an areola of lead. In a closed tube affords a feeble orange sublimate with a white one above. In an open tube, it fuses, and yields an odor of sulphur and a ring of oxide of antimony. Analysis, by Damour.

Sulphur,	19 38
Antimony,	29·95
Silver,	25·03
Lead,	24.74
Copper,	0·54
Iron,	0·30
Zinc,	0·40

From Mexico.

Chiviatite, Rammelsberg. Massive: Cleavable in three directions, one making an angle with the second of 153°, and with the third of 133° (Miller). G.=6·92. Lustre metallic. Color lead-grey. B. B. like aikinite. Analysis by Rammelsberg.

Sulphur,	18·00
Bismuth,	60·95
Lead,	16·73
Copper,	2·42
Iron,	1·09
Silver,	trace.

From Chiviato in Peru, with pyrites and barytes.

Cuprolumbite, Breithaupt; Kupferbleiglanz. Massive; granular. Cleavage, cubic. H.=2·5. G.=6·40 . . . 6·42. Lustre metallic. Color, blackish lead-grey. Streak black. Rather sectile and brittle.

In an open tube, fuses and gives off fumes of sulphur. B. B. on charcoal, surrounds the assay with an areola of oxide of lead and sulphate of lead. With soda, affords a metallic globule. Composition, $CuS+2Pbs$= sulphur 15·2, lead 65·0, copper 19·9. Analyses by Plattner.

Sulphur, (loss,)	15·1
Lead,	64·9
Copper,	19·5
Silver,	0·5

Occurs in Chili.

Digenite, Breithaupt. A mineral allied to redruthite. G.=4·56 ... 4·68. According to a blowpipe analysis by Plattner, consists of copper 70·2, silver 0·24, and sulphur 29·66. From Chili and from Sangerhausen, Thuringia.

Enargite, Breithaupt. In right rhombic prs. of 97° 53′ and massive, granular or columnar. Cleavage perfect, parallel with M. H.=3. G.=4·43 4·45. Lustre metallic. Color and streak, iron-black. Fracture uneven. Brittle.

Heated in an open tube, decrepitates and affords a sublimate of sulphur, and with more heat, a reddish-yellow one of sulphide of arsenic. B. B. on charcoal, gives off fumes of arsenic, antimony and zinc; and in the reduction-flame, with borax, yields a globule of copper. Analysis, by Plattner,—

Sulphur,	32·22
Arsenic,	17·59
Antimony,	1·61
Copper,	47·20
Iron,	0·56
Zinc,	0·22
Silver,	0·01

From Morococha, Cordilleras of Peru, at a height of 15,000 feet; found in large masses, occasionally with small druses of xls. along with tennantite, imbedded in crystalline limestone.

Pateraite, Haidinger. A new sulphide of molybdenum. Composition, $Ms\,S^3$.

Silberphyllinglanz. H.=1·0 ... 2·0. G.=5·0 ... 5·9. Foliated, with one perfect cleavage. According to Plattner, it is a mixture of naumannite, molybdenum and gold. From Deutsch Pilsen in Hungary.

Steinmannite, Zippe. Found in octahedrons with a cubic cleavage: also massive. H.=2·5. G.=6·83. Color lead-grey. B. B. on charcoal, gives fumes of sulphur and antimony, and finally affords a globule of lead containing silver. Occurs at Przibram.

Tinder Ore, Zundererz. Soft, like tinder, of a dull, dark reddish color. Composition, according to Bornträger,—

Arsenic,	12·60
Antimony,	16·88
Lead,	43·06
Silver,	2·56
Iron,	4·52

Occurs at Andreasberg and Clausthal in the Hartz.

Wittichite, Kobell. Kupferwismuthglanz, Kupferwismutherz: Cupreous Bismuth. H.=3·0 ... 3·5. G.=5·0. In long prismatic xls., cleavable very perfectly, in one direction, parallel to the prismatic axis. Fracture uneven. Lustre metallic. Tin-white to steel-grey. Streak black. Sectile. Opaque. Analysis, by Klaproth.

Copper,	34·55
Bismuth,	47·24
Sulphur,	12·28

Found at Gallenbach and Neuglück near Wittichen in Baden.

ORDER XIV. BLENDE.

Sp. 1. ORPIMENT, Dimorphine, *Scacchi;* Rauschgelb, *Hausmann.*

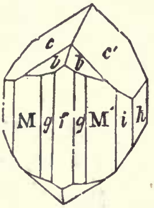
[H.=1·5 . . . 2·0. G.=3·48. In foliated masses. Color, lemon-yellow. Thin laminæ, flexible.]

Primary form, right rhombic prism. M on M =100° 40′.

Secondary form.

M on *c*	120° 00?	PHILLIPS.	M′ on *i*	162° 38.
M on *f*	140 00		*c* on *c′*	83 30
M on *g*	177 54		*c* on *b*	145 50

Fig. 684.



Cleavage, parallel with M not very perfect, or only in traces; but parallel with *f*, highly perfect. The faces of cleavage are streaked parallel to the edges of intersection with M. Fracture scarcely observable. Surface *f* rough, but even; all the other faces are streaked, parallel to their edges of combination with M, and generally uneven.

Lustre pearly metallic upon the perfect faces of cleavage, the rest resinous. Color, several shades of lemon-yellow. Streak lemon-yellow, generally, a little paler than the color. Semi-transparent . . . translucent on the edges.

Compound varieties. Reniform, botryoidal, and other imitative shapes. Composition, curved, lamellar; faces of composition commonly rough. Massive: composition granular, of various sizes of individuals; faces of composition uneven, often irregularly streaked.

B. B., upon charcoal, it burns with a blue flame, and emits fumes of sulphur and arsenic. It is soluble in the nitric, hydrochloric and sulphuric acids.

Soluble in aqua regia, or in ammonia.

Composition, As^2S^3= sulphur 39, arsenic 61. The *dimorphine* is found at a fumarole of the Solfatara in xls. not over half a millimeter in length. They appear to present two types of crystallization; i. e. rhombic prisms of 98° 6′ and of 100° 32.

Found in imbedded nodules, rarely in crystals, in blue clay, accompanied by sulphur. It occurs at Tajoua, near Neusohl in Lower Hungary, in the vicinity of Vienna, and in Wallachia and Servia. At Kapnik in Transylvania and Felsobanya in Upper Hungary, it occurs in metalliferous veins with galena, blende, arsenic and realgar. It is found at Halle, in gypsum, at St. Gothard in dolomite, at the Solfatara near Naples, as the result of volcanic sublimation, in brown coal at Fohnsdorf, Styria and near Julamerk in Koordistan, constituting an extensive Turkish mine. It is likewise found in China and Mexico. It is used as a pigment.

Sp. 2. REALGAR; Red Orpiment; Rothes Rauschgelb.

[H.=1·5 . . . 2·0. G.=3·56. In oblique, highly modified prs. and massive, granular. Color aurora-red. Streak orange-yellow, to aurora-red.]

Primary form, oblique rhombic prism. M on M=74° 14′.
Secondary forms.

Fig. 685.

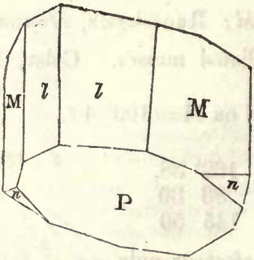
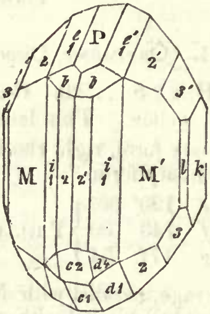


Fig. 686.



M on M	74° 30′	P on *l*	113° 16′
l on *l*	113 20	*n* on *n* over P	131 58

M on M	74° 15′	M′ on *e′*2	135° 2′
P on M	104 6	M′ on *e′*3	141 20
P on *b*	149 12	M′ on *i*1	172 6
P on *c*2	80 00	M′ on *i*2	160 42
P on *e*1	156 30	M′ on *k*	142 42
P on *e*2	138 22	M′ on *l*	163 35
P on *e*3	126 50	*c*1 on *c*2	150 38
P on *k*	90 00	*c*1 on *d*1	155 10
M on *b*	133 2	*c*1 on *d*2	137 20
M on *c*1	99 30	*c* on *d*1	125 61
M on *c*2	115 52	*c*1 on *k*	90 00
M′ on *d*1	119 30	*c*2 on *d*4	161 20
M′ on *d*2	131 34	*i*2 on *i*2′	112 55
M′ on *e*1	122 50		

PHILLIPS.

Cleavage, parallel to P and the shorter diagonal of the prism, rather perfect; parallel to *n* and M less distinct. Fracture conchoidal. Surface, the prisms streaked in the direction of the principal axis, parallel to that line: the rest of the faces commonly rough.

Lustre resinous. Color, aurora-red, several shades, little differing from each other. Streak orange-yellow to aurora-red. Compound varieties. Massive: composition granular, of various sizes of individuals, strongly connected. Fracture conchoidal, uneven.

B. B. on charcoal, it burns with a blue flame, and emits fumes of sulphur and arsenic. It is soluble in nitric, hydrochloric and sulphuric acids.

Composition, AsS= sulphur 29·91, arsenic 79·09.

Occurs along with orpiment; also found in small nodules with dufrénoysite and pyrites in dolomite at St. Gothard. More generally, it is met with in metalliferous veins, with ores of silver, lead and arsenic, and with several species of pyrites and of barytes. The chief localities are Kapnik and Nagyag in Transylvania, Felsobanya in Upper Hungary, Joachimsthal in Bohemia, Schneeberg in Saxony, Andreasberg in the Hartz, and in Koordistan, in Spain and Algeria.

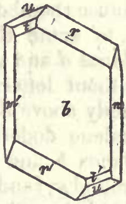
The *arsenolite* of Volger is a variety produced by the escape of a portion of the arsenic. A black crust sometimes forms also on realgar, which is supposed by Volger to be a sulphide, containing less sulphur than realgar.

Sp. 3. FIREBLENDE; Feuerblende, *Breithaupt*.

[H.=2. G.=4·2...4·3. In delicate xls. grouped like stilbite. Form, oblique rhombic pr. Color, hyacinth red.]

t on *b* =	143° 0′
u on *b*	123 34
m on *b*	110 29
a on *b*	90
r on *b*	148 42
r on *m*	121 36
r on *t*	149 6

Fig. 687.



The faces *b* are striated, parallel to their intersections with *t*. Twins. Translucent. Sectile, and somewhat flexible.

B. B. same as pyrargyrite. It contains 62·3 p. c. of silver, with antimony and sulphur.

Found at the Kurprinz mine, near Freiberg, and at Andreasberg, Hartz.

Sp. 4. KERMESITE; Red Antimony; Pyrostilbite, *Glocker;* Kermesome, *Chapman;* Rothspiesglaserz; Antimonblende; Pyrantimonite, *Breithaupt*.

[H.=1·0...1·5. G.=4·5...4·6. In very fine diverging, or interlaced, acicular xls.; and amorphous. Color cherry-red; streak brownish-red.]

Primary form, not well ascertained. Sectile. In thin, flexible fibres. Melts B. B. depositing a sublimate of oxide of antimony. Soluble in hydrochloric acid, with extrication of sulphuretted hydrogen. In a solution of caustic potash, its powder becomes yellow and is wholly dissolved. Composition, $SbO^3+2SbS^3=$ oxide of antimony 30·2, sulphide of antimony 69·8. Analysis by Rose.

Antimony,	74·45
Oxygen,	5·29
Sulphur,	20·49

It is formed from an alteration in antimonite, and occurs in veins of quartz at Malaczka near Posing in Hungary, at Braunsdorf, near Frieberg in Saxony, and at Allemont in Dauphiny.

Sp. 5. PYRARGYRITE, *Hausmann* and *Haidinger;* Red Silver (in part); Dark Red Silver; Aerosite; Rothgiltigerz; Argyrgthrose, *Beudant;* Silberblende, *Naumann;* Antimonsilberblende.

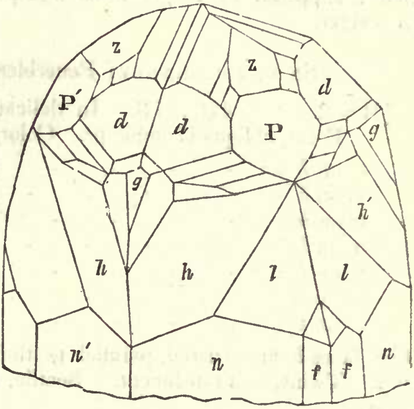
[H.=2·0...2·5. G.=5·7...5·9. In hexahedral prisms, with modifications like those of calcite. Color, carmine-red to blackish-grey. Sectile.]

Primary form, rhomboid, P on P=108° 42′.

Secondary form.

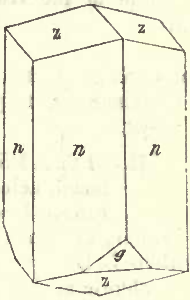
P on *z* (c. g.) =	172° 00′
P on *h*	141 50
P on *l*	158 22
d on *d* (c. g.)	125
h on *h*	134 40
n on *n*	120

Fig. 688.



The planes *z*, by their extension, tend to produce an obtuse rhomboid; the planes *g*, to acute rhomboids: the planes *d* and the four planes without letters, situated directly above them, to obtuse scalene dodecahedrons; the planes *h* and the three sets around *g*, *l* and the three elongated planes between *h* and *d*, all tend to acute, scalene dodecahedrons; *f* and *n*, lead to regular six-sided prisms.

Fig. 689.



Cleavage parallel with P, pretty distinct in some varieties. Fracture conchoidal. Surface, *f* and *n* striated vertically; P, *z*, and *g*, and most of the adjoining faces, streaked parallel to their common edges of combination. Lustre metallic-adamantine. Color, iron-black, lead-grey, sometimes approaching cochineal-red. Streak, cochineal-red, in shades corresponding to the color. Translucent to opaque.

Compound varieties. Twin crystals. Face of composition perpendicular, axis of revolution parallel to an edge of *z*. This kind of regular composition is frequently repeated, contiguous to all the terminal edges of *z*, as in fig. 702.

Fig. 690.

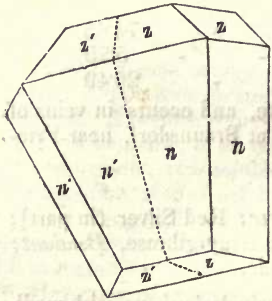
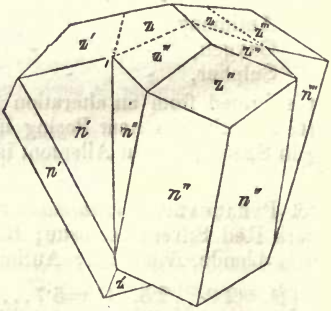


Fig. 691.



Face of composition parallel, axis of revolution perpendicular to *g*. Face of composition parallel to *n*, axis of revolution perpendicular to it. The individuals are sometimes continued beyond the face of composition. Massive: composition granular, of various sizes of individuals, strongly connected. If the composition becomes impalpable, fracture is uneven, even, or flat conchoidal. Plates, superficial coatings.

B. B. when heated, it first decrepitates, then melts, burning with a bluish flame, and emitting sulphurous acid, together with the white smoke of antimony. By continuing the heat, a globule of silver is obtained. Its powder heated in nitric acid, turns black, emits red fumes, and dissolves, leaving behind some sulphur and oxide of antimony. The solution yields with water a white precipitate, on the separation of which, muriatic acid occasions the deposition of chloride of silver.

Composition; $AgS+\frac{1}{3}Sb^2S^3$ = sulphur 17·5, antimony 23·5, silver 59·0. Analysis, from Andreasberg, by Bonsdorf.

Sulphur,	16·61
Antimony,	22·85
Silver,	58·95
Gangue,	0·30

Occurs in attached xls., massive and disseminated, in veins with calcite, galena, and other ores of silver and lead. It is found with calcite, arsenic, and galena at Andreasberg, at Freiberg Saxony, Joachimsthal, Altwoschitz, and Ratiborzitz in Bohemia, Wolfach in Baden, Schemnitz and Kremnitz in Hungary, Callington in Cornwall, and at Guanaxuato and Zacatecas in Mexico.

Sp. 6. **Proustite**, ***Beudant;*** Light Red Silver; Rubinblende, ***Hausmann;*** Lichter Rothgiltigerz; Arseniksilberblende.

[H.=2·0 . . . 2·5. G.=5·5 . . . 5·6. Forms like those of preceding species. Color and streak, light shades of cochineal-red.]

Primary form, rhomboid, P on P=107° 48′.

Secondary forms.

Fig. 692.

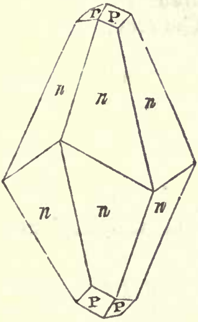


Fig. 693.

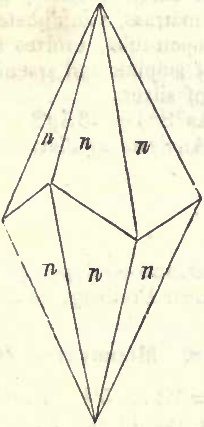
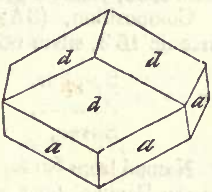


Fig. 694.



Other combinations occur in this species, resembling those of pyrargyrite. Cleavage parallel with P, rarely distinct. Fracture conchoidal to uneven. Surface *d* streaked parallel to its upper edges; *a* vertically. Lustre adamantine. Semi-transparent to translucent on the edges. Twin-crystals, and massive; composition granular, of various sizes of individuals, and also botryoidal.

B. B. on charcoal, at first decrepitates, melts easily, yielding fumes of sulphur and arsenic, and leaving a brittle globule, reducable with difficulty to pure silver. Partially soluble in nitric acid, leaving a residue of sulphur and arsenious acid. Caustic potash dissolves out sulphide of arsenic. Composition, $AgS+\frac{1}{3}As^2S^3=$ sulphur 19·4, arsenic 15·2, silver 65·4. Analysis, from Joachimsthal, by Rose:—

Sulphur,	19·51
Arsenic,	15·09
Silver,	64·67
Antimony,	0·67

Found in veins with arsenic and ores of silver, at Schneeberg, Johann-Georgenstadt, Annaberg, Freiberg, Marienberg in Saxony: in Bohemia, Baden, Alsace, Dauphiny, in Spain, Mexico and Peru.

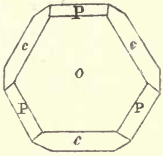
Sp. 7 XANTHOCONE, *Breithaupt*.

[H.=2·0 . . . 3·0. G.=5·15 . . . 5·19. In very thin hexagonal plates and massive. Color and streak, orange-yellow to brown. Transparent to translucent.]

Primary form, rhomboid, P on P =71° 34′.
Secondary form.

P on *o* =	110° 30′
o on *c*	100 35
P on *c*	121 39
c on *c*	63 18

Fig. 695.



Cleavage P and *o*. Fracture conchoidal to uneven. Lustre adamantine. Melts below redness, becomes lead-grey, and yields in the matrass, a sublimate of sulphide of arsenic. In the open tube, evolves sulphurous and arsenious acids. B. B. gives fumes of sulphur and arsenic. The remainder fused with soda, yields a globule of silver.

Composition, $(3AgS+As^2S^5)+^2(3AgS+As^2S^3)=$ sulphur 18·5, arsenic 15·3, silver 66·2. Analysis by Plattner.

Sulphur,	21·70
Arsenic,	15·32
Silver,	63·88

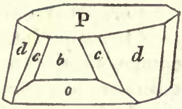
Named from ξανθος, *yellow*, and κονις, *powder*. Occurs with stephanite at the Himmelsfürst mine, near Freiberg, Saxony.

Sp 8. MIARGYRITE, *Rose*.

[H.=2·0 . . . 2·5. G.=5·3 . . . 5·4. In small, thick tabular or pyramidal prs. Color, iron-black. In thin flakes, deep blood-red. Streak dark cherry-red. Very sectile.]

Primary form, oblique rhombic prism of 39° 38′.

Fig. 696.



Secondary form.

P on *b*	-	98° 24′
P on *d*	-	109 16
b on *b*	-	135
b on *o*	-	129 50

Faces *b, c, d* striated, parallel to their mutual intersections. Cleavage P, *d* imperfect. Fracture imperfectly conchoidal. Opaque, except in thin splinters. Lustre adamantine.

Melts easily; and in the open tube affords sulphurous acid and oxide of antimony. B. B., on charcoal, with soda, yields a globule of silver. Caustic potash dissolves out sulphide of antimony. Composition, $AgS + Sb^2S^3 =$ sulphur 21·2, antimony 42·9, silver 35·9. Analysis, by Rose, sulphur 21·95, antimony 39·14, silver 36·40, copper 1·06.

Observed only at Braünsdorf, near Freiberg in Saxony, associated with mispickel; and named from μειων, *less*, and ἄργυρος, *silver*; because it contains less silver than other argentiferous ores.

Sp. 9. CINNABAR.

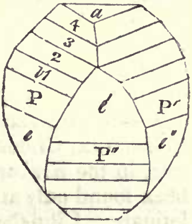
[H.=2·0 . . . 2·5. G.=8.99. Massive. Cochineal-red. Streak scarlet.]

Primary form, rhombic. P on P 71° 48′

Secondary form.

P on P′	- -	71° 48′	HAUY.
P on *b*2	- -	157 20	
P on *b*3	- -	152 8	
P on *e*	- -	159 18	
a on *b*1	- -	127 5	
a on *b*2	- -	133 25	
b on *b*3	- -	138 34	
a on *b*4	- -	146 31	
a on *b*1	- -	142 55	
e on *b*3	- -	131 26	

Fig. 697.



Cleavage parallel to the primary form, highly perfect. Fracture conchoidal. Surface of the crystals horizontally streaked, sometimes very deeply.

Lustre adamantine, inclining to metallic in dark colored varieties. Color, several shades of cochineal-red, the darker varieties inclining to lead-grey. Streak scarlet-red. Semi-transparent . . . translucent on the edges.

Compound varieties. Rarely, in some indistinct imitative shapes. Massive: composition, granular, of various sizes of individuals, generally small and often impalpable. In the last case, fracture becomes uneven, even, or flat conchoidol. Plates,s uperficial coatings. There is sometimes a tendency to thin columnar composition, the mass being friable, and the color scarlet-red.

The *hepatic cinnabar* is a compound variety of cinnabar, which is impure, and having on that account a streak, inclining to brown. The *dark red* cinnabar includes the crystals, and those compound varieties in which the individuals are still discernible; it is generally cochineal-red. The *bright red* cinnabar is friable, and of a scarlet-red color. The *compact* hepatic cinnabar contains reniform, massive varieties of a granular composition, consisting of impalpable individuals. The *slaty* hepatic cinnabar (*corallinerz*) is the same thing, only interrupted by irregularly streaked smooth faces, which possess a slaty appearance. These however are accidental, not having any relation to the composition itself. The *bituminous cinnabar* consists of cinnabar, intermixed with coarse coal or bituminous shale.

B. B. sublimes: with soda, yields mercury, sulphurous acid escaping. Composition, HgS=sulphur 13·8; mercury 86·2. Analysis, *a* from Westphalia, by Schnabel, *b* from California, by Bealey.

	a	*b*
Sulphur,	13·67	11·38
Mercury,	86·79	69·36
Iron,	——	1·23
Lime,	——	1·40
Alumina,	——	0·61
Magnesia,	——	0·49
Silica,	——	14·30

Cinnabar occurs chiefly in beds; and is sometimes accompanied by mercury amalgam at others, only by quartz and calcite. It is sometimes found in veins, along with iron ores.

It occurs in beds in gneiss, at Richenaw in Upper Carinthia, and at Hartenstein in Saxony; also at Dumbrawa in Transylvania, in greywacke. It is found included in irregular veins, situated in beds of limestone, at Harmagor, Windisch-Kappel, and at other places in Carinthia, but particularly at Neumarktel in Carniola in the Palatinate, and at Almaden in Spain. At Idria, it occurs in beds of bituminous shale, with bitumen and dark grey sandstone, associated with limestone. Other localities are Schemnitz, Cremnitz, and Rosenau in Hungary, at Horzowitz in Bohemia, in the Erzberg, near Eisenerz in Stiria. The hepatic cinnabar has been found only at Idria; the bright-red cinnabar at Wolfstein in the Palatinate. Cinnabar likewise abounds in Mexico and Peru, in China and Japan.

It is found abundantly at New Almaden, in a mountain to the south of San José, between the bay of Francisco and Monterey. The produce of New Mexico for the first six months of the present year has been 836,100 lbs. of mercury, the principal portion of which is sent to Mexico and China.

This ore is the source of the mercury of commerce.

Sp. 10. GREENOCKITE, *Brooke* and *Connel.*

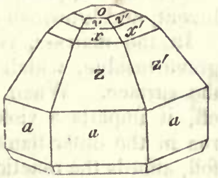
[H.=3·0 ... 3·5. G.=4·9 ... 4·99. In short hexagonal prisms and pyramids. Color and streak honey-yellow.]

Primary form, rhomboid

Secondary form.

Cleavage *o* and *a* semi-transparent to translucent. Lustre adamantine to resinous. Strong double refraction.

Fig. 698.



o on *a*	- 90°	*v* on *v*	- 135° 28
a on *o*	- 120	*x* on *x*	- 139 38
o on *v*	- 154 32	*z* on *e*	- 127 27
o on *x*	- 136 23		

In the matrass, decrepitates and turns red, while hot. B. B., on charcoal, with soda, deposits a red-brown sublimate. Soluble in warm hydrochloric acid, with evolution of sulphuretted hydrogen.

Composition, CdS = cadmium 77·7, sulphur 23·30. Analysis by Connel and Thomson.

Cadmium, - - -	77·30	77·6
Sulphur, - - -	22·56	22·4

Occurs in attached xls. on a porphyritic amygdaloid, at Bishopton in Renfrewshire, Scotland. Named after Lord Greenock, its discoverer.

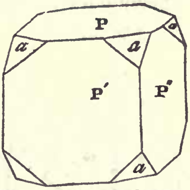
Sp. 11. **Manganblende**, *Breithaupt;* Alabandine, *Beudant;* Manganglanz, *Leonhard;* Schwarzerz, *Hausmann.*

[H.=3·5. . . . 4. G.=3·95 . . . 4·01. In cubo-8-drons and massive, granular. Color, iron-black. Streak dark green.]

Primary form cube.

Secondary form.

Fig. 699.



P on *a*=125° 16′

Cleavage octahedral; traces also of dodecahedral. Twin-xls. Face of composition parallel with *a*. Fracture uneven, imperfectly conchoidal. Opaque. Lustre imperfectly metallic. Acquires a brownish-black tarnish. Slightly brittle. Does not conduct electricity.

In the matrass, is unaltered. In the open tube, emits fumes of sulphur, and becomes greyish-green. B. B., on charcoal, melts with difficulty into a brown slag. With borax gives a reaction of manganese. Soluble in hydrochloric acid, with evolution of sulphuretted hydrogen.

Composition, MnS= sulphur 36·7, manganese 63·3. Analysis, by Arfvedson from Transylvania.

Manganese, - - - - -	62·10
Sulphur, . . . - -	37·

Found in veins, with nagyagite, blende and pyrites, at Nagyag in Transylvania; and in a vein of quartz at Rocinha da Gama in the province of Minas Geraes, Brazil; also in Mexico.

Sp. 12. **Hauerite**, *Hausmann.*

[H.=4·0. G.=3·46. In cubo-8-dral xls. and massive, in spheroidal groups. Color and streak, dark red-brown. Lustre adamantine, inclining to metallic; liable to a dull tarnish.]

Primary form, cube.

Secondary form.

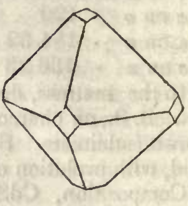


Fig. 700.

Cleavage P, perfect. In very thin plates, translucent, and brownish-red, by transmitted light.

In the matrass, yields sulphur, and leaves a green residue, which B. B., becomes brown on the surface. When all the sulphur is roasted off, it imparts a violet color to salt of phosphorus in the outer flame. With soda, on platinum foil, affords the reaction of manganese. Composition, $MnS^2=$ sulphur 53·7, manganese 46·0. Anaysis by Patera.

Sulphur, . - - -	53·64
Manganese, - - -	42·97
Iron, . - - -	1·30
Silica, - - - -	1·20

Found in clay with gypsum and sulphur at Kalinka near Végles and Altsohl in Hungary.

Sp. 13. **Blende**, Zinkblende, Sphalerite, *Glocker;* Cleiophane, *Nuttall;* Marasmolite, (*S.*). Przibramite, *Huot.*

[H.=3·5 ... 4·0. G.=3·9 ... 4·2. In tetrahedral, 8-dral and dodecahedral xls. and massive. Colors, various; red-brown, the prevalent shade. Lustre adamantine.]

Primary form, cube.

Secondary forms.

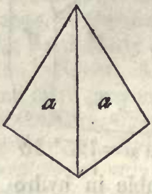


Fig. 701.

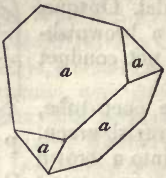


Fig. 702.

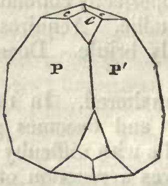


Fig. 703.

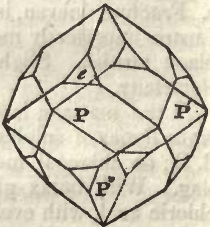


Fig. 704.

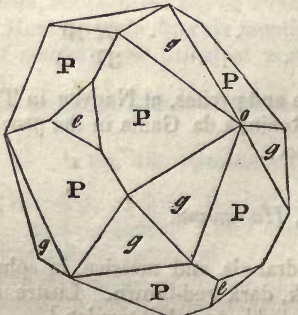


Fig. 705.

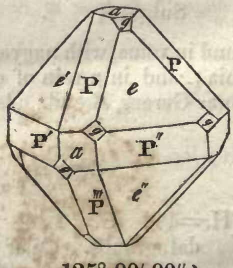


Fig. 706.

P on e - 144° 44′ 08″
g on g - 129 31 18 } Hauy.

P on a - 135° 00′ 00″
a on e - 125 15 52
c on c - 109 18 16 } Hauy.

In fig. 705, four of the obtuse solid angles, are replaced by tangent planes, while the remaining four are unaltered, except that they are formed from six, instead of three plane angles, as may be seen in the angle at *o*.

Cleavage dodecahedral (*P*) very perfect. Fracture conchoidal. Transparent to opaque. Color, green, yellow, red, brown and black. Streak white to reddish-brown. Twin-crystals.

Fig. 707.

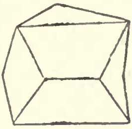
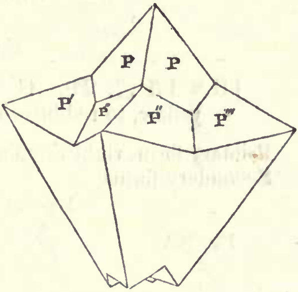


Fig. 708.



Octahedral hemitrope, and repeated as in fig. 708, and sometimes for a number of times. Reniform and other imitative shapes. Surface rough; composition columnar, often almost impalpable; straight, divergent, and frequently producing a second curved lamellar, or granular composition. Massive; composition, columnar, or granular, sometimes impalpable.

Decrepitates violently, when heated. B. B., on charcoal, fuses with difficulty. When strongly heated in the outer flame, deposits an areola of oxide of zinc. With soda, when powdered, it is reduced. Soluble in strong nitric acid, with the exception of the sulphur. Composition, ZnS = sulphur 33, zinc 67. Analyses, *a* fibrous from Przibram by Lowe, *b* white (*cleiophane*) from New Jersey by Henry, *c* from Tuscany (*marmatite*) by Becchi, *d* from Marmato (*marmatite*) by Boussingault, *e* from Middletown, Conn., (*marasmolite*) G.=3·7, by the author.

	a	*b*	*c*	*d*	*e*
Sulphur, -	33·15	32·22	33·65	76·8	38·65
Zinc, - -	61·40	67·46	48·11		49·19
Iron, -	2·29	——	16·23	FeS 23·2	12·16
Cadmium, -	1·50	trace	trace		

One of the most widely distributed and abundant species of the order. It occurs in beds and veins, and accompanied by galena, chalcopyrite, barytes, calcite, fluor and quartz. It also occurs in silver veins, with silver and other ores of this metal.

The localities are too numerous to be mentioned. Finely crystallized varieties are found in the lead region of Cumberland in England, at Schemnitz in Lower Hungary, and at Kapnik in Transylvania. It is abundant in the region of Southampton, Mass. in the lead veins, and at Middletown, Conn.; in the great lead district of the Western States, and at the localities of galena generally, throughout the United States.

APPENDIX TO ORDER BLENDE.

Rittingerite, Zippe. In small xls. Primary form, oblique rhombic prism. M on M=126° 18′. H.=1·5 ... 3·0. Lustre submetallic, adamantine. Color, blackish-brown to iron-black. Translucent and dull honey-yellow to hyacinth-red, in the direction of the axis. Streak orange-yellow. Brittle. B. B., fuses very easily, yielding an arsenical odor, and finally a globule of pure silver. Probably a compound of sulphide of silver and sulphide of antimony. From Joachimsthal. Breithaupt considers it to be identical with xanthocone.

CLASS III.

ORDER I. SULPHUR.

Sp. 1. SULPHUR.

[H.=1·5 ... 2·0. G.=2·0 ... 2·1. Xls. and massive. Color, yellow, to red-brown and grey. Sectile, or slightly brittle.]

Primary form, right rhombic prism. M on M=101° 46.
Secondary forms.

Fig. 709.

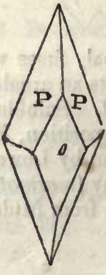


Fig. 710.

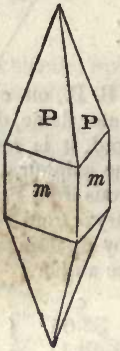


Fig. 711.

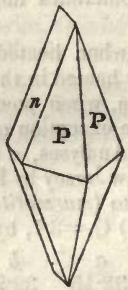


Fig. 712.

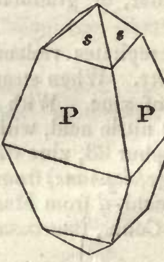
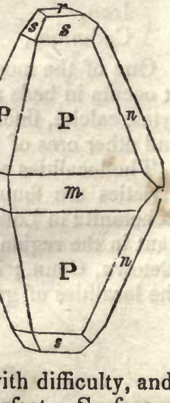


Fig. 713.



P on P	-	106° 38′
P on P over *n*	-	84 58
s on *s*	-	127 1
n on *n*	-	124 24
m on *m*	-	101 59
P on P over *m*	-	143 26
s on *r*	-	179 45

Cleavage, parallel with P and *m* imperfect, obtained with difficulty, and interrupted. Fracture conchoidal, sometimes highly perfect. Surface *n* commonly rough, the rest of the faces generally smooth and shining, possessing nearly the same physical quality.

Lustre resinous. Color, several shades of sulphur-yellow, inclining sometimes to red or green. Streak sulphur-yellow, passing into white. Transparent . . . translucent on the edges.

Compound varieties. Twin-crystals: axis of revolution perpendicular, face of composition parallel to a face of *r*. Imbedded globules: surface uneven; composition impalpable, often impure. Massive: composition, granular, often impalpable, strongly coherent; fracture uneven, even, flat conchoidal. Sometimes pulverulent.

Sulphur as it occurs in nature is pure, or is only mixed with bitumen or clay. It acquires resinous electricity by friction, is easily inflammable, and burns with a blue or white flame, and a pungent smell of sulphurous acid. It is insoluble in water, but when heated, unites readily with potash or soda. It may be obtained crystallized by sublimation, or still more easily from solutions in liquids. The forms of sulphur, crystallized from fusion, are incompatible with those of the present species. They are generally oblique rhombic prisms of 90° 32′, the terminal face of which is inclined to the obtuse edge of the prism, which is itself commonly replaced at an angle of 95° 46′. It occurs almost always in regular compositions. The crystals are at first transparent, but they soon become opaque.

Sulphur is generally met with in beds of gypsum, or in the accompanying strata of clay. It is associated with calcite and with celestine. It occurs in veins with chalcopyrite, galena and orpiment. It is deposited from several springs, and in large quantities from volcanos; sometimes it occurs in beds of bituminous coal.

Sulphur is found in splendid crystals and pure massive varieties; also, in globular concretions, (which however, are seldom without earthy or bituminous admixtures) in Sicily, and several provinces of Italy. It occurs in imbedded spheroidal masses of a brown color, which is owing to bitumen at Radoboy, near Crapina in Croatia. Near Cracovia in Poland, it is likewise met with, more or less in pure massive varieties and small crystals. The finest crystals, excepting those from Sicily, come from Cadiz in Spain. Small crystals have been observed investing the brown coal from Artern in Thuringia. It occurs in veins in Swabia, in Spain and in Transylvania. The earthy sulphur is found in Poland, in Moravia, and other countries; the volcanic sulphur in Iceland, near Vesuvius, in Milo and several islands of the Grecian Archipelago; in great profusion near the volcanos of Java and the Sandwich Islands. Sulphur also occurs in Savoy, in Piedmont, in Switzerland, at Lauenstein in Hanover, in South America, and many other countries.

Sulphur is said to occur in California. In very minute xls. it presents itself, in cavities of decomposing pyrites at many places in the gold regions of the Southern States; also at Green River, Henderson Co., N. Car., where an extensive vein or stratum of this ore exists, immediately contiguous to the decomposing granite in which the zircon is so largely found.

Sp. 2. SELENIUM, *Del Rio*.

[H. =2·0. G.=4·3. In incrustations of a submetallic lustre, and a greyish or brownish-black color. Translucent and red, in thin splinters. Brittle. Powder deep-red.]

Found at Culebras in Mexico.

*SULPHOSELENITE, (*S.*) Selensulphur. Massive. Color, orange-red. B. B., on charcoal, burns readily, with fumes of selenium and sulphur. Occurs at Vulcano, one of the Lipari Islands, and at Kilauea, Hawaii.

Order II. RESIN.

Sp. 1. Bitumen, Naphtha, Naphte, Mineral Oil, Seneca Oil, Erdöl; Steinöl, Brewsterline, Cryptoline, *Dana.*

[G.=0·7 . . . 0·8. Liquid; yellowish-brown; translucent; unctuous to the touch. Odor aromatic, bituminous.]

Boils below 212° and burns with a bright flame. Composition, (when pure) C^6H^5. Analysis, by Dumas, carbon 86·40, hydrogen 12·70.

Oozes either alone, or with water from the soil, or from clefts in certain rocks. Frequent at Kenhawa, Va., Scotsville, Ky., Oil Creek in Venango Co., Pa., Duck Creek, in Monroe Co., and at Liverpool, Ohio. It was formerly collected by the Seneca Indians, and is hence called Seneca or Genesee Oil. At Inniskillen, Canada West, the inspissated naphtha has been found, in places, to be two feet in depth.

It has been used both for fuel and light: in Persia and Burmah also, as a lotion in cutaneous diseases, and an embrocation in bruises and rheumatism. It is made use of in the manufacture of varnishes, and as a substitute for linseed oil in the formation of paints. The Egyptians employed it in embalming. *Brewsterline* and *cryptoline* of Dana, are two transparent fluids, found by Sir D. Brewster in the cavities of crystals, of topaz, chrysoberyl and quartz; and appear to be modifications of the present species. The former expands ¼th its size, by an increase above 50°, of 30° F. in temperature: it was sometimes indurated in the cavity, like resin; but on exposure leaves a residue of minute particles, which from the moisture of the hand alone, suddenly become fluid, extend and contract, the residue being volatile by heat and dissolving in acids, without effervescence. The cryptoline though in the same cavity, does not mix with the brewsterline. On exposure, it quickly hardens into a yellowish, non-volatile resin, insoluble in water or alcohol, but rapidly soluble with effervescence in acid.

Sp. 2. Scheererite, *Stromeyer;* Branchite, *Savi.*

In minute acicular xls. and crystalline grains, filling crevices in brown coal. Soft: unctuous. G=1·0 . . . 1·2. Fracture conchoidal. Lustre resinous. White, to grey, yellow and green. Transparent to translucent.

Tasteless. When heated, emits a faint aromatic odor. At 111° F. melts; the drops staining paper, but the spots disappearing on heating the paper. It boils at 197½°. On cooling, the mineral crystallizes in slender four-sided prisms. It takes fire easily, and is completely consumed, evolving much smoke and a feeble aromatic odor. Composition, according to Prinsep, carbon 73, and hydrogen 24.

Found at Uznach near St. Gallen, Switzerland. The *branchite* is colorless and translucent, fuses at 167°, but does not crystallize on cooling. G.=1·0. Dissolves in alcohol. Found in the brown coal of Mt. Vaso in Tuscany.

Tekoretin and *Phylloretin* of Forchammer, are resinous bodies, found in fossil-wood in Denmark. The former is crystallized, and fuses at 45° C.

It dissolves in ether, slightly in alcohol, and consists of $C^{10}H^{9}$=C 87·19 and H 12·81. Phylloretin fuses at 86—87° C, dissolves easily in alcohol; and appears to have the composition of $C^{8}H^{5}$.

Fichtelite, Bromeis. In crystalline folia and grains; fuses readily at 46° C, and becomes crystalline on cooling; slightly soluble in alcohol, easily so, in ether. Composition, (Bromeis) $C^{4}H^{3}$=C. 83·9; H 11·1. Found in the Fichtelgebirge.

Konlite, Schrötter. In crystalline scales. Soft. G.=0·88. Fuses at 107—114°C. Slightly soluble in alcohol; more so, in ether. According to Schrötter, is composed of $C^{2}H$=C 92·429, H 7·571. From near Redwitz, Bavaria in the Fichtelgebirge.

Konleinite, Kenngott. In thin plates, soluble in ether and alcohol. Soluble in sulphuric acid, but little so, in nitric, and not at all, in hydrochloric acid. Partly soluble in ammonia and in oil of turpentine. From the brown coal of Fossa in the Eger valley.

Sp. 3. Elaterite, *Hausmann;* Mineral Cauotchouc, Elastic Bitumen.

In soft, flexible, slightly elastic masses. G.=0·9 . . . 1·23. Lustre feebly resinous. Color, blackish-brown, of various shades. Sub-translucent. Analysis, from Derbyshire, by Johnston;

Carbon, - -	85·47	84·39	88·67	85·96	86·18
Hydrogen, - -	13·28	12·58	12·54	12·34	12·42

Found at the Odin mine at Castleton in Derbyshire, at Neuchatel, on the Island of Zante, at Montrelais near Nantes France, and at Woodbury, Conn.

Sp. 4. Hatchettine, *Conybeare;* Mineral Tallow.

H.=1·0. G.=0·60 (after fusion G.=0·98.) In masses resembling wax or train-oil. Translucent. Lustre slightly pearly. Yellowish-white, with a tinge of green. The specimens from Loch-Fyne, melt at 47°C; those from Methyr-Tydvil, at 76·6° C. Emits a bituminous odor, when heated. Partially soluble in ether, having a viscous, inodorous residue. Analysis, by Johnston;

Carbon, - - - - -	85·91
Hydrogen, - - - -	14·62

Besides the locality in Wales, it occurs at Inverary in Scotland.

Sp. 5. Hartite, *Haidinger.*

H.=1. G.=1·04. In crystalline masses, resembling wax, but having the form of oblique rhombic prs. of about 100°. Cleavage, only in traces. Lustre somewhat greasy. Color, white. Translucent. Brittle. Sectile.

At 74° C melts into a clear liquid. When heated, emits the odor of amber. Burns with much smoke. Readily soluble in ether; less so, in alcohol. Analysis by Schrötter;

Carbon, - - - -	87·47	87·50
Hydrogen, - - -	12·05	12·10

Found in clefts in brown coal and fossil wood, at Oberhart near Gloggnitz in Austria.

Hartine, Schrötter; *Psathyrin*, Glocker. Resembles the above; but crystallizes from a solution in naphtha, in needles. Color, white; without taste or odor. Fuses at 210° C, and distils at 260° C. Composition, according to Schrötter, $C^{20}H^{17}O^{2}$=C 78·26, H 10·92, O 10·82. From the brown coal of Oberhart, Austria.

Butyrite, Glocker, *Bogbutter* of Williamson, from an Irish peat swamp, fuses at 51° C, dissolves in alcohol and contains C 75·05, H 12·56, O12·39.

Irolite, Haidinger. H.=1. G.=1·008. Amorphous. Lustre greasy. Color, hyacinth-red. Pulverizes in the fingers. Thin fragments, subtranslucent. Fracture imperfect conchoidal. Softens at 76° C. (169° F.) but is still tenacious at 212° F; and hence its name, from ἰξός and λύω, to *dissolve.*

From Oberhart.

Ozocerite, Erdwachs, Rammelsberg. G.=0·94 . . . 0·97. Like a resinous wax, structure sometimes foliated. Color brownish-yellow by transmitted light, leek-green by reflected light,. Odor, pleasant. Fuses at 62° C.–84° C.; boils at 210° C.–300° C. Distils, without decomposition. No change in strong acid, and very little in hot alcohol. It is supposed to contain several distinct chemical compounds. Analysis, *a* from Moldavia by Magnus, *b* from Moldavia by Schrotter, *c* from Urpeth, Newcastle, by Johnston.

	a	*b*	*c*
Hydrogen, - -	15·15	13·78	14·06
Carbon, . -	85·75	86·20	86·80

Occurs in a sandstone of the salt formation in Moldavia, at Gresten near Gaming in Austria, and at Truskawiez in Galicia.

Chrismatine, Germar, is yellowish or oil-green, shining, translucent; unchanged at 68° to 78° F, but softens at 55 to 60° R. Burns with flame, without smell. Found at Wettin near Halle, Prussia, in a red argillaceous sandstone of the coal formation.

Sp. 6. IDRIALITE, *Schrötter*; Idrialine, *Dufrénoy.*

Unctuous. H.=1·0 . . . 1·5. G.=1·4 . . . 1·6. Fracture uneven. Color greyish-black, brownish-black to reddish-brown. Opaque. Streak brown, shining. Sectile.

Melts between 250 to 300° C. In the matrass, sublimes, and is deposited in bright, iridescent scales. Inflammable. Soluble in hot oil of turpentine, olive-oil, ether, acetic acid, and in kreosote. The solutions on cooling, deposit it, in greenish, yellow, pearly, crystalline scales. Analyses, *a* by Dumas, *b*, *c* by Schrötter, *d* by Bödeker:

	a	*b*	*c*	*d*
Carbon, - -	94·9	95·50	94·80	91·83
Hydrogen, -	5·1	5·19	5·99	5·30
Oxygen, - -	——	——	——	2·87

Found intermixed with cinnabar, in thin layers in slate, in the mercury mines of Idria.

Sp. 7. GUYAQUILLITE, *Johnston;* Berengalite, *Johnston.*

Soft. G.=1·092. Amorphous. Opaque. Bright yellow.

At 69·5° C. melts, and at 100° C. is perfectly liquid. After cooling, is viscous, translucent, and has a resinous lustre. Soluble in alcohol, forming a yellow, intensely bitter solution. Analysis by Johnston.

Carbon, - - -	76·67	77·35
Hydrogen, - - -	8·17	8·20
Oxygen, - - -	15·16	14·45

Found at Guyaquil in S. America. The *berengelite* has a conchoidal fracture, a resinous lustre, a dark brown color, inclining to green. Streak yellow. Taste bitter. Melts below 100° C., and remains soft. Unctuous. Soluble in alcohol and in ether, forming bitter solutions. Analysis, by Johnston;

Carbon, - - -	72·47	72·34
Hydrogen. - - -	9·20	9·36
Oxygen, - - -	18·33	18·30

Found in large masses, in the province of St. Juan de Berengela of S. America.

*WALCHOWITE, *Schrötter.*

H.=1·5...2·0. G.=1·03...1·06. Amorphous. Fracture conchoidal. Translucent. Lustre fatty, yellow to brown. Streak yellowish white. Brittle at 140° C. becomes elastic, at 250° C. melts into a yellow oil. Burns with a smoky flame and an aromatic odor. Soluble in 67 of alcohol and in 13 of ether. Analyses by Schrötter:

Carbon, - - -	80·30	80·19	80·70
Hydrogen, - .	10·68	10·74	10·62
Oxygen, - - -	9·02	9·08	8·68
Nitrogen, - -	0·18	0·18	0·18

Found in brown coal, at Walchow in Moravia.

Sp. 8. RETINITE, *Leonhard;* Retinasphaltum, *Hatchett.*

H.=1·0...2·0. G.=1·05...1·20. Amorphous. Fracture conchoidal. Semi-transparent to opaque. Yellow, brown and grey. Streak yellowish brown. Brittle. Acquires resinous electricity by friction.

Burns with a flame, attended by an aromatic smell. Analysis, *a* from Bovey by Hatchett, *b* from Halle by Bucholz, *c* from Cape Sable by Troost, *d* from Bovey by Johnston;

	a	*b*	*c*	*d*
Resin, soluble in alcohol,	55	91	55·5	59·32
Matter, insoluble in do.,	41	9	42·5	27·45
Earthy matter,	3	—	15	13·23

It is found in brown coal, common coal, and also in peat.

Sp. 9. Asphaltum, Mineral Pitch.

H=2. G.=1·0 . . . 1·2. Amorphous. Fracture conchoidal. Black to brownish black. Streak brown. Opaque. Acquires resinous electricity by friction. Odor bituminous. Fuses at 212° F. and burns with a bright flame, leaving a small quantity of ashes. Analyses, *a* from Auvergne by Ebelman, *b* from Peru by Boussingault;

	a	*b*
Carbon, - - -	76·13	88·63
Hydrogen, - -	9·41	9·69
Oxygen, - - -	10.34	1·68
Nitrogen, - -	2·32	
Ash, - - -	1·80	——

Found at Limmer in Hanover, and near Munster, at Soult, Lobsann, Bechelbrunn, on the Rhone, in Val Travers in Neuchatel, the Dead Sea, in Cornwall, Haughmond hill in Shropshire; but most abundantly at Trinidad; where, according to Manross, it covers a lake one and a half miles in circuit, the bitumen being cold and solid near the shores, but gradually increases in temperature and softness, towards the centre, where it is boiling. The ascent to the lake from the sea, a distance of three quarters of a mile, is covered with bitumen, upon which trees and vegetables flourish, and about Point La Braye, the masses of bitumen look like black rocks, as seen through the foliage. The lake is underlaid by a bed of mineral coal.

An earthy variety of bitumen found abundantly at Torbane, near Edinburg, Scotland, and in other countries, is possessed of very great value for giving origin to illuminating gas. It has been called the *Torbane mineral.* It is the *melanasphalt* of Wetherell, or the Albert coal of Nova Scotia. It is less fusible than pure asphaltum, and is partially soluble in the menstrua which dissolve asphaltum. It contains from 58 to 61 p. c. of volatile matter. Dr. Wetherill found that 4 parts were soluble in ether, and 30 in oil of turpentine.

Sp. 10. Copaline; Fossil Copal.

H.=2·5. G.=1·04. Resembles the resin copal, in color, lustre, transparency and difficult solubility in alcohol. When heated, emits an aromatic odor; and at a higher temperature volatilizes and burns with a yellow flame and much smoke, leaving little or no residue. Analyses, *a* and *b* from Highgate by Johnston, *c* from the East Indies by Duflos.

	a	*b*	*c*
Carbon, - -	85·41	85·68	85·73
Hydrogen, - -	11·70	11·48	11·50
Oxygen, - -	2·67	2·89	2·77
Ash, - -	0·03	——	——

Found in the blue clay near London, and near Mount Lebanon in Syria, where it is collected for the purposes of illumination, and goes by the name of *candle-stone.*

Sp. 11. Amber, Succinite, *Breithaupt;* Bernstein, *Succin.*

H.=2·0 . . . 2·5. G.=1·08. In irregular grains and spheroidal masses. Cleavage, none. Fracture conchoidal. Surface uneven and rough.

Lustre, resinous. Color, yellow, passing into red, brown and white. Streak, white, transparent to translucent. Not very brittle. Resinous electricity evolved by friction.

Burns readily with a yellow flame emitting an aromatic smell, and leaving a black, shining, coaly residue. Fuses at 289° C. Soluble in alcohol. Composition, $C^{10}H^{8}O$= carbon 78·96, hydrogen 10·51, oxygen 10·52. Analysis, *a* by Drapier, *b* by Schrötter;

	a	*b*
Carbon, - .	80·99	78·824
Hydrogen, - - -	7·31	10·228
Oxygen, - -	6·73	10·9
Lime, - - -	1·54	——
Alumina, - -	1·10	——
Silica, - - -	0·63	——

The vegetable origin of amber is now fully established. According to Prof. Goeppert, it is derived from at least eight species of plants, besides the Pinites succinifer. He detects the remains of 163 species of plants imbedded in the substance of amber; the fragments of a large number of insects are also present.

It occurs in beds of bituminous and brown coal, as well as in various parts of the green sand, of the tertiary formation. The principal supply is from the Prussian borders of the Baltic sea, where it is collected for the government, immediately after storms, which loosen it from its bed and throw it on shore. It is likewise found on the coast of Denmark, Spain, Sicily, Greenland, China, and other countries. Besides, it exists in clay near Paris, France; and with coal, in the departments of l'Aisne, du Gard, and du Bas Rhin. In England near London, and on the coast of Norfolk, Essex and Suffolk; it is found near Catania in Sicily, where it sometimes exhibits a peculiar blue tinge of color. In the Royal Museum at Berlin, there is a mass weighing 14 lbs.; and another still larger is known in Ava, India, which is traversed by veins of calcite.

It is valued for ornamental purposes, and in the fabrication of varnish, as well as for the production of succinic acid and the oil of amber.

Sp. 10. MELLITE, *Hauy*; Honey-Stone, Honigstein.

[H.=2·0 . . . 2·5. G.=1·55 . . . 1·65. In flat 8-dral xls.; inclination of upper to lower pyramid=93° 6′.]

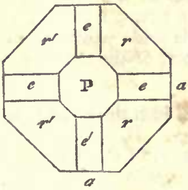
Primary form, right square prism.

Secondary forms.

Fig. 661.

r on *a*	-	120° 58′
r on *r*	-	118 04

Fig. 662.



P on *e*	-	143° 16′
e on *a*	-	126 44
e on *e*′	-	129 58
r on *r*′	-	118 14
r on *r*″	-	86 54

Cleavage parallel with *r* very difficult. Fracture conchoidal. Surface of P and *e* rough and curved: the others smooth and shining.

Lustre resinous, inclining to vitreous. Color, honey-yellow, inclining to red or brown. Streak white. Transparent to translucent. Sectile. It also occurs in small massive nodules and angular grains.

In the matrass, yields water, and carbonizes, without emitting any perceptible smell. B. B. on charcoal, burns white, leaving nothing but alumina. Soluble in nitric and in hydrochloric acid, and in caustic potash. Composition, HC^4HO^3+18HO = mellitic acid 40·31, alumina 14·35, and water 45·34. Analysis, by Wöhler:

Mellitic acid, - - - -	41·4
Alumina, . - - - -	14·5
Water, - - - -	44·1

Found in imbedded xls. in beds of brown coal at Artern in Thuringia, Lauschitz near Bilin in Bohemia, and at Walchow in Moravia.

* * *

APPENDIX TO ORDER RESIN.

Dinite, Meneghini. A crystalline aggregate, resembling ice, with a yellowish tinge. Without odor, or taste. Fragile. Insoluble in water; very soluble in ether, and in bisulphide of carbon; little soluble in alcohol. The etherial solution on standing, deposits large crystals of the dinite. Melts with the warmth of the hand; heated in a close vessel, distils over, without suffering decomposition. When melted, resembles a yellowish oil; on cooling, crystallizes in large transparent crystals. Found by Prof. Dini in lignite, at Lunigiana, Tuscany.

Dopplerite. G. = 1·089. In thin plates. Color brownish black. Streak dull brown. Lustre resinous to vitreous. When in thin plates, reddish brown, by transmitted light. Becomes elastic, on exposure to the light. Heated to 100° C., loses 78·5 p. c. of water. Composition $C^8H^5O^5$. According to Schrötter, a homogeneous peaty substance, from whose cellulose, two parts of water are removed. It resembles a black pitch. On treating the fresh mineral with potash, ammonia is given off. Named after M. Doppler. Occurs near Aussee, in Styria.

Piauzite, Haidinger. An earthy, laminated resin. Color brownish black. Streak yellowish brown. H. = 1·5. G. = 1·22. Fuses at 315° C. (600° F.), and burns with an aromatic odor and much smoke, leaving 5·96 p. c. of ash. Soluble in ether and caustic potash, also in absolute alcohol. Heated in a glass tube, a yellowish oily fluid volatilizes, having an acid reaction. Occurs in brown coal at Piauze, near Neustadt in Carniola.

Pyropissite, Kenngott. Massive. Forms a seam from six to eight inches thick, in brown coal. Fracture earthy; color dull yellowish brown. Opaque. Streak shining and greasy. Unctuous. Burns readily, with a brownish yellow flame, and a weak aromatic odor. Heated, fuses to a pitchy, porous mass, soluble in oil of turpentine, and slightly so in alcohol. Burns like bitumen. Soluble in sulphuric acid; slightly so, in hydrochloric, or nitric acid. According to Marchand, affords on distillation, 62 p. c. of paraffine, one pound of the mass giving three cubic feet of illuminating gas. Occurs at Weissenfels.

Pyroretin, Reuss. In plates, an inch thick, and in nodules. Brittle, brownish black. Lustre resinous. Unctuous. H. = 2. Streak dull wood-brown. When heated, it blackens and melts at 212° F.; but on cooling forms a pitchy mass. Burns with a reddish yellow flame, with a smell like amber, and leaving a coaly residue. Dissolves in hot alcohol, and is deposited again on cooling. Analysis by Staněk, carbon 80·02, hydrogen 9·42, oxygen 10·56. Found in the brown coal of Aussig, Bohemia.

Scleretinite, Mallet. In small oval masses, from the size of a pea to that of a hazel-nut. H. = 3. G. = 1·136. Color black, but red-brown by transmitted light. Streak cinnamon-brown. Lustre vitreous to resinous, rather brilliant. Translucent in thin splinters. Brittle; fracture conchoidal. Heated in platinum foil, swells up, burns like pitch, with a disagreeable, empyreumatic smell, and a smoky flame, leaving a coal, rather difficult to burn, and finally, a little gray ash. In a glass tube, yields a yellowish brown, oily product of a nauseous, empyreumatic odor. Insoluble in water, alcohol, ether, caustic and carbonated alkalies, or dilute acids; and even strong nitric acid acts slowly. Composition $C^{10}H^{7}O$ = carbon 77·05, hydrogen 8·97, oxygen 10·28. Analysis, by Mallet:

Carbon,	76·74	77·15
Hydrogen,	8·86	9·05
Oxygen,	10·72	10·12
Ash,	3·68	3·68

Occurs in the coal formation of Wigan England, and appears to be identical with pyroretin.

ORDER III. COAL.

Sp. 1. COAL, Anthracite, Glance-coal, Mineral Carbon, Bituminous Coal, Brown Coal, Jet.

H.=1·5 . . . 2·5. G.=1·2 . . . 1·42. No regular form or structure: sometimes dividing easily by cleavages into cubical or prismatic fragments. Fracture conchoidal. Color, mostly black, sometimes inclining to greyish or brown. Some varieties exhibit tarnished colors. Opaque. Sectile in different degrees. Not very brittle. G. of common Newcastle and Pittsburg coal = 1·27, of bituminous wood = 1·28, of Cannel coal = 1·43, of Pennsylvania anthracite = 1·8, of Rhode Island = 1·26, of Welch = 1·36.

There are three leading varieties of coal, which are generally known under the names of *anthracite*, (a dry, non-bituminous coal,) *common* or *bituminous coal* and *brown coal*. This last is of a brown color, and exhibits the structure of wood more distinctly than the others. It occurs moreover in the tertiary formations, and in alluvion. The following table illustrates some of the most important facts connected with the chemical composition of the three kinds.

	Fixed carbon.	Volatile combustible matter.	Water.	Ash.
Penn. anthracite,	87·45	3·84	1·34	7·37
" "	90·45	4·88	——	4·67
Maryland bituminous coal,	73·01	15·80	1·25	9·84
Virginia "	50·99	36·63	1·64	10·74
Indiana "	58·44	33·99	2·20	4·97
Pittsburg, Pa., "	64·72	32·95	——	2·31
Newcastle, carbon,	87·95	Hyd., 5·24	O & N 5·41	1·40
Lancashire, "	83·75	" 5·66	" " 8·04	2·55
Elbogen brown coal, "	73·79	" 7·46	" " 13·79	4·96

For additional information respecting the chemical history of coal, and for a general survey of its most important localities, reference may be had to the subjoined notes, taken from Schoedler and Medlock's Book of Nature and from Dana's Mineralogy.*

"The formation of *brown coal* (a species of coal which occurs in many parts of Germany) is ascribed to a period anterior to the history of the human race. More or less large masses of wood have been suddenly buried, or gradually concealed and changed in appearance, by the constant accumulation of earthy deposits. Brown-coal pesents the remarkable transition-process between ordinary coal and mere wood; and this, of course, differs according to the circumstances under which the coal has been formed. In brown-coal are found stems, with the woody annular rings quite apparent; also seeds, leaves and bark. Some specimens of this formation, on the contrary, are earthy, or black and solid, affording no indications of a ligneous or vegetable origin. The brown coal, the name of which is derived from its color, has considerable density, acquired by the pressure of the mass of earth under which it has been formed. We can form an idea of this enormous pressure from the fact, that trunks of trees originally cylindrical, have been flattened and pressed into an ellipti-

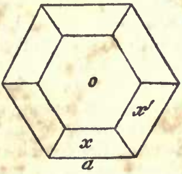
Sp. 2. GRAPHITE, Plumbago, Black-lead.

[H.=1·0 . . . 2·0. G.=2·08. Rarely in hexagonal tables; usually in scales, massive and granular. Color, iron-black. Streak, black, shining. Opaque.]

Primary form, rhomboid.

Secondary form.

Fig. 604.



Cleavage, parallel with *o*, which face is striated triangularly, parallel to the alternate terminal edges: Lustre metallic; the highest degrees on plane *o* and the perfect faces of cleavage. Sectile. Thin laminæ are highly flexible. When the composition is fine granular, or compact, the fracture becomes conchoidal. B. B., infusible, but burns very slowly, leaving a slight residue of oxide of iron. Composition, carbon, mixed with a variable quantity of iron, amounting in some instances, to 10 p. c. In some less

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cal shape. This kind of coal is an excellent fuel, though sometimes associated with sulphide of iron, which gives to it a disagreeable odor when burned.

"The origin of our common coal must be ascribed to a still earlier period. This, as well as brown-coal, is undoubtedly of vegetable origin, being formed from stems of trees and other ligneous matter. But these, in a long series of years, and by constant pressure, have been so much altered, that, for a long time, the vegetable origin of coal was doubted. This doubt, however, has been removed, on the one hand, by the fact, that turf and brown-coal form a transition-series between the vegetable matter and common coal; and on the other hand, by the circumstance that different remains of stems of well-known forms of vegetables have been discovered. The microscope also plainly reveals the cellular structure, even in the most solid coal.

"The difficulty of accounting for such astonishing masses of coal, sometimes found in layers of 40 feet thick, is still unresolved. It is certain that the carbonization of such enormous masses of wood must have been a process of many thousands of years' duration.

"Coal is compact, black and shining. Its specific gravity is 1·3, and if compared with the density of wood and of charcoal, it becomes evident, that the same bulk of coal contains a far larger quantity of combustible matter. On this account it is an excellent fuel, but being denser, it is more difficult to kindle; and requires a greater supply of air to keep it in combustion, than either wood or charcoal.

"We are not, however, entitled to consider coal as pure carbon. It always contains oxygen, hydrogen, and a small quantity, viz., from 1 to 2 per cent. of *nitrogen.* Moreover we meet with certain mineral constituents, particularly *sulphur* in combination with iron. It is evident that the dense superincumbent mass of earthy matter in the carbonaceous strata has prevented their complete carbonization. The carbonization, however, can be accomplished by a process analogous to that used in the carbonizing of wood. In this process the sulphur, which is so prejudicial to the use of coal, is in the mean time separated from it: the product obtained is called *coke.* As this material, with the exception of its mineral constituents, consists entirely of carbon, and possesses a great density, it forms the most valuable of all fuels, when a high degree of heat is required in a small space. Hence it is almost exclusively employed in generating steam in locomotives. Coke has a grey, shining, almost metallic, sometimes a slaggy, appearance, and is so dense that it sounds, when struck with a hard body. Coal is found under a great variety of aspects, and of very unequal composition and quality, as the subjoined tabular view shows very conspicuously. It is evident that it is of less value, the more mineral, and consequently incombustible, material it contains. The different kinds of coal, when pulverized and heated, comport themselves in three ways. They either swell up and finally cake together, and are therefore distinguished as *caking-coal,* this kind being particularly adapted for forges and for gas-lighting: or the particles of pulverized coal, sinter together, and this coal is therefore called *sinter-coal;* whilst the so-called pure varieties, small proportions of silica, alumina, lime and oxides of titanium and copper are present.

Found in beds in gneissoid, slaty and ancient hornblendic rocks. It sometimes replaces mica and talc in certain rocks, particularly in rather

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sand-coal remains powdery. The latter is much less valuable than the other varieties. One of the best kinds of coal occurring in England is the *cannel*, or *candle-coal*, which burns with a beautifully clear flame, hence its name. This property and the applicability of coal for gas-lighting depend chiefly on the amount of *hydrogen* it contains.

" Now that we have become acquainted with wood, turf, brown-coal and coal, we will subjoin some general considerations in reference to the value of these various combustibles, as materials for fuel. All our modes of obtaining artificial heat, depend on the combination of carbon and hydrogen with oxygen, which produces the phenomena of combustion.

" Hence it may be stated as a rule, that those bodies which contain in an equal weight, the largest quantity of unoxidized carbon and hydrogen are the most valuable fuels. In 100 lbs. of green wood we have only 20 lbs. of carbon, while 100 lbs. of dry wood contain 40 lbs.

"The heat which fuel yields is entirely dependent on the manner of its combustion, since equal weights of coal under similar circumstances, when perfectly consumed, yield an equal supply of heat. A perfect combustion, however, is such, wherein no particle of carbon escapes without being converted into the highest oxygen compound, namely, carbonic acid.

" An evident loss of heat is experienced in every furnace from which unconsumed gas and vapor, in the form of smoke, or inflammable gas (carbonic oxide, which burns with a blue flame), escapes into the atmosphere.

" In the use of fuel the following points are of importance, viz., the quantity of carbon, hydrogen, water, and mineral substances which they contain; then the density; and finally, the most perfect combustion by a sufficient draught of air.

Dried at 100° C. (212° F.)	Density.	100 parts, by weight, contain			
		Carbon.	Hydrogen.	Oxygen.	Mineral Constituents.
Charcoal, - - - - -	0·187	99·07	—	—	0·03
Coke, - - - - -	1·08	95	—	—	to 5·
Caking-coal, - - - -	1·28	87	5	5	1·3
Cannel-coal, - - - -	1·31	67	5	8	2·5
Brown-coal (best quality), -	1·37	66	4·8	18	2·7
Turf (best quality), - -	—	58	5·9	31	4·6
Brown-coal (ligneous), -	1·27	51	5	30	1·29
Beech-wood, - - - -	0·728	49	6	44	—
Ditto (dried in the air), -	—	40	—	—	—

"The above table clearly shows that the proportion of oxygen decreases in the same ratio as we proceed towards older carbonaceous formations; whilst in wood we find 44 per cent. of oxygen; the quantity in many kinds of coal decreases to about 5 per cent."—*The Book of Nature,* p. 310.

" The beds of coal occur interstratified with clay slate, and sandstone, or grit rock, forming distinct layers, varying from a fraction of an inch to 30 feet or more in thickness. In the United States, the anthracites occur east of the Alleghany range, in rocks that have undergone great contortions and fracturings, while the bituminous are found farther west in rocks that have been less disturbed; and this fact and other observations have led some geologists to the view, that the anthracites have lost their bitumen by the action of heat.

" Extensive beds of mineral coal occur in Great Britain, covering about one-tenth the whole area, or 11,859 square miles; in France; in Spain; in Belgium, covering one-twenty-second the whole area, or 518 square miles; in Netherlands, Prussia, Bavaria, Austria, Northern Italy, Silesia, Spain, Russia on the south near the Azof.

old beds of granular limestone It likewise occurs in rocks as new as the coal formation. A very remarkable deposit of graphite is found in greenstone trap, at Borrowdale in Cumberland, and another at Craigman in Ayrshire, in the coal formation. It abounds in Ceylon, in Greenland, in Germany, France and Spain. The most productive region for its occurrence in the U. States, is northern New York, in the counties bordering

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It is found in Asia, abundantly in China, in Persia in the Cabul territory, and in the Khorassan or Northern Persia, in Hindoostan, north of the Gulf of Cutch, in the province of Bengal (the Purdwan coal field) and Upper Assam, in Borneo, Labuan, Sumatra, several of the Phillippines, Formosa, Japan, New South Wales and other parts of New Holland, New Zealand, Kerguelen's Land; in America, besides the United States, in Chili, at the Straits of Magellan, Northwest America on Vancouver's Island near the harbor of Camosack, at Bellingham Bay in Puget's Sound, at Melville Island in the Arctic seas, and in the British Provinces of Nova Scotia, New Brunswick and Newfoundland.

" In the United States there are four extensive coal areas. One of these areas, the Apalachian coal field, commences on the north, in Pennsylvania and southeastern Ohio, and sweeping south over western Virginia and eastern Kentucky and Tennessee, to the west of the Apalachians, or partly involved in their ridges, it continues to Alabama near Tuscaloosa, where a bed of coal has been opened. It has been estimated to cover 65,000 square miles. It embraces several isolated patches in the eastern half of Pennsylvania. The whole surface in Pennsylvania has been estimated at 15,437 square miles. or one-third the whole area of the State. A second coal area (the Illinois) lies adjoining the Mississippi, and covers the larger part of Illinois, the western part of Indiana, and a small northwest part of Kentucky; it is but little smaller thân the preceding. A third occupies a portion of Missouri and Iowa west of the Mississippi. The second and third are separated by only a narrow belt of silurian rock, and properly belong together as one; and the united area is half larger than that of the Apalachian coal field. A fourth covers the central portion of Michigan. Besides these, there is a smaller coal region a (fifth) in Rhode Island, which crops out across the north end of the island of Rhode Island, and appears to the northward as far as Mansfield, Massachusetts. Out of the borders of the United States, on the northeast, commences a sixth coal area, that of Nova Scotia and New Brunswick, which covers, in connection with that of Newfoundland, 18,000 square miles, or two-ninths the whole area of these Provinces.

" The mines of western Pennsylvania, commencing with those of the Blossburg basin, Tioga Co., those of the States west, and those of Cumberland or Frostburg, Maryland; Richmond or Chesterfield, Va., and other mines south, are *bituminous.* Those of eastern Pennsylvania, constituting several detached areas,—one the *Schuylkill* coal field, on the south, worked principally at Mauch Chunk on the Lehigh, and at Pottsville on the Schuylkill; another, the *Wyoming* coal field, worked at Carbondale, in the Lackawanna region, and near Wyoming, besides others intermediate, those of Rhode Island, Massachusetts, and some patches in Virginia, are *anthracites.* Cannel coal is found near Greensburg, Beaver Co., Pa., in Kenawha Co., Va., at Peytona, etc.; also in Kentucky, Ohio, Illinois, Missouri, and Indiana.

" In England, the principal coal fields are the Manchester of Lancashire and Cheshire; the Great Central of South Yorkshire, Nottingham and Derby; that of South Wales, Glamorganshire, &c.; the Newcastle field of Northern England. In Scotland, a range of beds extends across from the Firth of Forth to the Firth of Clyde; whole area 1650 square miles. In Ireland, the three are the Limeric fields about the mouth of the Shannon, the Kilkenny fields to the eastward, and those of Ulster on the north. Mineral coal occurs in France, in small basins, 88 in number, and covering in all, according to Taylor, 1-117th of the whole surface. The most important are the basin of the Loire, between the Loire and the Rhone, and that of Valenciennes on the north, adjoining Belgium. In Belgium, it occupies a western and eastern division, the western in the provinces of Namur and Hainault, and the eastern extending over Liége.

" Coal beds more recent than the true coal era are sometimes worked. That of Richmond, Virginia, is supposed to be of the lias era; the coal of Brora in Sutheron Lake George and Lake Champlain. In a highly crystalline state, it occurs also, in the spinel-limestone of Orange Co., N. Y. and northern New Jersey. The most important mine of the common variety (suitable for black lead pots) is in gneiss, at Sturbridge, Mass. Small lumps of a fine quality for crayons, are occasionally met with, in Buncombe Co., N. C.

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land, and of Bovey, Yorkshire, are oolitic in age. Tertiary coal occurs on the Cowlitz, in Oregon, (anal. 14).

" Bituminous coal, Carboniferous in age, (See J. Hall, in Rep. of Stansbury's Exped. 1852, 401), occurs on the Rocky Mountains, according to Lieut. Abert, near the Raton Pass—lat. 37° 15′, long. 104° 35′—also according to Fremont, and probably of the same age, near lat. 41½°, lon. 111° on Muddy River.

" R. C. Taylor, in his extensive work on coal gives the following table showing the proportional areas of coal land in Europe and America, p. xv.—*Dana,* p. 29.

Countries.	Entire area each country	Area of coal land.	Proportions of coal to their whole areas.	Relative parts in 1000 of coal areas.
	Square miles English.	Square miles.		
Great Britain, Ireland, Scotland and Wales,	120,290	11,859	1–10	64
Spain, [Asturias region], - - - -	177,781	3,408	1–52	18
France, [area of fixed concessions] in 1845,	203,736	1,719	1–118	9
Belgium conceded lands, - - - -	11,372	518	1–22	3
Pennsylvania, United States, - -	43,960	15,437	1–3	84
British Provinces of New Brunswick, Nova Scotia, Cape Breton and Newfoundland,	81,113	18,000	1–4½	98
Prussian Dominions, - - - - -	107,937			
Austrian Prov. containing coal or lignite,	150,000			
The United States of America, - - -	2,280,000		1–17	
The twelve principal coal-producing States,	565,283	133,132	1–4	724
		184,073		1000 "

CHEMICAL ARRANGEMENT OF THE SPECIES.

Division I. INORGANIC TYPE.
Division II. ORGANIC TYPE.

INORGANIC DIVISION.

Class I. Elements.
Class II. Oxygen and Haloidal Compounds.
Class III. Oxy-salts.

ORGANIC DIVISION.

Class I. Hydro-, oxy-hydro-, and nitro-oxy-hydro-carbons.

Class II. Hydrous carbo-oxygen, and hydro-carbo? salts.

Class I. (of Division I.) ELEMENTS.

Order I. Metalloids.

Section a, simple.

1. Nitrogen	N.
2. Hydrogen	H.
3. Diamond	C.
4. Graphite	C.
5. Sulphur	S.
6. Selenium	Se.

Section b, mixed.

7. Air - - N^2O.
8. Sulphoselenite S, Se.

ORDER II. METALS.

Section a, single.

1. Iron - - Fe.
2. Arsenic - As.
3. Antimony - Sb.
4. Bismuth - Bi.
5. Tellurium - Te.
6. Copper - - Cu.
7. Lead - - Pb.
8. Mercury - - Hg.
9. Silver - - Ag.
10. Gold - - Au.
11. Platinum - Pl.
12. Palladium - Pd.

Section b, mixed.

13. Amalgam - Ag, Hg^2.
14. Iridosmine - Ir, Os.
15. Svanbergite - Ir, Pl.

CLASS II. OXYGEN AND HALOIDAL COMPOUNDS.

ORDER I. OXYGEN COMPOUNDS.

Section a, Dinoxides.

1. Cuprite - - Cu^2O.
2. Chalcotrichite - Cu^2O.

Section b, Protoxides.

3. Water - - HO.
4. Periclase - MgO.
5. Zincite - - ZnO.
6. Tenorite - CuO.
7. Lithargite - PbO.

b^1, Hydrous.

8. Brucite, - MgO, HO.
9. Nemalite - MgO, HO, or Mg, FeO, HO.

Section c, Sesquioxides.

10. Corundum - Al^2O^3.
11. Braunite - Mn^2O^3.
12. Hematite - Fe^2O^3.

13. Martite	Fe^2O^3.
14. Arsenite	As^2O^3.

c^1, *Double sesquioxides.*

15. Chrysoberyl	Al^2, Be^2O^3.
16. Ilmenite	$Fe^2Ti^2O^3$.

c^2, *Hydrous sesquioxides.*

17. Diaspore	$HO.\ Al^2O^3$.
18. Gibbsite	$3HO.\ Al^2O^3$.
19. Manganite	$HO.\ Mn^2O^3$.
20. Turgite	$HO.\ 2Fe^2O^3$.
21. Stilpnosiderite	$HO.\ Fe^2O^3$.
22. Göthite	$HO.\ Fe^2O^3$.
23. Limonite	$HO.\ Fe^2O^3$.

Section d, Proto-sesquioxides.

24. Spinel	$MgO.\ Al^2O^3$.
25. Hausmannite	$MnO, 2Mn^2O^3$.
26. Magnetite	$FeO.\ Fe^2O^3$.
27. Dimagnetite	$FeO.\ Fe^2O^3$.
28. Automalite	Zn, FeO, Al^2O^3.
29. Chromite	$Fe, MgO.\ Cr^2Al^2O^3$.
30. Crednerite	$3CuO.\ Mn^2O^3$.
31. Franklinite	$Fe, Zn, MnO.\ Fe^2, Mn^2O^3$.

d^1, *Hydrous.*

32. Volknerite	$6MgO.\ Al^2O^3+16HO$.
33. Houghite	$x\ MgO.\ Al^2O^3+xHO$.

Section e, Binoxygen compounds.

34. Carbacid	CO^2.
35. Sulphacid	SO^2.
36. Pyrolusite	MnO^2.
37. Polianite	MnO^2.
38. Cassiterite,	SnO^2.
39. Plattnerite	PbO^2.
40. Rutile	TiO^2.
41. Brookite	TiO^2.
42. Anatase	TiO^2.

e^1, *Hydrous.*

43. Xanthitane	TiO^2HO.

Section f, Proto-binoxides.

44. Psilomelane	$RO.\ MnO^2+HO.\ MnO^2$? $RO=Mn, Ba, KO$.

Section g, Teroxy-compounds.

45. Quartz - SiO^3.

g¹, Hydrous.

46. Opal - - $xSiO^3. HO$.
47. Sassolin - $3HO. BO^3$.
48. Vitriolacid - $HO. SO^3$.

ORDER II. BROMIDES.

1. Bromite - $AgBr$.

ORDER III. CHLORIDES.

Section a, single.

1. Ammonia - Am.
2. Muriatacid - HCl.
3. Sylvine - KCl.
4. Salt - - $NaCl$.
5. Salmiak - $Am. HCl$.
6. Cotunnite - $PbCl$.
7. Kerate - - $AgCl$.
8. Calomel - - $HgCl$.

a¹, Hydrous.

9. Hydrophilite - $CaCl. HO$.
10. Eisenchlore - $FeCl. HO$.
11. Carnallite - $KCl+MgCl+12HO$.

Section b, Oxy-chlorides.

12. Matlockite - $PbO, PbCl$.
13. Mendipite - $PbCl+2PbO$.

b¹, Hydrous.

14. Atacamite - $CuO, Cl. HO$, or $CuCl+3CuO. HO$.
15. Marcylite. $(CuO, Cl. HO.)$
16. Percylite - $Pb, CuO, Cl. HO$.

Section c, Bromo-chlorides.

17. Embolite - $AgBr, Cl$.

ORDER IV. IODIDES.

1. Iodite - - AgI.
2. Coccinite - HgI.

ORDER V. FLUORIDES.

Section a, simple.

1. Fluor - - CaF.
2. Fluellite - Al^2F^3.

3. Cryolite - $3NaF.\ Al^2F^3$.
4. Chiolite - $3NaF.\ 2Al^2F^3$.
5. Yttrocerite - Ca, Ce, YF.

Section b, Oxy-fluorides.

6. Fluocerite - $Ce^2F^3Ce^2O^3.\ 4HO$.

ORDER VI. SULPHIDES.

Section a, with single base.

1. Manganblende MnS.
2. Hauerite - MnS^2.
3. Pyrrhotine - FeS.
4. Pyrites - - FeS^2.
5. Marcasite - FeS^2.
6. Blende - - ZnS.
7. Greenockite - CdS.
8. Syepoorite - CoS.
9. Linnæite - $CoS.\ Co^2S^3$.
10. Millerite - NiS.
11. Realgar - AsS.
12. Orpiment - As^2S^3.
13. Molybdenite - MoS^2.
14. Pateraite - MoS^3.
15. Antimonite - Sb^2S^3.
16. Bismuthine - Bi^2S^3.
17. Redruthite - Cu^2S.
18. Harrisite - Cu^2S.
19. Covelline - CuS.
20. Galena - - PbS.
21. Cinnabar - HgS.
22. Argentite - AgS.
23. Akanthite - AgS.

Section b, with more than one base.

24. Nicopyrite - Fe, NiS.
25. Chalcopyrite - $Cu^2S.\ Fe^2S^3$.
26. Cuban - - $3Fe, Cu^2S.\ Fe^2S^3$.
27. Bornite - $3Cu^2S.\ Fe^2S^3$.
28. Stannine - $Cu^2, Sn, Fe, ZnS.\ Sn^2Fe^2S^3$.
29. Sternbergite - $3Fe, AgS.\ Fe^2S^3$?
30. Grünauite - $NiS.\ Ni^2, Bi^2S^3$.
31. Tannenite - $Cu^2S.\ Bi^2S^3$.
32. Wittichite - Cu, BiS.
33. Patrinite - $3Pb, Cu^2S.\ Bi^2S^3$.

ORDER VII. SELENIDES.

Section a, single base.

1. Berzeline - Cu^2Se.
2. Clausthalite - $Pb\,Se$.
3. Naumannite - $Ag\,Se$.

Section b, with double base.

4. Eucairite - $Cu^2Se+Ag\,Se$.
5. Zorgite - Pb, Cu^2Se ?
6. Lehrbachite $Hg, PbSe$.

Section c, Sulpho-selenides.

7. Onofrite - HgS, Se.

ORDER VIII. ARSENIDES.

Section a, single.

1. Leucopyrite - Fe^2AS^3.
2. Nickelin - $Ni\,AS$.
3. Placodin - Ni^4As.
4. Rammelsbergite $Ni\,As^2$.
5. Chloanthite - $Ni\,As^2$.
6. Smaltine - $Co\,As^2$.
7. Skutterudite $Co\,As^3$.
8. Domeykite - Cu^3As.

Section b, double.

9. Safflorite - Co, Fe, As.

Section c. Sulpho-arsenides.

10. Chathamite $Fe, Ni\,As^2(CoS\ ?)$
11. Mispickel - $Fe\,As^2+Fe\,S^2$.
12. Gersdorffite - $Ni\,As^2+Ni\,S^2$.
13. Tennantite - $4Cu^2S.\ As^2S^3$.
14. Enargite - $3Cu^2S.\ As^2S^3$.
15. Dufrénoysite $2Pbs.\ As^2S^3$.
16. Proustite - $3AgS.\ As^2S^2$.
17. Xanthocone $2(3AgS.\ As^2S^3)+3Ag^3.\ As^2S^3$.

ORDER IX. ANTIMONIDES.

Section a, single.

1. Discrasite - Ag^2Sb.
2. Breithauptite $Ni\,Sb$.

Section b, Sulpho-antimonides.

3. Berthierite - $3FeS.\ 2Sb^2S^3$.
4. Wolfsbergite $Cu^2S.\ Sb^2S^3$.

5.	Boulangerite	$3PbS.\ Sb^2S^3$.
6.	Zinkenite	$PbS.\ Sb^2S^3$.
7.	Heteromorphite	$2PbS.\ Sb^2S^3$.
8.	Jamesonite	$3PbS.\ 2Sb^2S^3$.
9.	Brogniardtite	$Pb, AgS.\ Sb^2S^3$.
10.	Frieslebenite	$3Pb, AgS.\ Sb^2S^3$.
11.	Bournonite	$3Pb, Cu^2S.\ Sb^2S^3$.
12.	Kobellite	$3Pb, FeS, Bi^2, Sb^2S^3$.
13.	Plagionite	$4PbS.\ Sb^2S^3$.
14.	Fireblende	$Ag, Sb\ S$.
15.	Miargyrite	$AgS.\ Sb^2S^3$.
16.	Pyrargyrite	$3AgS.\ Sb^2S^3$.
17.	Stephanite	$6AgS.\ Sb^2S^3$.

Section c, Sulpho-arseno-antimonides.

18.	Ullmannite	$NiSb^2+NiS$, or $NiSb^2.\ NiS^2$.
19.	Tetrahedrite	$4Cu^2, Fe, Ag, ZnS.\ Sb^2S^3$.
20.	Geocrinite	$5PbS, Sb^2, As^2S^3$.
21.	Wolchite	Pb, Cu^2S, Sb^2, As^2S^3.
22.	Polybasite	$9AgS.\ Sb^2, As^2S^3$.

ORDER X. TELLURIDES.

Section a, single.

1.	Hessite	$Ag\ Te$.
2.	Altaite	$Pb\ Te$.

Section b, double.

3.	Sylvanite	Au, Ag, Fe^3, and Au, Ag, Pb, Fe^3Sb^3 ?

Section c, Sulpho-tellurides.

4.	Nagyagite	$Pb, Au, Fe\ S$, &c.

CLASS III. OXY-SALTS.

ORDER I. CARBONATES.

Section a, single.

1.	Witherite	$BaO.\ CO^2$.
2.	Strontianite	$SrO.\ CO^2$.
3.	Calcite	$CaO.\ CO^2$.
4.	Aragonite	$CaO.\ CO^2$.
5.	Magnesite	$MgO.\ CO^2$.
6.	Diallogite	$MnO.\ CO^2$.
7.	Chalybite	$FeO.\ CO^2$.
8.	Smithsonite	$ZnO.\ CO^2$.

a^1. *Hydrous.*

9.	Carbammonite	$Am.\ 2CO^2+HO$.

10. Natron - - $NaO.\ 9HO+HO.\ CO^2.$
11. Trona - - $2NaO.\ CO^2+2(2HO.\ CO^2).$
12. Thermonatrite $2NaO.\ CO^2+HO.\ CO^2.$
13. Hydrocalcite - $CaO.\ Co^3+5HO.$
14. Hydromagnesite $Mg, CaO.\ 4HO+3(Mg, CaO.\ CO^3).$
15. Lanthanite - $LaO.\ 3HO+2LaO.\ CO^2.$
16. Hydrozincite $ZnO.\ 3HO+2ZnO.\ CO^2.$
17. Texasite - $2(NiO.\ 3HO)+NiO.\ CO^2.$
18. Malachite - $CuO.\ HO+CuO.\ CO^2.$
19. Azurite - $CuO.\ HO+2(CuO.\ CO^2).$

Section b, double.

20. Barytocalcite $Ba, CaO.\ CO^2.$
21. Alstonite - $Ba, CaO.\ CO^2.$
22. Dolomite - $Ca, MgO.\ CO^2.$
23. Ankerite - $Ca, FeO(Mn, MgO).\ CO^2.$
24. Mesotine - $Mg, FeO.\ CO^2.$
25. Manganocalcite $Mn, CaO.\ CO^2.$

b^1, *Hydrous.*

26. Gaylussite - $Na, CaO.\ HO+2(2HO.\ CO^2).$
27. Hydrodolomite $Mg, CaO.\ 4HO+3(Mg, CaO.\ CO^2).$

Section c, carbonate with chloride.

28. Phosgenite - $PbO, Cl.\ CO^2.$

Section d, carbonate with fluoride.

29. Parisite - $Ce, La, DiO, FHO+4(Ce, La, DiO.\ CO^2).$

ORDER II. PHOSPHATES.

Section a, anhydrous.

1. Apatite - $10CaO, F, Cl.\ 3P^2O^5.$
2. Pyromorphite $10PbO, Cl, F.\ 3P^2O^5.$
3. Zwieselite - $10Fe, MnO, F.\ 3P^2O^5.$
4. Wagnerite - $4MgO, F.\ P^3O^5.$
5. Amblygonite $3Li, NaO, F.\ P^2O^5+3Al^2O^3F^32P^2O^5.$
6. Herderite - $CaO, F;\ Al^2O^3;\ P^2O^5.$
7. Monacite - $3Ce, LaO.\ P^2O^5.$ and $3Ce, La, ThOP^2O^5.$
8. Xenotime - $4YOP^2O^5.\ (3YO.\ P^2O^5\ ?).$

Section b, Hydrous, or with hydrates, fluorides, chlorides, &c.

9. Pyroclasite - $(HO, CaO, F, Cl.\ P^2O^3.)$
10. Wavellite - $(HO.\ Al^2O^3.)+2(5HO.\ P^2O^5.)$
11. Fischerite - $3HO.\ 2Al^2O^3+5HO.\ P^2O^5.$
12. Hitchcockite $(HO, Al^2O^3, P^2O^5, ZnO.)$
13. Hopeite - $ZnO, CdO;\ HO;\ P^2O^5.$
14. Turquoise - $2(HO.\ Al^2O^3)+3HO.\ P^2O^5.$

15. Cacoxene - $2(3HO.\ Fe^{2}Al^{2}O^{3})+5HO.\ P^{2}O^{5}$?.
16. Dufrénite - $5(FeO,\ HO)+3FeO.\ 2P^{2}O^{5}$?
17. Delvauxene - $3HO.\ 2Fe^{2}O^{3}+20HO.\ P^{2}O^{5}$.
18. Vivianite - $3(FeO.\ HO)+5HO.\ P^{2}O^{5}$.
19. Uranite - $[2(CaO,HO)+5HO.\ P^{2}O^{3}]+[4(HOU^{2}O^{3})+5HO.\ P^{2}O^{5}]$.
20. Torberite - $[2(Cu.\ HO)+5HO,\ P^{2}O^{5}]+[4(HO.\ U^{2}O^{3})+5HO.\ P^{2}O^{5}]$.
21. Plombgomme $6(3HO.\ Al^{2}O^{3})+3PbO.\ P^{2}O^{5}$.
22. Cherokine - $(HO,\ Al^{2}O^{3},\ P^{2}O^{5},\ PbO)$.
23. Lunnite - $3(CuOHO)+3CuO.\ P^{2}O^{5}$.

ORDER III. ARSENIATES WITH CHLORIDES.

Section a. Anhydrous.

1. Mimetite - $3(Pb,\ CaO)\ (As^{2}O^{5},P^{2}O^{5})+\frac{1}{3}PbCl$.
2. Hedyphane - $10Pb,\ CaO,Cl.\ 3As^{2},\ P^{2}O^{5}$.
3. Kuhnite - $3(Ca,\ Mg,\ MnO)\ As^{2}O^{5}$.

Section b, Hydrous.

4. Roselite - $Co,\ Ca,\ MgO;\ HO;\ As^{2}O^{5}$.
5. Pharmacolite $2(CaO.\ HO)+3HO.\ As^{2}O^{5}$.
6. Haidingerite $2(CaO.\ HO)+HO.\ As^{2}O^{5}$.
7. Scorodite - $HO.\ Fe^{2}O^{3}+HO;\ As^{2}O^{5}$.
8. Simplesite - $FeO;\ HO;\ As^{2}O^{5}$.
9. Pharmacosiderite $4(2HO.\ Fe^{2}O^{3}.)+3(3HO.\ As^{2}O^{3})$.
10. Erythrine - $3(CoO.\ HO)+5HO.\ As^{2}O^{5}$.
11. Euchroite - $4(CuO.\ HO)+3HO.\ As^{2}O^{5}$.
12. Chalcophyllite $8(CuO.\ HO)+15HO.\ As^{2}O^{5}$.
13. Liroconite - $[2(3HO.\ Al^{2}O^{3})+5HO.\ As^{2}O^{5}]+[8(CuO._{5}HO)+5HO.\ As^{2}O^{3}]$.
14. Aphanesite - $3(CuO.\ HO)+3CuO.\ As^{2}O^{5}$.
15. Kupaphrite - $5(CuO.\ HO)+5HO.\ As^{2}O^{5}$.
16. Arseniosiderite $[2(CaO.\ HO)+3CaO.\ As^{2}O^{5}]+3[3HO.\ Fe^{2}O_{3}+Fe^{2}O^{3}.\ As^{2}O^{5}]$.
17. Beudantite - $HO;\ Fe^{2}O^{3};\ As^{2}O^{5};\ PbO;\ SO^{3}$.
18. Lavendulan - $CO,\ NiO;\ HO;\ As^{2}O^{5}$.

Section v. Arseniates with phosphates.

19. Olivenite - $CuO.\ HO+3CuO(As^{2},\ P^{2}O^{5})$.

ORDER IV. ANTIMONIATES.

1. Romein - $4CaO.\ 3Sb^{2}O^{5}$.

Order V. Sulphates.

Section a. Anhydrous.

1. Aphthitalite - $KO.\ SO^3$.
2. Thenardite - $NaO.\ SO^3$.
3. Barytes - $BaO.\ SO^3$.
4. Celestine - $SrO.\ SO^3$.
5. Anhydrite - $CaO.\ SO^3$.
6. Anglesite - $PbO.\ SO^3$.
7. Glauberite - $Na, CaO.\ SO^3$.

Section b. Hydrous.

8. Mascagnine - $3AmO.\ SO^3+3HO.\ 2SO^3$.
9. Mirabilite - $NaO.\ 9HO+HO.\ SO^3$.
10. Gypsum - $CaO.\ HO+HO.\ SO^3$.
11. Epsomite - $MgO.\ HO+6HO.\ SO^3$.
12. Aluminite - $3HO.\ Al^2O^3.\ SO^3+6HO.\ SO^3$.

Keramohalite, $Al^2O^3.\ SO^3+2(9HO.\ SO^3)$.

13. Alum - $KO.\ Al^2O^3+4(6HO.\ SO^3)$.

Solfatarite $NaO.\ Al^2O^3+4(6HO.\ SO^3)$.
Tchermigite $Am.\ O.\ Al^2O^3+4(6HO.\ SO^3)$.
Iron alum. $FeO\ Al^2O^3+4(6HO.\ SO^3)$.
Apjohnite $MnO.\ Al^2O^3+4(6HO.\ SO^3)$.
Pickeringite $Fe, MgO, Al^2O^3+4(6HO.\ SO^3)$.

14. Manganvitriol $MnO.\ HO+6HO.\ SO^3$.
15. Melanterite - $FeO.\ HO+6HO.\ SO^3$.
16. Coquimbite - $F^2O^3.\ 2SO^3+HO.\ SO^3$.
17. Copiapite - $3HO.\ 2Fe^2O^3+5(3HO.\ SO^3)$.
18. Goslarite - $ZnO.\ HO+6HO.\ SO^3$.
19. Johannite - UO, CoO, HO, SO^3.
20. Chalcanthite $CuO.\ HO+4HO.\ SO^3$.
21. Pyromeline - $NiO.\ HO+6HO.\ SO^3$.
22. Botryogene - $[3(FeO.\ HO)+2(3HO.\ SO^3)]+3[3HO.\ Fe^2\ O^3+2(3HO.\ SO^3)]$.
23. Voltaite - $[3Fe, KO,\ SO^3)+2(3HO.\ \ SO^3)+2[Fe^2Al^2O^32SO^3+3HO\ SO^3.]$
24. Alunite - $[KO.\ Al^2O^3+3HO.\ 2SO^3]+[3HO\ Al^2O^3+Al^2O^3.\ 2SO^3]$.

Jarosite $KO.\ SO^3+4(Fe^2O^3.\ SO^3)+6HO+Fe^2O^3HO$.

25. Pissophane - $2(3HO.\ Fe^2, Al^2O^3)+9HO.\ SO^3$.
26. Astrakanite - $Mg, NaO.\ HO+HO.\ SO^3$.
27. Polyhalite - $2(3Ca, Mg, KO.\ 2SO^3)+3HO.\ 2SO^3$.
28. Cyanochrome $K, CuO, 2SO^3+6HO$.
29. Picromerid - $Mg.\ CuO.\ SO^3+3HO$.
30. Brochantite - $3(CuO.\ HO)+CuO.\ SO^3$.
31. Linarite - $CuO.\ HO+PbO.\ SO^3$.

Section c, with carbonates.

32.	Lanarkite -	$PbO.\ CO^2+PbO.\ SO^3$.
33.	Caledonite -	$Pb.\ CuO.\ CO^2+PbO.\ SO^3$.
34.	Leadhillite -	$3(PbO.\ CO^2)+PbO.\ SO^3$.

Section d, with phosphates.

35.	Glaubapatite -	$(HO, CaO, P^2O^5, F, Cl, NaOSO^3.)$?
36.	Diadochite -	$[3HO.\ Fe^2O^3+2(5HO.\ P^2O^5)]+4[3Fe^2O^3+3HO.\ SO^3.]$

ORDER VI. BORATES.

Section a. Anhydrous.

1.	Boracite -	$3MgO.\ 4BO^3$.
	Rhodizite	CaO, BO^3.

Section b. Hydrous.

3.	Borax -	$NaO.\ 5HO+2(3HO.\ BO^3)$.
4.	Hydroboracite	$2(Ca, MgO.\ BO^3)+6HO.\ BO^3$.
5.	Hayesine -	$3(Ca, NaO.\ Bo^3)+6HO.\ BO^3$.

ORDER VII. SILICATES.

Section a, of anhydrous protoxides

1.	Chrysolite -	$3Mg^3.\ SiO^3$.
2.	Chondrodite -	$4MgO.\ F.\ SiO^3.\ F^3$.
3.	Willemite -	$3ZnO, SiO^3$.
	Troostite,	$3Zn, Mn, FeO.\ SiO^3$.
4.	Wollastonite	$3CaO.\ 2SiO^3$.
5.	Pyroxene -	$3Ca, Mg, FeO.\ 2SiO.^3$
	Achmite	$NaO.\ SiO^3+Fe^2O^3.\ 2SiO^3$.
	Diopside	$3Mg, CaO.\ 2SiO^3$.
	Saussurite	$3Ca, NaO.\ SiO^3+2(Al^2Fe^2O^3.\ SiO^3)$.
	Diallage	$3Mg, Ca, FeO.\ 2SiO^3$.
	Bronzite	$3Mg.\ FeO.\ 2SiO^3$.
	Hypersthene	$3Mg, FeO.\ 2SiO^3$.
6.	Rhodonite -	$3MnO.\ 2SiO^3$.
7.	Fowlerite -	$3Mn, FeO.\ 2SiO^3$.
8.	Spodumene -	$3LiO.\ 2SiO^3+4(Al^2O^3.\ 2SiO^3)$.
9.	Hornblende -	$4Mg, Ca, FeO.\ 3SiO^3$.
	Tremolite	$4Mg, CaO.\ 3SiO.^3$
	Anthophyllite	$4Mg, FeO.\ 3SiO^3$.
	Arfvedsonite	$4Fe, NaO.\ 3SiO^3$.
10.	Gadolinite -	$5(3RO.\ SiO^3)+2R^2O^3SiO^3$, where $RO=Y, Ce\ La, Ca, MgO$, and $R^2O^3=Be^2Ce^2Fe^2O^3$.

11. Babingtonite $5Ca, FeO.\ 4SiO^8$.
12. Danburite - $Ca, NaO.\ Si, BO^3$.

Section b, of anhydrous sesquioxides.

13. Staurotide - $2Al^2Fe^2O^3.\ SiO$.
14. Kyanite - $3Al^2O^3.\ 2SiO^3$.
15. Fibrolite - $3Al^2O^3.\ 2SiO^3$.
16. Andalusite - $4Al^2O^3.\ 3SiO^3$.
17. Zircon - $Zr^2O^3.\ SiO^3$.
18. Phenacite - $Be^2O^3.\ SiO^3$.
19. Beryl - $Al^2Be^2O^3.\ 2SiO^3$.
20. Euclase - $4Al^2, Be^2O^3.\ 3SiO^3$.
21. Topaz - $3Al^2O^3, F^3.\ 2SiO^3, F^3$.
22. Eulytine - $Bi^2O^3, Fe^3O^3;\ SiO^3.\ P^2O^5;\ F$.

Section c, of anhydrous proto-sesquioxides.

23. Gehlenite - $3(3CaO.\ SiO^3)+3Al^2O^3.\ SiO^3$.
24. Lievrite - $3(3Fe, CaO.\ SiO^3)+2Fe^2O^3.\ SiO^3$.
25. Melilite - $2(3Ca, Mg, NaO.\ SiO^3)+A^2O^3SiO^3$.
26. Dipyre - $4(Ca, NaO.\ Si.\ O^3)+3(Al^2O^3.\ SiO^3)$.
27. Garnet (almandine) $3FeO.\ SiO^3+Al^2O^3.\ SiO^3$.
    Essonite $3CaO.\ SiO^3+Al^2O^3.\ SiO^3$.
    Spessartine $3MnO.\ SiO^3+Al^2O^3.\ SiO^3$.
    Pyrope $3Mg, Fe, CrO.\ SiO^3+Al^2O^3.\ SiO^3$.
    Allochroite and Aplome $3CaO.\ SiO^3+Fe^2O^3.\ SiO^3$.
28. Uwarowite - $3CaO.\ SiO^3+Cr^2O^3.\ SiO^3$.
29. Idocrase - $3Ca, FeO.\ SiO^3Al^2Fe^2O^3.\ SiO^3$.
30. Sarcolite - $3CaO.\ SiO^3+Al^2O^3.\ SiO^3$?.
31. Scapolite - $3Ca, NaO.\ 2SiO^3+2(Al^2Fe^2O^3.\ SiO^3)$.
32. Epidote - $3Ca, FeO.\ SiO^3+2(Al^2Fe^2O^3.\ SiO^3)$.
    Zoisite $3CaO.\ SiO^3+2(Al^2O^3.SiO^3$.
33. Allanite - $3(3RO.\ SiO^3)+2(R^2O^3.\ SiO^3)$, or $3RO.\ SiO^3+R^2O^3SiO^3$; where $RO=Fe, Ce, La, Y, Mg, Mn O$, and $R^2O^3=Al^2Fe^2O^3$.
34. Cerite - $CeO.\ 3HO+2CeO.\ SiO^3$.
35. Sodalite - $3NaO.\ SiO^3+3(Al^2O^3)+Na Cl$.
36. Haüyne - $3NaO.\ SiO^3+3(Al^2O^3.\ SiO^3)+2(CaO.\ SO^3)$.
37. Ultramarine $Na, CaO;\ Al^3O^3;\ SiO^3;\ SO^3$.
38. Nepheline - $2Na, KO.\ SiO^3+2(Al^2O^3.\ SiO^3)$.
39. Leucite - $3KO.\ 2SiO^3+3(Al^2O^3.\ 2SiO^3)$.
40. Barsowite - $3CaO.\ 2SiO^3+3(Al^2O^3.\ SO^3)$.
41. Boltonite - $Mg, Fe, CaO;\ Al^2O^3;\ SiO^3$.
42. Iolite - $3Mg, FeO.\ 2SiO^3+3(Al^2O^3.\ SiO^3)$.
43. Axinite - $3Ca O.\ 2Si BO^3+2(Al^2, Fe^2.\ Mn^2O^3Si.\ BO^3)$.

44. Isopyre - $CaO.\ SiO^3+Al^2Fe^2O^3.\ SiO^3.$
45. Feldspar - $KO.\ SiO^3+Al^2O^3.\ 3SiO^3.$
46. Albite - $NaO.\ SiO^3+Al^2O^3.\ 3SiO^3.$
47. Oligoclase - $Na, CaO.\ SiO^3+Al^2O^3.\ 2SiO^3.$
48. Ryacolite - $Na, CaO.\ SiO^3+Al^2O^3.\ SiO^3.$
49. Labradorite - $Ca, NaO.\ SiO^3+3Al^2O^3.\ SiO^3.$
50. Anorthite - $3Ca, MgO.\ SiO^3+3(Al^2O^3.\ SiO^3).$
51. Mica - $KO.\ SiO^3+4Al^2O^3.\ 4SiO^3.$
52. Lepidolite - $Li, KO.\ F.\ SiO^3+Al^2O^3\ F^3.\ SiO^3.$
53. Phlogopite - $2(3Mg, KO.\ F.\ SiO^3)+Al^2O^3SiO^3.$
54. Biotite - $3Mg, K, FeO, F.\ SiO^3+Al^2Fe^2O^3.\ SiO^3.$
55. Margarite - $2(Ca, NaO.\ HO)+4Al^2O^3.\ 3SiO^3.$
56. Lepidomelane $3Fe, KO.\ SiO^3+3(Fe^2Al^2O^3.\ SiO^3).$
57. Tourmaline Si, BO^3; $Al^2Fe^2Mn^2O^3$; Ca, Mg, Li, Fe, MnO, &c. The oxygen ratios for the protoxides, the peroxides and boric acid, vary much.
58. Petalite - $3Li, NaO.\ 4SiO^3+4(Al^2O^3.\ 4SiO^3).$

Section d, of hydrous protoxides.

59. Apophyllite $2Ca, KO.\ F.\ SiO^2+HO.\ SiO^3.$
60. Okenite - $3CaO.\ 2SiO^3+2(3HO.\ SiO^3).$
61. Pectolite - $Ca, NaO.\ HO.+3(Ca, NaO.\ SiO^3).$
62. Talc - $MgO.\ 2HO+5(Mg, FeO.\ SiO^3).$
63. Steatite - $MgO.\ 2HO+5(Mg, FeO.\ SiO^3).$
64. Nephrite - $3Mg, CaO.\ 2SiO^3.$
65. Serpentine - $3(MgO.\ 2HO)+2(3Mg, FeO.\ 2SiO^3).$
66. Antigorite - $MgO.\ HO.\ +3Mg, FeO.\ 2SiO^3.$
67. Picrosmine - $2(3MgO.\ SiO^3)+3HO.\ 2SiO^3.$
68. Kerolite - $3(MgO\ HO)+HO.\ 2SiO^3.$
69. Meerschaum $MgO.\ HO+HO.\ SiO^3$
70. Hemimorphite $3(ZnO.\ HO)+3ZnO.\ 2SiO^3.$
71. Dioptase - $3CuO.\ SiO^3+3HO.\ SiO^3.$
72. Chrysocolla - $3(CuO.\ HO)+3HO.\ 2SiO^3.$
73. Cerite - $CeO.\ 3HO+2CeO.\ SiO^3.$
74. Thorite - $ThO.\ 3HO+2ThO;\ SiO^3.$

Section e, of hydrous proto-sesquioxides.

75. Comptonite - $3(Ca, NaO.\ Al^2O^3)+2(3HO.\ 2SiO^3).$
76. Prehnite - $2CaO.\ Al^2O^3+HO.\ 2SiO^3.$
77. Gismondin - $2(Ca, KO.\ Al^2O^3)+3(2HO, SiO^3.)$
78. Ittnerite - $Ca, Na, KO;\ Al^2O^3;\ HO;\ SiO^3;\ SO^3.$
79. Analcime - $3(NaO.\ Al^2O^3)+2(3HO.\ 4SiO^3).$
80. Laumonite - $3(CaO.\ Al^2O^3)+4(3HO.\ 2SiO^3).$
81. Eudnophite - $3(NaO.\ Al^2O^3)+2(3HO.\ 4SiO^3).$
82. Chabasie - $CaO.\ Al^2O^3+3(2HO.\ Si^2O^3).$

83.	Gmelinite	$Na, CaO.\ Al^2O^3+3(2HO.\ SiO^3)$.
84.	Natrolite	$NaO.\ Al^2O^3+2(HO.\ SiO^3)$.
85.	Scolezite	$CaO.\ Al^2O^3+3HO.\ 2SiO^3$.
86.	Levyn	$CaO.\ Al^2O^3+2(2HO.\ SiO^3)$.
87.	Harmotome	$3(BaO.\ Al^2O^3)+5(3HO.\ SiO^3)$.
88.	Faujasite	$Ca, NaO.\ Al^2O^3+3(3HO.\ SiO^3)$.
89.	Stilbite	$3[CaO.\ Al^2O^3+2(3HO.\ 2SiO^3]+[Al^2O^3.\ SiO^3+3HO.\ 2SiO^3)]$.
90.	Epistilbite	$CaO.\ Al^2O^3+4(HO.\ SiO^3)$.
91.	Brewsterite	$Sr.\ BaO.\ Al^2O^3+4(HO.\ SiO^3)$.
92.	Edingtonite	$CaO;\ HO;\ Al^2O^3;\ SiO^3$.
93.	Chlorite.	$3(3HO.\ Al^2, Fe^2O^3)+2(5Mg, FeO.\ 2SiO^3)$.
	Ripidolite	$4HO.\ Al^2Fe^2O^3+5Mg, Fe\ O.\ 2SiO^3$.
	Pennin	$HO;\ Al^2, Fe^2O^3;\ Mg, FeO;\ SiO^3$.
	Leuchtenbergite	$3HO.\ Al^2O^3+5MgO.\ 2SiO^3$.
94.	Stilpnomelane	$3HO.\ Al^2, Fe^2O^3+3(Fe, MgO.\ SiO^3)$?
95.	Cronstedite	$5(FeO.\ HO)+3Fe, MgO.\ 2SiO^3)$.
96.	Catapleiite	$3Na, CaO.\ 2Zr^2O^3+6(HO.\ SiO^3)$.
97.	Anthosiderite	$Fe^2O^3.\ 2SiO^3+HO.\ SiO^3$.
98.	Carpholite	$3HO.\ Al^2Mn^2Fe^2O^3+Al^2Mn^2Fe^2O^3$.
99.	Saponite	$[3(MgO.\ 2HO)+2(3MgO.\ 2SiO^3)]+[MgO.\ Al^2O^3+3HO.\ SiO^3]$.
100.	Agalmatolite	$K, CaO.\ 2HO+2(Al^2O^3.\ 2SiO^3)$.

I. *Appendix to section e.*

Sphragide	$NaO.\ Al^2Fe^2O^3;\ SiO3$.
Damourite	$KO.\ 2HO+3Al^2O^3.\ 4SiO^3$.
Groppite	$2(MgO.\ HO)+Al^2O^3.\ 2SiO^3$.
Spadaite	$MgO.\ 4HO+4(MgO.\ SiO^3)$.
Stolpenite	$[CaO.\ HO+3HO.\ 2SiO^3]+3[3HO.\ A^2O^3+3HO.\ 2SiO^3$.
Gilbertite	$2(CaO.\ HO)+5Al^2O^3.\ 6SiO^3$.
Chlorophaeite	$Fe, MgO.\ 3HO+3HO.\ SiO^3$.
Quincite	$3(Fe, MgO)\ 3HO.\ (2SiO^3).\ 3HO.\ Fe^2O^3+(HO.\ SiO^3)$.
Pinguite	$[FeO.\ HO+2(3HO.\ SiO^3)]+2[HO.\ Fe^2O^3+3HO.\ SiO^3]$.
Pimelite	$[3(NiO.\ HO)+2(HO.\ SiO^3)]+[3HO.\ 2Al^2O^3+HO.\ SiO^3$.
Pipestone	$3(Ca, NaO.\ HO)+2(Al^2O^3.\ 3SiO^3.)$
Catlinite	$SiO^3;\ Al^2O^3;\ HO;\ MgO$.
Kaolin	$(3Al^2O^3.\ 2SiO^3)+3HO.\ SiO^3)$.

Malthacite	$3HO, Al^2, Fe^2O^3+4(3HO. SiO^2)$.
Lithomarge	$3HO. 2Al^2O^3+3(HO SiO^3)$.
Pholerite	$(HO. Al^1O^3+HO. SiO^3)$.
Nontronite	$3HO. Fe^2O^3+2(HO. SiO^3.)$
Halloysite	$3HO. Al^2O^3+3HO. SiO^3$.
Dillnite	$3HO. 2Al^2O^3+HO. SiO^3$.
Montmorillonite	$3HO. Al^2O^3+3HO. 2SiO^3$.
Allophane	$2(3HO. Al^2O^3)+2(3HO. SiO^3)$.
Lenzinite	$3HO. Al^2O^3+HO. SiO^3$.
Wad	$MnO. HO+2(HO. MnO^2)$.
Scarbroite	$9(6HO. Al^2O^3)+2(3HO. SiO^3)$.
Asbolan	$Co, CuO. 2HO+2(HO. MnO^2)$.
Kollyrite	$3(3HO. Al^2O^3)+6HO. SiO^3$.
Pelokonite	$CuO. Mn^2O^3. Fe^2O^3. SiO^3$.
Meloschin	$3(HO. Al^2, Cr^2O^3)+2(3HO. SiO^3.)$

Section f. Silicates with aluminates.

101.	Clintonite -	$HO. 2Al^2O^3 + 2Ca, MgO. SiO^3$, or $RO. SiO^3+RO^2. Al^2O^3+HO(RO=Mg, Ca FeO)$.
102.	Chloritoid -	$Fe, MgO. Al^2O^3+Fe^2O^3. SiO^3. HO$.
103.	Ottrelite -	$Fe, MnO. Fe^2O^3$?$+Al^2O^3. SiO^3. HO$.

Section g, Silicates with chlorides, fluorides and sulphides,

104.	Eudyalyte -	$2(3Na, Ca, FeO. Cl. 2SiO^3)+Zr^2O^3 2SiO^3$.
105.	Leucophane	$4(3Ca, NaO, F. 2SiO^3)+3Be^2O^3. 2SiO^3$.
106.	Pyrosmalite	$3HO. Fe^2O^3Cl^3+2(3Fe, MnO. 2SiO^3.)$
107.	Helvin -	$3Mn. FeO. S. SiO^3+Be^2, Mn^2O^3. SiO^3$?.

Section h. Silicate with carbonate.

108.	Davyne -	$2NaO. SiO^3+2(Al^2O^3 SiO^3(+Ca, NaO. CO^2$.

ORDER VIII. CHROMATES.

1.	Lehmannite -	$PbO. CrO^3$.
2.	Melanochroite	$3PbO. 2CrO^3$.
3.	Vauquelinite	$3Pb, CuO. 2CrO^3$.

ORDER IX. MOLYBDATES.

1.	Wulfenite -	$PbO. MoO.^3$.

ORDER X. TUNGSTATES.

1. Scheelite - $CaO.\ WO^3$.
2. Wolfram - $Fe, Mn\ O, WO^3$.
3. Stolzite - $PbO.\ WO^3$.

ORDER XI. TITANATES.

Section a.

1. Perofskite - $CaO.\ TiO^2$.
2. Polymignite $TiO^2;\ Zr^2O^3;\ Fe^2O^3;\ Mn^2O^3YO.\ CaO\ CeO$.
3. Pyromelane $(Al^2, Fe^2, Be^2\ ?, O^3,\ TiO^2.)$?
4. Rutherfordite $(TiO^2, (Ce^2O^3;\ YO.\ U^2O^3.)$
5. Mengite - $TiO^2;\ Fe^2, Mn^2O^3;\ Z2^2O^3$.

Section b. Titanates and silicates.

6. Sphene - $2(CaO.\ SiO)+CaO.\ 3TiO^2$.
7. Keilhauite $4Ca, YO.\ 3TiO^2+Al^2, Fe^2O^3$.
8. Schorlomite $2(2Ca, FeO.\ TiO^2)Fe^2O^3.\ 2SiO^3$.
9. Tschewkinite Ce, La, Di, CaO, $SiO^3\ TiO^2$, &c.
10. Oerstedite - $TiO^2;\ SiO^3;\ Zr^2O^3$, Ca, Mg, FeO; HO.
11. Mosandrite - Ti. O^2; SiO^3; Ce La, Mn, Ca, Mg, KO HO.

Section c. Silico-titanates, with boric acid.

12. Warwickite - 3 Mg, FeO. TiO^2+BO^3. ?

ORDER XII. COLUMBATES,

(*sometimes with titanates, tungstates, niobates, pelopates and silicates.*)

1. Pyrochlore - Ca, Ce NaO, F. Nb. Pe WO^3; TiO^2.
2. Microlite - Ca O; Ta, WO^3.
3. Fergusonite 6YO. TaO^3 ? and Ce, Sn, U, FeO. Zr^2O^3.
4. Yttrotantalite Ta O^3; YO; and Ca, U, Fe, Cu, Ce, La, Mg, Zr TiO^2, HO.
5. Columbite - Fe, MnO; Nb, Pe O^3.
6. Tantalite - Fe, MnO. Ta O^3.
7. Euxenite - TaO^3; YO, CeO, CaO, UO; TiO^2; HO.
8. Polycrase - TiO^2; TaO^3, ZrO^{32}; Fe^2O^3YO, UO, CeO, &c.
9. Samarskite Fe, U, YO; Nb, Pe, WO^3.
10. Aeschynite 2(Ce, La, FeO. Nb, ZiO^2) + Ca^2O^33Nb, TiO^2.

ORDER XIII. NITRATES.

1. Nitre - $KO+NO^5$.
2. Nitratin - $NaO+NO^5$.

a^{1}. *Hydrous.*

3. Nitrocalcite $CaO; HO; NO^{5}$.
4. Nitromagnesite $MgO; HO; NO^{5}$.

ORGANIC DIVISION.

CLASS I. HYDRO-, OXY-HYDRO-, AND NITRO-OXY-HYDRO-CARBONS.

ORDER I. HYDRO-CARBONS.

1. Carbhydrogen - $C\,H$.
2. Könleinite - $C^{2}H$.
3. Phylloretin - $C^{8}H^{5}$.
4. Tekoretin - $C^{6}H^{5}$.
5. Fichtelite - $C^{4}H^{3}$.
6. Branchite - $C\,H$.
7. Hatchettine - $C\,H$.
8. Ozokerite - $C\,H$.
9. Naphtha - $C\,H$.
10. Chrismatine - $C\,H$?
11. Elaterite - $C\,H$?
12. Idrialite - $C\,H$.
13. Piauzite - $C\,H$.
14. Ixolyte - $C\,H$.
15. Hartite - $C^{4}H^{5}$.
16. Scheererite - $C\,H^{2}$.

ORDER II. OXYHYDRO-CARBONS.

1. Pyropissite - $C\,H\,O$.
2. Retinite - $C\,H\,O$.
3. Naphthadil - $C\,H\,O$.
4. Succinite - $C^{10}H^{8}O$.
5. Guyaquillite - $C^{20}H^{13}O^{3}$.
6. Berengelite - $C^{40}H^{31}O^{8}$.
7. Middletonite - $C^{12}H^{8}O$.
8. Copaline - $C^{40}H^{32}O$.
9. Psathyrite - $C^{20}H^{17}O^{2}$.
10. Butyrite - $C^{33}H^{32}O^{3}$.

ORDER III. NITRO-OXYHYDRO CARBONS.

1. Coal - - $C\,H\,O\,N$.
2. Dopplerite - $C\,H\,O\,N$.

CLASS II. HYDROUS CARBO-OXYGEN, AND HYDRO-CARBO-SALTS.

ORDER I. OXALATES.

1. Oxacalcite - $CaO+C^2O^3+HO$.
2. Thierschite - $CaO+C^2O^3+HO$?
3. Oxalite - $2FeO+2C^2O^3+3HO$.

ORDER II. MELLATES.

1. Mellite - $Al^2O^3+3C^4O^3+18HO$.

ORDER III. PIGOTATES?

1. Pigotite - $4Al^2O^3+C^{12}H^5O^8+27\,HO$.

NATURAL HISTORY ARRANGEMENT

OF THE

SPECIES,

ADOPTED IN THIS TREATISE; WITH ANNOTATIONS AND REFERENCES.

[*Following the species will generally be found its author's name: if in capitals, it denotes that he, both described and named the mineral; if abbreviated and in italics, it is intended to show that the author has merely changed the name, in order to avoid the compound or chemical designation under which it had been previously known. The numbers occasionally met with in parentheses, refer to notes at the bottom of the page, introduced to supply information not in the body of the work. The page on which the general description occurs, is also designated.*]

CLASS I.

ORDER I. GAS.

Sp. 1. Hydrogen, p. 64.
2. Ammonia, p. 64.
3. Carbhydrogen, *Shep.*, p. 64.
4. Nitrogen, p. 64.
5. Air, p. 64.
6. Sulphydrogen, *Shep.*, p. 64.
7. Muriatacid, *Shep.*, p. 64.
8. Carbacid, *Shep.*, p. 64.
9. Sulphacid, *Shep.*, p. 64.

ORDER II. LIQUID.

Sp. 1. Water, p. 65.
2, Vitriolacid, *Shep.*, p. 65.

ORDER III. SOLUBLE.

Section A.

Sp. 1. Nitrocalcite, Shepard, p. 65.
2. Nitromagnesite, Shepard, p. 65.
3. Nitre, p. 65.
4. Nitratin, *Haid.*, p. 65.
5. Hydrophilite (1), Hausmann.
6. Eisenchlore, Hausmann, (2), Chloride of Iron.
7. Salmiak, *Haus.*, p. 65.
8. Salt, Chloride of sodium, p. 65.
9. Sylvine, *Beud.*, p. 66.
10. Mascagnine, *Reuss*, p. 66.
11. Pissophane, Breithaupt, (3).
12. Carnallite, Rose, (4).

Section B.

13. Carbammonite, *Shep.*, p. 66.
14. Natron, p. 66.
15. Thermonatrite, *Haid.*, p. 66.
16. Trona, Klaproth, p. 66.
17. Borax, p. 67.
18. Phosphammonite, *Shep.*, p. 67.
19. Mirabilite, *Haid.*, p. 67.
20. Epsomite, *Beud*, (5) p. 67.
21. Melanterite, *Haid.*, p. 67.

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(1) *Hydrophyllite.* Known only in very dilute solution. Composition, chloride of calcium.

(2) *Eisenchlore.* Known only in solution, and in a state of mixture with the sesquichloride of iron. Composition, chloride of iron.

(3) *Pissophane.* Amorphous, or stalactitic. H.=1·5. G.=1·93 . . . 1·98. Lustre vitreous. Color pistachio-, asparagus-, or olive-green. Transparent. Fragile. Fracture conchoidal. B.B., becomes black. Heated in a glass tube, gives alkaline water. Soluble in hydrochloric acid; nearly insoluble in water. Analysis by Erdmann:

	Green.	Yellow.
Alumina, - - - - - -	34·155	6·799
Peroxide iron, - - - - -	9·738	40·060
Sulphuric acid, - - - -	12·700	11·899
Water, - - - - - -	41·69	40·141

Found at Garnsdorf (*Garnsdorfite*) near Saalfield, and at Reichenbach, Saxony, on alum-slate.

(4) *Carnallite.* Occurs mixed with salt at Stassfurt. Granular; lustre shining, somewhat greasy. Structure undetermined. Dissolves easily in water. Composition, according to Oesten, chloride of magnesium 31·36, chloride of potassium 24·27, chloride of sodium 5·10, chloride of calcium 2·62, water 35·57. Part of this water is united to the chloride of calcium, so that the water of the pure mineral is reduced to about 33 p. c. The composition then becomes $K\,Cl + Mg\,Cl + 12HO$. The name is in honor of von Carnall, of the Prussian mines.

(5.) *Epsomite.* Masses, a foot in diameter, are found at the Alum Cave in Sevier Co., Tenn.

22. Coquimbite, Breithaupt, (1).
23. Manganvitriol, Glocker, (2).
24. Goslarite, *Haid.*, p. 68.
25. Chalkanthite, *Kenn.*, p. 68; Blue Vitriol.
26. Pyromeline, *Kob.*, p. 68; Nickel-vitriol.
27. Alum, p. 68.
    - Solfatarite, *Shep.*, (3).
    - Tschermigite, *Dan.*, (4).
    - Apjohnite, Glocker, (5).
    - Pickeringite, Hayes, (6).

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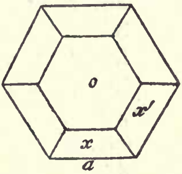
(1) *Coquimbite.* In hexagonal prisms, with terminal edges deeply replaced.

Fig. 717.



x on o	151° 0′
x on x'	128 8

Cleavage *a* and *x*, imperfect. Fracture conchoidal, to uneven. Transparent; white, passing into blue and green. H.= 2·0 ... 2·5. G.=2·0 ... 2·1. Taste vitriolic. In the matrass, yields water and sulphurous acid. Soluble in cold water. On heating the solution, peroxide of iron is thrown down. Analysis by Rose:

Sulphuric acid,	43·55	43·55
Peroxide iron,	24·11	52·21
Alumina,	0·92	0·78
Lime,	0·73	0·14
Magnesia,	0·32	0·21
Silica,	0·31	0·37
Water,	30·10	29·98

Found in xls., and massive, in a thick bed, in green feldspar, in the district of Copiapo in Coquimbo. The Blakeite of Dana, is referred by him to this species, notwithstanding it assumes the 8-dral form on re-crystallization.

(2) *Manganvitriol.* Sulphate of manganese. Imperfectly distinguished.

(3) *Solfatarite.* In white, or yellowish fibrous crusts. Analysis, by Thomson, sulphate of soda, 15·5, sulphate of alumina 37·4, water 47·1. Found at the island of Milo, at the Solfatara near Naples, and at Mendoza, on the eastern Andes.

(4) *Tschermigite,* Ammonia-alum. Fibrous and in 8-dra. That from Tschermig, Bohemia, according to Pfaff, contains;

Alumina,	12·14
Ammonia,	6·58
Sulphuric acid,	36·00
Water,	45·00

(5) *Apjohnite,* Manganese-alum. In silky fibres, resembling asbestus. Apjohn obtained,

Alumina,	10·65
Sesquiox. mang.,	7·33
Sulphuric acid,	39·79
Water,	48·15
Sul. magnesia,	1·08

Occurs at Lagoa Bay, S. Africa, and at Alum Point, Great Salt Lake, Rocky Mountains.

(6) *Pickeringite.* Magnesia-alum. In white, silky, fibrous masses, becoming opaque on exposure. Composition, from Iquique, according to Hayes,

Sulphate of magnesia,	13·4
Sulphate of alumina,	38·3
Water,	48·3

Found covering the floor of a cave (to the depth of six inches) near the Bosjesman river, S. Africa.

28. Voltaite, Scacchi, (1), p. 71.
29. Reussin, Karsten, p. 68.
30. Thenardite, Casaseca, p. 69.
31. Gaylusite, Boussingalt, p. 69.

Section C.

32. Sassolin, Karsten, p. 69.
33. Copiapite, Haidinger, p. 69.
    Misy, p. 69.
34. Alunogene, *Beud.*
    Keramohalite, Jurasky, (2).
35. Botryogene, Haidinger, p. 70.
36. Stypticite, Hausmann, (3).
37. Johannite, Haidinger, p. 70.
38. Bieberite, Haidinger, p. 70.
39. Arcanite, *Haid.*, p. 70.
40. Misenite, Scacchi, p. 71.
41. Polyhalite, Stromeyer, p. 70.
42. Loweite, Haidinger, p. 71.
43. Astrakanite, Rose, p. 71.

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(1) *Voltaite.* In 8-dra cubes and dodecahedrons. Lustre resinous. Oil-green, greenish-black, brown to black. Streak greyish-green. Opaque. Soluble in water with difficulty, and at the same time suffering decomposition. Composition, according to Scacchi,

Sulphate protox. iron,	15·4
" perox. iron,	40·6
Water,	44·

First found at the Solfatara near Naples, by Breislak (1792), and since by Ulrich, at the Rammelsberg mine, near Goslar. At the latter place, it contains traces of protox. manganese, also.

(2) *Keramohalite.* In crystalline crusts and six-sided tables, with two angles of 92°, and four of 134°. Primary form, an oblique rhombic prism. G.=1·6 ... 1·7. Composition, according to Jurasky,

Alumina,	14·80
Protox. iron,	2·15
Sulphuric acid,	36·75
Water,	44·60
Insoluble,	2·01

Occurs in druses with melanterite, near Königsberg, Hungary.

(3) *Stypticite.* Fibrous; silky; yellowish-green, greenish-grey. Brittle. Single fibres slightly flexible. H.=2·5. G.=2·5. Taste sour and astringent. Analysis, *a* from Copiapo, by Rose, *b* from Chili (variety *fibroferrite*) by Prideaux.

	a.	*b.*
Sulphuric acid,	31·73	28·9
Perox. iron,	28·11	34·4
Lime,	1·91	——
Magnesia,	0·59	——
Water,	36·56	36·7

Found with coquimbite in the province of Coquimbo.

CLASS II.

ORDER I. HALOID.

Section A.

Sp. 1. Felsobanyite, HAIDINGER (1).
2. Apatelite, MEILLET, p. 71.
3. Aluminite, *Jam.*, p. 72.
4. Struvite, *Ulex.*, p. 72.
5. Vivianite, p. 72.
6. Erythrine, *Beud*, p. 73.
7. Roselite, LEVY, (2).
8. Köttigite, *Dan.* (3). Zinkarseniat, OTTO KÖTTIG.
9. Pharmacolite, HAUSMANN, p. 73.
10. Haidingerite, TURNER, p. 74.
11. Gypsum, p. 74.
12. Hydroboracite, *Hess*, p. 75.
13. Hayesine, *Dan.* Borate of lime, HAYES, p. 75.
Ulexite, *Dan.*, Tiza, p. 76.
14. Hydrozincite, *Kenn.* Zinc-bloom, SMITHSON, p. 76.
15. Hydromagnesite, KOBELL, p. 76.

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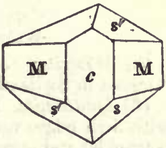
(1) *Felsobanyite.* In six-sided folia with two angles of 112°. Cleavage face pearly. Usually in concretions. H.=1·5. G.=2·33. Color snow-white, surface often yellowish. Analysis, by von Hauer, sulphuric acid 16·47, alumina 45·53, water 37.27. Occurs at Felsobanya in Hungary.

(2) *Roselite.* Right rhombic prisms of 135°. Secondary form.

M on M	-	135° 0′
M on *o*	-	157 30
s′ on *c*	-	140 42

Fig. 718.



H.=3·0. Cleavage parallel with shorter diagonal, perfect. Fracture conchoidal. Translucent. Lustre vitreous. Color deep rose-red. Streak white. In the matrass, yields water, and becomes black. B. B., in the outer flame, imparts a deep blue color to borax. Soluble in hydrochloric acid. Contains arsenic acid, lime, magnesia, oxide of cobalt and water. Occurs in small attached xls. at Schneeberg.

(3) *Kottigite.* In fibrous crusts and massive (supposed to be isomorphous with erythrine and vivianite).

H.=2·5 ... 3·0. G.=3·1.

Cleavage, perfect in one direction. Translucent. Lustre of fracture silky. Color light carmine-red to peach-blossom red. Streak reddish-white. In the matrass, yields water and assumes a pale smalt-blue color. B. B., on charcoal in the outer flame, fuses, emits fumes of arsenic, leaving a slag of oxide of zinc. Gives the reaction of cobalt and nickel. Soluble ln acids. Composition, $ZnO\ AS^2O^5+8HO$. Analysis, by Kötting,

Arsenic acid (loss), - - - - -	37·17
Oxide of zinc, - - - - -	20·52
Oxide of cobalt, - - - - -	6·91
Oxide of nickel, - - - - -	2·00
Lime, - - - - - - -	trace
Water, - - - - - -	23·40

Found with smaltine in the Daniel mine, near Schneeberg.

16. **Hydrodolomite**, *Dan.*, (1). Dolomite-sinter, Kobell.
17. **Wiserite**, Haidinger, (2).
18. **Oxalite**, *Haus.*, Humboldtine, Rivero, p. 76.
19. **Medjidite**, Smith, p. 76.
20. **Houghite**, Shepard, p. 77.
21. **Völknerite**, Hermann, p. 77.
22. **Arseniosiderite**, Dufrenoy, p. 77.
23. **Oxacalcite**, *Shep.*, p. 78. Whewellite, Brooke and Miller.
24. **Hopeite**, Brewster, p. 78.
25. **Diadochite**, Breithaupt, p. 90.
26. **Pitticite**, Hausmann, p. 78.
27. **Delvauxine**, Dumont, p. 89.
28. **Lanthanite**, *Haid.* (3). Carb. cerium, Berzelius.
29. **Anhydrite**, p. 78.
30. **Cryolite**, Abildgaard, (4), p. 79.
31. **Chiolite**, *Haid.*, p. 79.
32. **Calcite**, *Haid.*, p. 79.
33. **Hydrocalcite**, *Dan.*, (5). Hydrous carb. lime, Scheerer.
34. **Fluellite**, Wollaston, p. 88.
35. **Allophane**, Stromeyer, p. 88.

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(1) *Hydrodolomite.* In sinter-like, globular or stalactitic masses of a yellowish-white color and a dull earthy fracture. Found in isolated masses at Somma. Analysis, by Kobell,

Lime, - - - - - - -	25·92
Magnesia, - - - - - -	24·28
Carbonic acid, - - - - -	33·10
Water, - - - - - -	17·40

(2) *Wiserite.* A hydrated carbonate of manganese, found at Gonzen, near Sarganz in Switzerland.

(3) *Lanthanite.* In thin rectangular plates, aggregated by their broader faces, and with their edges variously replaced. Primary form a right rectangular prism. Also botryoidal and massive: coarsely granular; particles slightly coherent. Color pale rose-red, pink, or pale yellowish white. Lustre pearly to vitreous, resembling stilbite. Transparent to translucent. It is not found at Norwich, Conn., but with the zinc ores of the Saucon valley, Lehigh Co., Pa., and with blende and marcasite in the Canton copper and lead mine, in Cherokee Co., Georgia. Exceedingly rare.

(4) *Cryolite.* Occurs at Evigtok, 12 miles from Arksut, on the Arksut Fiord, in granitic gneiss. It forms an interstratified mass 80 feet thick and 300 long, bounded by chalybite, quartz, fluor and galena; and is intersected by a vein of quartz-rock containing coarsely crystallized feldspar, cryolite, cassiterite, columbite and ores of iron, lead and zinc. The galena contains 45 oz. of silver to the ton; and is worked. The cryolite is black upon the under side of the bed. Mr. J. W. Taylor, who describes it, infers that the white color of its superior surface, is owing to the former contiguity of trap, which is now seen only at the extremities of the deposit.

(5) *Hydrocalcite.* This is the *hydrous carbonate of lime* of Scheerer, and the *hydrokonite* of Hausmann. It occurs in small rhomboids, forming an incrustation on wood, under water. Composition, carbonate of lime 52·4, water 47·6. Exposed to the air, the water passes off. The xls. contain 1 p. c. of organic matter. By the action of absolute alcohol, it loses two equivalents of water and becomes $CaO, CO^2 + 3HO$. A blue limestone from Vesuvius, analyzed by Klaproth, had 11 p. c. of water.

36. Schrötterite, Glocker, (1).
37. Pyrargillite, Nordenskiold, p. 88.
38. Dillnite, Haidinger, (2).
39. Hitchcockite, Shepard, (3).
40. Gibbsite, Torrey, p. 89.
41. Dufrénite, Brongniart, p. 89.
42. Carphosiderite, Breithaupt, p. 89.
43. Cacoxene, Steinmann, p. 90.
44. Wavellite, Phillips, p. 90.
45. Pennite, *Herm.* Hydro-nickel magnesite, Shepard, p. 91.
46. Aragonite, p. 90.
47. Dolomite, p. 92.
48. Diallogite, *Beud.*, p. 96.
49. Manganocalcite, Breithaupt, p. 97.

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(1) *Schrötterite.* Called also, *Opal-allophane.* H.=3·0 ... 3·5. G.=1·95 ... 2·05. Color greenish, yellowish, and spotted with brown. Analysis, by Schrötter. Soluble in acids. B. B., like allophane.

Silica, - - - -	11·95	11·93
Alumina, - - -	43·30	46·28
Perox. iron, - - -	2·95	2·68
Lime, - - - -	1·30	1·03
Protox. copper, - - -	25	25
Water, - - - -	35·50	35·50

In nests, between clay slate and limestone. From Freienstein, Styria.

(2) *Dillnite.* Fracture flat conchoidal, even, earthy. Opaque. Dull white. H.=3·5. G.=1·8 ... 2·0. Analysis, by Hutzelmann and Karafiat, *a* compact, *b* earthy.

	a.	*b.*
Silica, - - - -	22·40	33·53
Alumina - - - -	56·90	53·00
Lime, - - - -	trace	0·88
Magnesia, - - - -	0·44	1·76
Water, - - - -	21·13	20·05

It is the gangue of the diaspore of Schemnitz.

(3) *Hitchcockite.* Massive. In coatings and botryoidal. Sometimes concentric like allophane. H.=2·75 ... 3. Gr.=2·909. Color, white, greyish, bluish and rarely with a tinge of green. Lustre vitreous to adamantine. Transparent to translucent. Heated in a glass tube, it emits much moisture. B. B., phosphoresces brightly, turning of a pale yellow color, while hot. Infusible. Moistened with nitrate of cobalt and ignited, it assumes a very rich blue color. In the state of powder, when moistened with sulphuric acid and heated, it tinges the flame of the candle green. With borax, it readily melts, attended by effervescence, into a transparent glass, which on cooling, has a faint tinge of blue. With soda, it quickly changes to a deep yellow color, attended by the reduction of oxide of zinc, and by a deposit of its oxide upon the charcoal, which has a yellow color while it is hot. Soluble without effervescence, in warm nitric or hydrochloric acid. By full ignition, in the state of powder, it loses 29·45 p. c.; and is inferred to be a hydrated phosphate of alumina, with oxide of zinc. Occurs in thin crusts, like hyalite, upon the joints of quartzy mica-slate, at the Canton copper-, and lead-mine, in Cherokee county, Ga. It is associated with marcasite, pyrites, galena, chalcopyrite, automalite and staurotide. Named after Dr. Hitchcock, of Amherst College.

50. Magnesite, (1).
51. Ankerite, HAIDINGER, p. 94.
52. Mesitine, BREITHAUPT, p. 94.
    Emmonsite, THOMSON, (2).
53. Plumbocalcite, JOHNSTON, (3).
    Neotype, BREITHAUPT, (4).
54. Fluor, p. 95.

Section B.

55. Glaubapatite, SHEPARD, (5).
56. Dreelite, DUFRENOY, p. 97.
57. Celestine, p. 97.
58. Barytes, p. 98. Heavy Spar.

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(1) *Magnesite.* Not known to exist in acicular xls., as stated on p. 90, but is simply massive; usually amorphous: very rarely cleavable. Chiefly from Gulsen and Steinmarck; also from Hrubschitz, Moravia. Analysis of cleavable varieties, *a* from Snarum, by Scheerer, *b* from Saltzburg by Dufrénoy, *c* from Arendal by Münster.

	a.	*b.*	*c.*
Carb. acid,	51·45	50·6	52·57
Magnesia,	47·30	43·1	46·22
Protox. iron,	0·79	5·2	0·37
Water,	0·47	——	——

Analysis of compact, *d* from Baumgarten, *e* from Salem, both by Stromeyer, *f* from Hrubschitz by Lampadius, *g* from Salem by Henry, *h* from Greece by Brunner, *i* from Madras by Pfeiffer.

	d	*e*	*f*	*g*	*h*	*i*
Carb. acid,	50·22	51·83	51·0	51·0	49·47	50·64
Magnesia,	47·36	47·89	47·0	46·0	51·03	46·12
Lime,	——	0·28	——	——	——	0·35
Ox. mang.,	0·21	——	silica	1·5	——	——
Water,	1·39	——	1·6	0·5	——	0·16

The specimen from Madras contained in addition, soda, 0·40, potash 0·67, alumina 0·26, silica 0·23, phosphoric acid and chlorine, in traces.

(2) *Emmonsite.* Snow-white, massive, granular to compact. Composition, according to Thomson, carbonate of strontian, with 12·5 p. c. of carbonate of lime. Found at Schoharie, N. Y. The *strontianocalcite* of Genth is probably related to this mineral.

(3) *Plumbocalcite.* In rhomboids of 104° 53′, having a peculiar greyish-white color, with a somewhat oily lustre. Also massive. H. rather below 3. According to Johnston, contains carbonate of lime 92·2, carbonate of lead 7·8. Found at Waulockhead, in the Lead Hills, Scotland.

(4) *Neotype.* Contains beside carbonate of lime, a little carbonate of barytes. G.=2·82 ... 2·83.

(5) *Glaubapatite.* Crystals small tabular; in druses, forming botryoidal and stalactitic masses: columnar, fibres somewhat flattened and radiating from the centre of little, oval masses and stalactites. Color, pale yellowish, or greenish brown. Translucent. H.=3·5. G.=2·6. Also massive, with a conchoidal fracture, and of a dark chocolate brown color, to nearly black. Brittle.

When heated in a glass tube, gives water; at the same time turning brown and evolving a slight organic odor. B. B., it does not decrepitate, but turns brown on the first impression of the heat, and quickly fuses with ebullition, coloring the flame yellow, with a very distinct tinge of green, around the heated mass. It finally yields a semi-transparent glass. With borax, melts into a colorless glass. When powdered, the mineral dissolves without effervescence, in hydrochloric and in nitric acid,

59. Witherite, Werner, p. 101.
60. Barytocalcite, Brooke, p. 102.
61. Alstonite, Breithaupt, p. 102.
62. Strontianite, Sulzer, p. 103.
63. Chalybite, Glock, p. 105.
64. Pyroclasite, Shepard, (1).
65. Parisite, Spada, p. 105.
66. Yttrocerite, Berzelius, p. 105.
67. Fluocerite, *Haid.*, p. 105.
    Fluocerine, *Haus.*, p. 106.
68. Xenotime, Beudant, p. 106.

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affording solutions of a porter-brown color, from which, ammonia throws down the same precipitate as in pyroclasite. Analysis gave the following result:

Phosphate of lime, - - - -	74·00
Sulphate of soda, - - - - -	15·10
Water, with traces of organic matter; sulphate of lime and chloride of sodium, - -	10·30
	99·40

It occurs abundantly in irregular corroded, drusy shaped masses, (but very rarely crystalline) often coated on one side with pyroclasite; and sometimes, the two species are intimately blended together. It is named out of regard to its relationship to apatite, and to glauber's salt.

From Mong's Island on the Musquito coast of the Caribbean Sea; where it is found along with pyroclasite, closely associated with, and apparently altered by, trap.

(1) *Pyroclasite.* Massive; in large tuberose and reniform masses, much resembling the menilite-opal, from Menil Montant near Paris; except, that they are flatter, more irregular, and rarely oval on both sides. In this respect, they more resemble the large druses of calcedony from Faroe or the hemimorphite from Cumberland. Structure indistinctly concentric; and when broken across (through masses of an inch thick) it presents a banded surface, like agates or ribbon-jasper. Color, cream-white; but on the botryoidal surfaces which have been exposed to the weather, milk-white: and presenting when viewed with a single lens, a very remarkable corroded appearance, much resembling the vermicular surface of marble, as employed in architecture. Lustre dull, feebly resinous on a fresh fracture. Opaque. Brittle. Fracture even, to sub-conchoidal. H.=4·0. G.=2·36 ... 2·4.

Heated in a glass tube, it flies to pieces with a brisk decrepitation; much of the mineral being at the same time projected from the tube. At the same time, it turns of a dark color, emits moisture and a feeble animal odor, not more perceptible however than in many secondary limestones when heated. It is impossible to hold a piece of the unheated mineral before the flame of the blowpipe, long enough to acquire redness; but occasionally, a fragment large enough for this purpose, coming from the heated glass tube, will bear ignition in the platina forceps, without flying to pieces. It then instantly becomes white, phosphoresces strongly, tinging the flame yellow, slightly tipped with green. At length, it fuses on the edges into a white glassy enamel; and the fragment being placed upon a piece of moistened tumeric paper, occasions a feebly alkaline reaction. The heated mass on being moistened with sulphuric acid, tinges the flame of the blowpipe momentarily, of a still deeper green. The powdered mineral, mixed into a paste with sulphuric acid, and heated in a glass tube, produced an etched ring just above the charge in the tube, indicating the presence of fluorine. Fused with borax, the mineral dissolves into a clear glass, unless there is an excess of the powder.

The powdered mineral is almost wholly taken up, by hydrochloric and by nitric acid, without sensible effervescence; forming a porter-colored solution, from which ammonia precipitates the characteristic bulky white precipitate of hydrated triphosphate of lime. It consists of about 80 p. c. phosphate of lime (mingled with some magnesia), and 10 p. c. of water; the remaining 10 p. c. consisting of a mixture of carbonate of lime, sulphate of lime, sulphate of soda, insoluble matter, and traces

Castelnaudite, DAMOUR, (1.)
69. Childrenite, LEVY, p. 106.
70. Alunite, BEUDANT, p. 106.
Jarosite, BREITHAUPT, (2).
71. Herderite, HAIDINGER, p. 107.
72. Monacite, BREITHAUPT, p. 109.
73. Cryptolite, WÖHLER, p. 110.
74. Zwieselite, BREITHAUPT, p. 112, (3).
75. Phosphocerite, WATTS, p. 110.
76. Wagnerite, FUCHS, p. 110.
77. Smithsonite, *Beud.*, p. 110. Calamine.
78. Hemimorphite, *Kenn.*, p. 111. Electric Calamine.
79. Willamite, LEVY, p. 112.
Troostite, SHEPARD, (4).
80. Triplite, p. 112.
81. Berzelite, KUHN, p. 118.
82. Ficinite, BERNHARDI, (5).

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of chloride of sodium and fluorine. The name alludes to its property of flying to pieces, when heated.

From Mong's Island on the Musquito coast of the Caribbean Sea, where it is found along with glaubapatite, closely associated with, and apparently altered by trap.

(1) *Castelnaudite.* In imperfect xls. and irregular grains. Cleavage in two directions. H. above 4. Lustre greasy, adamantine. Color greyish-white to pale yellow. B. B., whitens, but does not melt. With borax, dissolves, and gives a colorless pearl, which becomes white and opaque in the oxydating flame. Dissolves with extreme slowness in salt of phosphorus, giving a colorless glass. Soluble in heated, concentrated sulphuric acid. Probably a hydrous phosphate of yttria. From the diamond sands of Bahia, in Brazil.

(2) *Jarosite.* An iron-alum, found at Baranco Jaroso in the Sierra Almagera, Spain, which crystallizes in rhomboids of 88° 58′. Color, yellowish. Cleavage basal. Analysis by Scheerer;

Sulphuric acid, - - - - - -	28·8
Perox. iron, - - - - - -	62·5
Potash, - - - - - - -	6·7
Alumina, - - - - - - -	1·7
Water, - - - - - - -	9·2

(3) *Zwieselite.* Prismatic. Cleavage in one direction, perfect; indistinct in several others. Fracture imperfectly conchoidal to uneven. Translucent on the edges. Lustre resinous. Color clove-brown. Streak greyish-white. H. = 5·0. G. = 3·07. Decrepitates, when heated. B. B., melts easily into a blackish-blue, magnetic globule. With fluxes, gives the reaction of iron and manganese. Soluble in warm hydrochloric acid. When moistened in powder, by strong sulphuric acid, affords hydrofluoric acid. Analysis, *a* by Fuchs, *b* and *c* by Rammelsberg.

	a	*b*	*c*
Phosphoric acid, - -	35·60	not determ'd.	30·33
Protoxide of iron, -	35·44	40·90	41·42
Protox. of mang., - -	20·34	24·33	35·25
Fluorine, - - -	3·18	not determ'd.	6·00
Iron, - - - -	4·76	——	——
Silica, - - - -	0·68	——	——

Found at Zwiesel near the Bodenmais, Bavaria.

(4) *Troostite.* Its identity with willemite has not yet been fully established.

(5) *Ficinite.* Oblique rhombic prs. Cleavage perfect in one direction, also in a second, inclined 129° to the former. Color, black; within, greenish brown. Lustre weak, waxy to pearly. H.=5·0 ... 5·5. G=3·4 ... 3·53. Subtranslucent. In a

ORDER II. MALACHITE.

Sp. 1. Aurichalchite, BÖTTGER, p. 76.
2. Buratite, DELESSE, p. 76.
3. Annabergite, *B.* and *M.*, p. 117. Nickel green.
4. Kupaphrite, *Shep.*, p. 117. Kupferschaum, WERNER.
5. Chrysocolla, *Jam.*, p. 117.
6. Tamarite, *B.* and *M.*, p. 118. Copper-mica, *Jam.*
7. Liroconite, *Beud.*, p. 118.
8. Symplesite, BREITHAUPT, p. 118.
9. Pharmacosiderite, *Haus.*, p. 119.
10. Texasite, *Kenn.*, p. 119. Emerald-Nickel. SILLIMAN.
11. Uranite, *Jam.*, p. 119.
12. Torberite, *B.* and *M.*, (1). p. 120.
13. Liebigite, SMITH, 120.
14. Aphanesite, *Beud.*, p. 121.
15. Atacamite, BLUMENBACH, p. 120.
16. Marcylite, SHEPARD, (2).
17. Volborthite, ROSE, p. 121.
18. Chileite, *Kenn.* (3). Vanadiate lead and copper. DOMEYKO.

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glass tube yields water, without much change. B. B., fuses to a semi-metallic slag, which is magnetic; with borax and salt of phosphorus to a clear bead, colored by iron, which on cooling, becomes opaque. Analysis by Ficinus.

Phosphoric acid,	12·82
Sulphuric acid,	4·07
Protox. iron,	58·85
Protox. mang.,	6·82
Lime,	0·17
Silica,	0·17
Water,	16·87

From Bodenmais, Bavaria.

(1) *Torberite.* This is the copper-uranite. H.=2·0 ... 2·5. G.=3·5 ... 3·6: and is now regarded as a distinct species from uranite.

(2) *Marcylite.* In flattened reniform masses, an inch or more in diameter. Color black. Fracture even; dull. H.=3. G.=4·0 ... 4·1. In small fragments, fuses in the flame of a candle, tinging it of a rich greenish-blue color. B. B. chloride of copper is volatilized and spreads over the support, pure copper being finally obtained. In powder, it is chiefly dissolved in aqua ammoniæ. Analysis, by the author.

Copper,	54·30
Oxygen and chlorine,	36·20
Water,	9·50

Found in a red gypseous clay; and loose, in the soil of the Wachita Mts., in the Red River country; and named from Capt. Marcy, its discoverer.

(3) *Chileite.* Color dark brown, or brownish-black; earthy, resembling a ferruginous clay. Found in cavities, in an arseniated pyromorphite, along with amorphous cerussite and malachite. B. B., fuses easily into a blebby, black pearl. With salt of phosphorus, or borax, gives a clear green pearl and a mixed globule of lead, antimony and copper. Soluble in nitric acid. Analysis, by Domeyko.

Vanadic acid,	13·5	13·33
Arsenic, "	4·6	4·68
Phosphoric "	0·6	0·68
Protox. copper,	14·6	16·97
" lead,	54·9	51·97

Found at the silver-mine, called Mina Grande, in Chili.

19. Olivenite, *Jam.* p. 122.
20. Scorodite, BREITHAUPT, p. 122.
21. Euchroite, BREITHAUPT, p. 123.
22. Brochanite, LEVY, p. 123.
23. Cyanotrichite, *Glock.*, p. 124. Lettsomite.
24. Azurite, *Beud.*, p. 180.
25. Malachite, WERNER, p. 125.
26. Thrombolite, BREITHAUPT, p. 128.
27. Libethenite, BREITHAUPT, p. 126.
28. Lunnite, BERNHARDI, p. 126.
29. Conichalcite, BREITHAUPT, (1).
30. Cornwallite, ZIPPE, (2).
31. Erinite, HAIDINGER, p. 128.
32. Dioptase, HENRY, p. 127.

ORDER III. BARYTE.

1. Percylite, BROOKE, p. 129.
2. Selbite, *Haid.*, p. 129
3. Kerate, *Haid.*, p. 129.
4. Iodite, *Haid.*, p. 130.
5. Bromite, *Haid.*, p. 130.
6. Embolite, BREITHAUPT, p. 130.
7. Coccinite, *Haid.*, p. 130.
8. Calomel, p. 130.
9. Valentinite. p. 131.
10. Senarmontite, *Dan.* Octahedral oxide antimony, M. H. DE SENARMONT.
11. Vauquelinite, STEFFENS, p. 131.
12. Lehmannite, *B.* and *M.*, p. 132. Beresofite, *Shep.*
13. Melanochroite, HERMANN, p. 132.
14. Wulfenite, *Haid.*, p. 132.

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(1) *Conichalcite.* Reniform and massive. H.=4·5. G.=4.12. Color, pistachio-green, inclining to emerald-green. Subtranslucent. Brittle. Fracture splintery. Analysis, by Fritzsche,

Arsenic acid,	30·68
Phosphoric acid,	8·81
Vanadic acid,	1·78
Protox. copper,	31·76
Lime,	21·36
Water,	5·61

From Andalusia, Spain.

(2) *Cornwallite.* H.=4·5. G.=4·166. Amorphous. Color, blackish, or verdigris-green. Analysis, by Lerch,

Arsenic acid,	30·21
Phosphoric acid,	2·16
Protox. copper,	54·61
Water,	13·02

Found with olivenite at Cornwall.

15. Leadhillite, *Beud.*, p. 133. Sulphato-tri-carb. lead, Brooke.
16. Caledonite, *Beud.*, p. 134. Cupreous sulphato-carb. lead, Brooke.
17. Linarite, Brooke, p. 134.
18. Lanarkite, *Beud.*, p. 134. Sulphato-carb. lead, Brooke.
19. Anglesite, *Beud.*, p. 135.
20. Mendipite, *Breit.*, p. 136.
21. Cotunnite, *Kob.*, p. 136.
22. Phosgenite, *Breit.*, p. 136.
23. Matlockite, Gregg, p. 136.
24. Cerussite, *Haid.*, p. 137.
25. Stolzite, *Haid.*, p. 138.
26. Pyromorphite, *Haus.*, p. 139.
27. Mimetite, *Haid.*, p. 140.
28. Hedyphane, Breithaupt, p. 140.
29. Cherokine, Shepard, (1).
30. Vanadinite, *Haid.*, p. 140.
31. Bleinerite, *Nic.*, p. 140.
32. Dechenite, Bergemann, p. 141.
33. Descloizite, Damour, (2).
34. Plombgomme, p. 141.
35. Bismutite, *Breit.*, p. 141.
36. Scheelite, *Leonh.*, p. 142.

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(1) *Cherokine.* In slightly acuminated hexagonal prisms, somewhat drusy; botryoidal and massive. Color, white, with a tinge of pink, interiorly; the outside being often greenish or bluish-white. Lustre adamantine. Several indistinct cleavages parallel to the prismatic axis. Fracture uneven. Translucent. H.=3·75 ... 4. G.=4·81. Heated in a tube, affords a little moisture, becomes milk-white and opaque. B. B., becomes yellow, while hot, phosphoresces slightly, swells up and melts with effervescence into a yellow globule (a slight yellow areola, surrounding the mass); on cooling does not crystallize, but is perfectly glassy, colorless and semi-transparent. In powder, moistened with sulphuric acid, does not tinge the flame of the candle green. With soda, effervesces violently, is brick-red while hot, yellow when cold, affording an abundance of lead globules and a large ring, yellow while hot but white on cooling. Heated with nitrate of cobalt, it affords the deep blue, characteristic of alumina. Soluble in nitric acid without effervescence. It is chiefly phosphate of lead; but also contains hydrate or phosphate of alumina (or both) and oxide of zinc. It differs from plombgomme by containing much less water, and possessing an inferior specific gravity. Found in seams and cavities with pyrites, chalcopyrite, quartz and staurotide at the Canton mine in Cherokee Co., Ga.; and named from the county in which it occurs.

(2) *Descloizite.* In right rhombic prisms of 122° 6′, having the acute angles deeply replaced, to form dihedral summits of 116° 25′. H.=3·5. G.=5·83. Lustre bright. Color olive-green to black. Lustre bronze. By transmitted light, the color approaches red. B. B., fuses, and is partially reduced to a globule of metallic lead, enveloped in black scoria. Gives in the reducing flame with borax, a green glass; and with nitre in the oxydating flame, a violet-color, due to manganese. With salt of phosphorus, in the reduction flame, gives a chrome-green color. Dissolves in cold dilute nitric acid. Analysis, by Damour: vanadic acid 22·46, ox. lead 54·70, ox. zinc 2·04, oxides of mang. 11·32, sand 3·44.

In very minute xls., with pyromorphite, from South America.

37. Eulytine, *Breit.*, (1).
38. Romein, Dufrenoy, p. 114.

ORDER IV. OCHRE.

1. Xanthitane, Shepard, (2).
2. Tellurite, *Nic.*, 143.
3. Molybdine, *L.* and *Gregg*, p. 143.
4. Arsenite, *Haid.*, p. 143.
5. Bismucone, *Shep.*, p. 143. Bismuth-ochre.
6. Wolframine, *L.* and *Gregg*, p. 144.
7. Cervantite, *Dan.* p. 144.
8. Cumengite, *Kenn.*, (3). Hydrous Antimonic acid, Cumenge.
9. Plattnerite, Haidinger, (4).
10. Minium, p. 144.
11. Palladinite, *Shep.*, p. 144.

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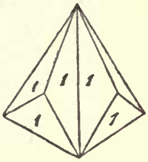
(1) *Eulytine.* (Bismuth-blende). Primary form, cube. Secondary form.

Fig. 719.



Also in twins. The faces 1 are striated parallel to their intersections with those of the dodecahedron. Lustre adamantine. Color brown to yellow and black. Semi-transparent. H.=4·5 ... 5·0. G.=5·96. B. B., on charcoal, melts with effervescence into a brown bead, coating the support of a yellowish-brown color. With soda, yields bismuth. In salt of phosphorus, leaves a skeleton of silica. Soluble in hydrochloric acid, forming a jelly. Analysis, by Karsten:

Silica, - - - - - - -	22·23
Oxide of bismuth, - - - - - -	69·38
Perox. iron, - - - - - -	2·40
Ox. mang., - - - - - -	0·80
Phosphoric acid, - - - - -	3·31
Water, fluorine and loss, - - -	2·38

Found in very small, attached crystals and druses, in the cobalt veins of Schneeberg, and at Braunsdorf, Saxony.

(2) *Xanthitane.* In hollow crystals with the form of sphene, and pulverulent. Color, pale yellowish white, resembling some varieties of sulphur or of decomposing wulfenite. Lustre generally feeble, but in some instances bright and resinous. Brittle. H.=3·5. G.=2·7 to 3·0. Cleavage indistinct. Heated in a glass tube, emits moisture; and B. B., has all the reactions of titanic acid. It contains 12·5 p. c. of water, and consists of titanic acid with traces of zirconia. It is found in a decomposing feldspar, associated with zircon, at Green River, Henderson Co., N. C.; and probably proceeds from the decomposition of sphene.

(3) *Cumengite.* A white powder or crust, occurring with cervantite in the province of Constantine, Algeria, It afforded Cumenge,

Antimony, - - - - - -	62
Oxygen, - - - - - - -	17
Water, - - - - - - -	15
Perox. iron, - - - - - - -	1
Gangue, - - - - - - -	3

(4) *Plattnerite.* In hexagonal prisms with replaced basal edges; pseudomorphous after pyromorphite. Cleavage indistinct. G.=9·39 ... 9·45. Lustre metallic adamantine. Color iron-black. Streak brown. Opaque. Composition, PbO^2 ? Leadhills, Scotland, at Vera Cruz, and many other places.

SUB-ORDER, ARGIL.

Melanolite, Wurtz, p. 162.
Pimelite, Karste,n p. 145.
Wad, Karsten, p. 145.
Asbolane, *B.* and *M.*, (1).
Miloschin, Herder, p. 144.
Wolchonskoite, Kammerer, p. 145.
Pelokonite, Richter, (2). Copper-black.
Bole, Werner, p. 115.
Pinguite, Breithaupt, p. 116.
Quincite, Berthier, p. 147.
Nontronite, Berthier, p. 115.
Montmorillonite, Salvetat, (3).
Groppite, Svanberg, p. 149.
Lithomarge, p. 115.
Meerschaum, Werner, p. 162.
Spadaite, Kobell, p. 152.
Pipestone, Thomson.
Saponite, p. 151.
Gilbertite, Thomson, (4).
Pholerite, p. 114.
Damourite, Delesse, p. 161.
Halloysite, Berthier, p. 114.
Kaolin, pp. 114, 187.
Lenzinite, John, p. 114.
Kollyrite, Friesleban, p. 114.
Scarbroite, Vernon, p. 115.

ORDER V. PICROSMINE.

Sp. 1. Agalmatholite, *Leonh.*, p. 146.
2. Dysyntribite, Shepard, p. 146.

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(1) *Asbolane.* To the account on p. 145 of earthy cobalt, the following analysis of asbolane from Kamsdorf, by Rammelsberg, is added:

Protox. mang.,	40·05
Oxygen,	9·47
Oxide cobalt,	19·45
Oxide copper,	4·35
Perox. iron,	4·56
Barytes,	0·50
Potash,	0·37
Water,	21·23

(2) *Pelokonite.* Supposed to be a variety of asbolane. Color liver-brown. H.=3. G.=2·567.

(3) *Montmorillonite* Rose-red, fragile. From Montmorillon, Confolens in Charente, France.

(4) *Gilbertite.* An altered mica, which has lost the alkalies, wholly, or in part. H.=2·75. G.=2·648. From Stonagwyn, St. Just., Cornwall. The variety from Saxony is supposed by Zschau, to be derived from topaz.

3. **Kerolite**, BREITHAUPT, p. 146.
4. **Marmolite**, NUTTALL, p. 147.
5. **Hisingerite**, BERZELIUS, p. 115.
6. **Dermartine**, BREITHAUPT, p. 147.
7. **Serpentine**, p. 147.
8. **Picrosmine**, HAIDINGER, p. 148.
9. **Antigorite**, SCHWEISSER, p. 155.
10. **Picrolite**, HAUSMANN, p. 148.
    Chrysotile, KOBELL, p. 149.
11. **Bastite**, HAIDINGER, (1), p. 199.
12. **Williamsite**, SHEPARD, p. 149.

ORDER VI. MICA.

Section A.

Sp. 1. **Talc**, p. 150.
2. **Chlorite**, p. 150. Pennine.
3. **Chalcodite**, SHEPARD, 152.
4. **Graphite**, p. 373.
5. **Corundophilite**, SHEPARD, p. 153.
6. **Epichlorite**, RAMMELSBERG, p. 154.
7. **Brucite**, *Beud.*, p. 154.
    Nemalite, NUTTALL, p. 154.
8. **Thuringite**, BREITHAUPT, (2).

---

(1) *Bastite.* In addition to the properties of this mineral given on p. 199, the following may be supplied. In the matrass, yields water. B. B., becomes brown and magnetic, melting only on the edges of the thinnest splinters. With borax, forms a glass, which while hot, shows the color of iron; and when cold, that of chrome. Completely decomposed by sulphuric acid; imperfectly by hydrochloric. Analyses; *a* and *b*, of crystallized bastite from the Harz by Köhler, *c* of compact.

	a	*b*	*c*
Silica,	43·90	43·07	42·36
Magnesia,	25·85	26·16	28·90
Lime,	2·64	2·75	0·63
Protox. iron,	13·02	10·91	13·27
" mang.,	0·53	0·57	0·85
Ox. chrome,	——	2·37	——
Alumina,	1·28	1·73	2·18
Water,	12·43	1243	12 07

(2) *Thuringite.* Massive. Cleavage distinct in one direction. Lustre pearly. Olive-green. Streak siskin-green. H.=2·0 ... 2·2. G.=3·151 ... 3·157. Analysis by Rammelsberg,

Silica,	22·41
Perox. iron,	21·94
Protox. iron,	42·60
Magnesia,	1·16
Water,	17·40

It occurs at Saalfeld.

9. Jenkinsite, Shepard, p. 155.
10. Cronstedite, Steinmann, p. 155.

Section B.

11. Lepidolite, Werner, p. 156.
12. Mica, p. 156.
13. Biotite, Hausmann, p. 158.
14. Phlogopite, Breithauht, p. 158.
15. Margarite, Fuchs, p. 159.

Section C.

16. Lepidomelane, Soltmann, p. 159.
17. Stilpnomelane, Glocker, p. 159.
18. Pyrosmalite, Hausmann, p. 160.
19. Clintonite, Fitch and Mather, p. 160.
20. Chloritoid, Breithaupt, p. 160.
21. Ottrelite, Hauy, p. 161.

Order VII. ZEOLITE.

1. Stilbite, Hauy, p. 163.
2. Heulandite, Brooke, p. 163.
3. Epistilbite, Rose, p. 164.
4. Chabasite, Werner, p. 164.
5. Gismondine, Marignac, p. 165.
6. Edingtonite, Haidinger, p. 166.
7. Harmotome, Hauy, p. 166.
8. Phillipsite, Levy, p. 167.
9. Apophyllite, Hauy, p. 167.
10. Comptonite, Brewster, p. 168.
11. Scolecite, Fuchs, (1), p. 168.

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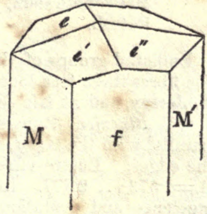
(1) *Scolecite.* The lime-mesotype (p. 169) properly constitutes the species now called scolecite. Primary form an oblique rhombic prism. M on M.=91° 36′.

Secondary form. M on *f*=131° 12′.

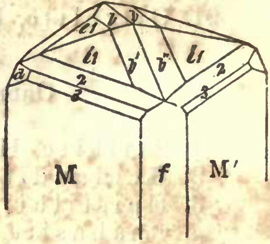
Cleavage parallel to M perfect. H.=5·0 ... 5·5. G.=2·2 ... 2·3. It is completely decomposed by hydrochloric acid, leaving a residue of oxalate of lime. B. B., curls up, and melts into a blebby glass.

Fig. 720.



12. **Natrolite**, Klaproth, (1), p. 168.
13. **Pectolite**, Kobell, (2).
14. **Okenite**, Kobell, p. 170.
15. **Laumonite**, Hauy, p. 170.
16. **Brewsterite**, Brooke, p. 171.
17. **Datholite**, Werner, p. 171.
18. **Analcime**, Hauy, p. 172.
19. **Eudnophite**, Weibye, p. 176.
20. **Faujasite**, Damour, p. 173.
21. **Davyne**, *B.* and M., p. 174. Cancrinite, Rose.
22. **Ittnerite**, Gmelin, (3).
23. **Haüyne**, Neergard, p. 173.
24. **Ultramarine**, p. 173.
25. **Sodalite**, Thomson, p. 144.
26. **Nepheline**, Hauy, p. 174.

Fig. 721.



(1) *Natrolite.* This is the soda-mesotype, p. 169. Primary form, right rhombic prism. M on M=91°. Secondary form,

M on *e*	-	115°	60′
M on *f*	-	134	30
e′1 on *e*′1 on *f*		108	20
e′1 on *e*1	-	143	20

Cleavage parallel to M perfect. B. B., melts quietly into a clear glass. Almost entirely soluble in oxalic acid. Sometimes a small portion of the soda is replaced by lime. Natrolite is the most usual species.

(2) *Pectolite.* Imperfectly fibrous, radiating, greyish-white. Lustre pearly. Translucent on the edges H.=4·0 ... 5·0. G.=2·74 ... 2·75. In the matrass, yields water. B. B., melts easily into a white lead. In powder, is decomposed by hydrochloric acid, leaving a flocky residue of silica. After ignition, forms a jelly with hydrochloric acid. Analyses by Heddle, *a* from Ratho, *b* from Bishoptown, *c* from Bavaria (variety *Osmelite*).

	a	*b*	c
Silica,	52·83	52·07	52·91
Lime,	32·79	32·80	32·76
Soda,	9·75	9·60	6·10
Water,	3·04	2	4·01
Alumina, Perox. iron, Manganese soda,	0·88	4·20	0·86
Potash,	——	——	2·79

Radiated groups of this mineral, according to Greg, occurs in Ayrshire, having the fibres three feet long. It is the stellite of Thomson. It occurs at Bergen Hill, N. Jersey, and at Isle Royal, Lake Superior. Also at Skye.

(3) *Ittnerite.* Primary form, cube. Secondary, rhombic dodecahedron. Cleavage parallel with the latter, distinct. Fracture flat conchoidal to uneven. Translucent on the edges. Lustre vitreous to resinous. Color dark bluish, to ash-grey. H.=5·5. G.=2·373 ... 2·377. In the matrass, yields water. B. B., melts easily, with intumescence and evolution of sulphurous acid, into a blebby opaque glass. It is decomposed by concentrated hydrochloric acid, disengaging hydrosulphuric acid, and

27. **Leucite**, Werner, p. 175.
28. **Carpholite**, Werner, p. 182.
29. **Prehnite**, Werner, p. 176.

Order VIII. SPAR.

1. **Leucophane**, Esmark, p. 91.
2. **Wollastonite**, Hauy, p. 177.
3. **Scapolite**, Werner, p. 177.
4. **Sarcolite**, Thomson, (1), p. 172.
5. **Dypyre**, Hauy, p. 179.
6. **Chiastolite**, Karsten, (2), p. 223.
7. **Melilite**, Carpi, p. 179.
8. **Eudyalite**, Stromeyer, p. 180.
9. **Lazulite**, Karsten, p. 180.
10. **Turquoise**, p. 181. Kallaite, Fischer.
11. **Periclase**, Scacchi, p. 181.
12. **Amblygonite**, Breithaupt, p. 181.
13. **Feldspar**, p. 185.
14. **Albite**, Rose, p. 188.
15. **Oligoclase**, Breithaupt, p. 189.
16. **Ryacolite**, Rose, p. 189.
17. **Anorthite**, Rose, p. 190.
18. **Labradorite**, *Beud.*, p. 191.

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forming a jelly of silica. Boiling water dissolves out sulphate of lime. Analyses, by C. Gmelin and Whitney:

Silica,	34·02	35·69
Alumina,	28·40	29·14
Perox. iron,	0·62	——
Lime,	7·27	5·64
Soda,	12·15	12·57
Potash,	1·57	1·20
Sulphuric acid,	1·86	4·62
Chlorine,	0·75	1·25
Water and loss,	10·76	9·83

Found in xls. and massive in basalt on the Eichberg, at Ober-Rotwheil on the Kaiserstuhl, in Baden.

(1) *Sarcolite.* Primary form, right rhombic prism. Summits surmounted by 25 planes, one set of which are hemihedral (only the alternate occurring). H.=6·0. G.=2·54. Fracture conchoidal. Semi-transparent ... translucent. Lustre vitreous. Color flesh-red to white. Very brittle. B. B., fusible. Analysis by Scacchi;

Silica,	42·11
Alumina,	24·50
Lime,	32·43
Soda,	2·93

Found among the debris of the older eruptions of Vesuvius.

(2) *Chiastolite.* The crystals of this mineral found at Lancaster, Mass., manifest a tendency to an acute pyramidal termination, not agreeable to any observed forms of andalusite. Its constantly preserved lower degree of hardness, equalling only 4·5 ... 5, and an inferior Gr., which is but 2·9, seem to justify the separation of this mineral from andalusite, with which species it has been associated for the last twenty years.

19. Barsowite, Rose, p. 190.
20. Spodumene, D'Andrada, p. 182.
21. Babingtonite, Levy, p. 183.
22. Epidote, Hauy, p. 183.
23. Hornblende, Werner, p. 193.
24. Pyroxene, Hauy, p. 196.
25. Fowlerite, (1).
26. Boltonite, Shepard, p. 182.
27. Rhodonite, *Beud.*, p. 192.
28. Petalite, D'Andrada, p. 193.
29. Nephrite, Werner, p. 192.

ORDER IX. GEM.

1. Opal, Plinius, p. 201.
2. Pitchstone, Werner, p. 202.
3. Isopyre, Haidinger, p. 202.
4. Helvin, Werner, p. 204.
5. Chondrodite, D'Ohsson, p. 203.
6. Idocrase, Hauy, p. 205.
7. Garnet, Werner, p. 206.
8. Ouarowite, Hess, p. 206.
9. Schorlomite, Shepard, p. 257.
10. Chrysolite, Werner, p. 208.
11. Quartz, p. 209.
12. Iolite, p. 130. Dichroite, Cordier, p. 130.
13. Boracite, Werner, p. 208.
    Rhodizite, Rose, p. 218.
14. Danburite, Shepard, p. 218.

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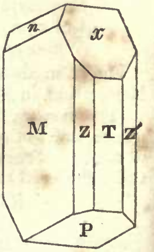
(1) *Fowlerite.* Primary form, doubly oblique prism. Secondary form.

Fig. 722.



	Greg.	Dauber.
M on T -	92° 40′	92° 22′
M on P - -	93 50	93 28½
T on P -	110 40	111 8½
M on *z* - -	136 20	136 8½
M on *z′* -	138 20	138 11½
M on *n* - -	148 42	148 47
T on *x* -	142 30	142 39½
M on *x* - -	86 35	85 24

Cleavage parallel to M and T nearly equally perfect. The foregoing angles have been obtained by Greg and Dauber from xls., coming from the Paisberg iron-mine in Phillipstadt, Sweden, and which were named *paisbergite* by Igelström. It now appears that they are identical with the rhodonite of Przibram, Bohemia, the *silicate of manganese*, of Cumberland, R. I., (see Am. Journ. of Science, vol. xvii, p. 142) and the *fowlerite* of Franklin N. Jersey. This last mineral was thus designated, thirty years ago, by Nuttall and others, in honor of the late Dr. Fowler, of Franklin. It is not certain that it is distinct from rhodonite.

15. Axinite, Hauy, p. 239.
16. Tourmaline, Werner, p. 219.
17. Staurotide, Hauy, p. 22.
18. Andalusite, Lametherie, p. 223.
19. Kyanite, p. 224.
20. Fibrolite, Bournon, p. 225.
21. Zircon, Werner. p. 226.
22. Phenacite, Nordenskiöld, p. 228.
23. Diaspore, Hauy, p. 228.
24. Euclase, Hauy, p. 223.
25. Beryl, Werner, p. 229.
26. Chrysoberyl, Werner, p. 231.
27. Topaz, Werner, p. 232.
28. Spinel, Werner, p. 239.
29. Automalite, Eckeberg, (1).

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(1) *Automalite.* Primary form, cube.
Secondary forms.

Fig. 723.

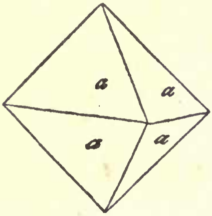


Fig. 724.

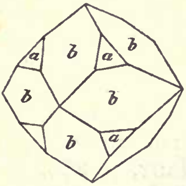
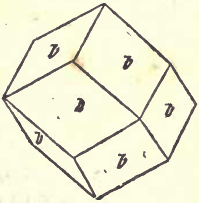


Fig. 725.



Surface *b*, striated parallel to their intersections with *a*,

Cleavage, cubic, (distinct), and octahedral. Color dark leek-green, to greyish-black. H,=7·5 … 8·0. G.=4·23 … 4·9. B. B., infusible. In powder, with soda, on charcoal, in the inner flame, deposits a sublimate of zinc. In powder, fuses with bisulphate of potash, into a mass which is completely soluble in water. Analysis, *a* from Fahlun, *b* from the U. States by Abich, *c* from Bodenmais by Kobell:

	a	*b*	*c*
Alumina,	55·14	57·00	49·62
Perox. iron,	5·85	——	9·60
Oxide zinc,	30·02	34·80	26·67
Protox. iron,	——	5·55	7·99
Magnesia,	5·25	2·22	3·40
Protox. mang.,	traces.	traces.	1·44
Silica (from the mortar),	3·84	1·22	——

The *dysluite* has G.=4·55, and contains,

Alumina,	30·49
Perox. iron,	27·97
Protox. "	12·55
Oxide zinc,	16·80
Protox. mang.,	7·60

Very perfect xls. of automalite occur in the Canton-mine in Cherokee Co., Ga., associated with chalcopyrite, galena, hitchcockite and staurotide: also at Haddam, Conn., along with chrysoberyl, beryl, zircon and bismuthine.

30. Corundum, WERNER, p. 235.
31. Diamond, p. 237.

ORDER X. ORE.

Section A.

1. Cuprite, *Haid.*, p. 241.
2. Chalcotrichite, GLOCKER, p. 241.
3. Zincite, *Haid.*, p. 242.
4. Thorite, *Beud.*, p. 242.
   Orangite, KRANTZ, p. 243.
5. Warwickite, SHEPARD, p. 243.
6. Perofskite, ROSE, p. 243, (1).
7. Tritomite, WEIBYE, p. 244.
8. Cerite, BERZELIUS, p. 244.
9. Sphene, p. 245.
10. Keilhauite, ERDMANN, p. 286.
11. Wohlerite, SCHEERER, p. 247.
12. Pyrochlore, WOHLER, p. 248.
13. Microlite, SHEPARD, p. 248.
14. Lievrite, WERNER, p. 249.
15. Tscheffkinite, ROSE, p. 249.
16. Allanite, THOMSON, p. 250.
17. Gadolinite, EKEBERG, p. 252.
18. Pyromelane, SHEPARD, p. 253.
19. Anatase, HAUY, p. 253.
20. Brookite, LEVY, p. 254.
21. Rutile, WERNER, p. 255.
22. Polymignite, BERZELIUS, p. 256.
23. Euxenite, SCHEERER, p. 256.

Section B.

24. Mengite, ROSE, p. 257.
25. Yttrotantalite, EKEBERG, p. 258.
26. Æschynite, BERZELIUS, p. 258.
27. Samarskite, ROSE, p. 259.
28. Rutherfordite, SHEPARD, p. 260.
29. Polycrase, SCHEERER, p. 261.
30. Columbite, p. 261.
31. Tantalite, p. 262.
32. Cassiterite, *Beud.*, p. 263.
33. Wolfram, p. 264.
34. Pechuran, p. 265.

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(1) *Perofskite.* This rare mineral is also found in the valley of Zermatt, Switzerland. Color pale yellow to brown. G. = 4·03. H. = 5·5.

Section C.

35. Chromite, *Haid.*, p. 267.
36. Ilmenite, *Kup.*, p. 267.
37. Irite, Hermann, p. 269.
38. Iserine, Werner, p. 269.
39. Magnetite, *Haid.*, p. 270.
40. Dimagnetite, Shepard, p. 271.
41. Hematite, p. 271.
42. Martite, Breithaupt, p. 275.
43. Franklinite, Berthier, p. 275.

Section D.

44. Turgite, Hermann, p. 276.
45. Göthite, *Beud.*, p. 277. Pyrrhosiderite, Ullmann.
46. Stilpnosiderite, Ullmann, p. 278.

Section E.

47. Pyrolusite, *Haid.*, p. 279.
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(1) *Tellurium.* Primary form, rhomboid. Secondary, double six-sided pyramids with summits truncated, and inclined to pyramidal planes under 122° 24′. Cleavage parallel with edges of the base of the pyramid, distinct, but with the terminal planes, indistinct. Opaque. Lustre metallic. Tin-white. H.=2·0 ... 2·5. G.=6·1 ... 6·3. B. B., melts, and is dissipated in a dense smoke with a greenish flame. Solution in sulphuric acid is red. Analysis, by Petz, tellurium 97·21, gold 2·79. In sandstone with gold and pyrites at Facebay in Transylvania.

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ORDER XIII. GLANCE.

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19. Aikinite, *Chap.*, p. 337.
20. Berthierite, Haidinger, p. 338.
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24. Dufrénoysite, Damour, p. 340.
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ORDER III. COAL.

1. Coal, p. 372. (1).

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(1) *Coal.* The coal raised from the mines of Great Britain in 1855, amounted to 64,453,070 tons, which was 207,331 less than during the previous year. The value, estimated at ten shillings per ton (at pit's mouth) was £32,222,000.

The coal raised the present year from the mines of Illinois, though but recently opened, is estimated to reach 362,000 tons.

APPENDIX.

Allophane.—Found at Morgantown, Berks Co., Pa.

Almagerite.—*Anhydrous Sulphate of Zinc, Breit.* Found in xls. isomorphous with anglesite and barytes, at the mine of Baranco Jaroso in the Sierra Almagrera, Spain. G.=4·33.

Alvite.—*Forbes* and *Dahll.* Xls. like zircon. H.=5·5. G.=3·60. Color red-brown; by weathering; changes to grey. Lustre greasy. Translucent on the edges, to opaque. Fracture splintery. B. B., infusible, but losing the reddish color. With borax, affords a glass, which is greenish-yellow while hot, and colorless when cold: with salt of phosphorus, a yellow glass, to green, and finally colorless on cooling. An analysis, on a very small quantity and somewhat altered, gave:

Silica,	20·33
Alumina and glucina,	14·11
Zirconia,	3·92
Perox. iron,	9·66
Oxide cerium,	0·27
Yttria,	22·01
Thorina?	15·13
Lime,	0·40
Copper and tin,	traces.
Water,	9·32
	97·24

Found at Helle and Narestö in Norway.

Ammiolite—*Dana.* Antimonite of Mercury, *Domeyko.* A red powder, found in the quicksilver mines of Chili; also proceeding from the decomposition of tetrahedrite, at Silberg, Westphalia: named from *αμμιον vermilion.* According to Domeyko, consists of

Antimonious acid,	12·5
Protox. mercury,	14·0
Perox. iron,	22·3
Silica,	26·5
Water and loss,	24·7
	100·

Anthosiderite.—*Hausmann.* In yellow fibrous or feathery tufts upon magnetite, from the Minas Geraes, Brazil. H.=6·5. G.=3·6. Opaque, or slightly translucent. Gives sparks with the steel. Tough. B. B., becomes red-brown, then black, and finally fuses to a black magnetic slag. Dissolves in hydrochloric acid. Analysis, by Schnedermann:

Silica,	60·40
Perox. iron,	34·99
Water,	3·59
	98·66

Antimonophyllite.—In thin inequiangular 6-sided prs. Contains oxide of antimony. Locality unknown.

Aphrosiderite. *See Chlorite.*

Aræoxene.—*Kobell.* Imperfectly crystalline, with an indistinct fibrous structure. H.=3. Deep red to brownish. Streak pale yellowish. B. B., fuses with intumescence, yielding an arsenical odor, and a globule of lead. With borax, gives in the reduction flame, a bright green glass; in the oxidation flame, a light olive-green, becoming clear yellow, and pale green, when cold. Easily decomposed by hydrochloric acid; the liquid first yellow, then brown, and after giving out chlorine, emerald-green. On adding alcohol, heating and pouring off the solution from the chloride of lead, it is still green; but after concentration by a vapor-bath, and dilution, it takes a fine sky-blue color: in which respect, it is like other vanadium compounds. According to Kobell, it contains 48·7 oxide of lead and 16·32 of zinc, with vanadic acid. From Dahn in the Palatinate.

Arsenomelan.—*Waltershausen.* Longitudinally striated prs.; tin-white, lead-grey and iron-black. Found with dufrénoysite. Composition, same as zinkenite, with the substitution of arsenic for antimony.

Arsenphyllite.—*Breithaupt.* Has the composition of arsenite, but occurs under the form of a right rhombic prism. It is therefore to be regarded as a distinct species.

Astrophyllite.—*Scheerer.* A mineral closely related to mica, found in large and very distinct 6-sided prisms, from an oblique rhombic prism, of about 120°. The xls. generally elongated in the direction of the clinodiagonal. Color gold-yellow, bronze to black. Laminæ only slightly elastic. It contains the usual constituents of mica, with about 3 p. c. of water. Found at Brevig, Norway.

Atelesite.—*Breithaupt.* Xls. oblique rhombic prisms. Color, sulphur-yellow. Lustre adamantine. It contains bismuth; and occurs with eulytine at Schneeberg in Saxony.

Ballesterosite. Pyrites in cubes, containing traces of zinc and tin. Found in Galicia.

Bamlite.—*Erdmann.* Resembles kyanite. Columnar, somewhat plumose. Cleavage only in one direction. H.=5·0 ... 7. G.=2·98. Greenish-white, or bluish. Analysis by Erdmann; silica 56·9, alumina 40·73, perox. iron 1·04, lime 1·04. Found at Bamle, Norway.

Barolite. Massive; cellular. H.= 4. Greenish-black. Opaque. Lustre glimmering. Streak greyish green. B. B., infusible. Soluble in hydrochloric acid. In a tube yields water, and becomes brownish. Contains the usual ingredients of argillite, which it seems to be. Found at Barolon, Cote du Nord, France.

Beraunite.—*Breithaupt.* Found in limonite near Beraun, Bohemia, and near Kertsh, Crimea. Supposed to be an altered vivianite.

Bergmannite.—Decomposed, or altered nepheline.

Binnite.—*Heusser.* In prismatic xls. striated lengthwise. Primary, right rhombic prism. Color steel-grey to black. Streak a darker red than that of dufrénoysite, with which it occurs, in the dolomite of Binnen. Brittle. Fracture conchoidal.

Nickel-Bournonite.—*Rammelsberg.* G.= 5 52 ... 5·59. It contains about 5 p. c. of nickel and cobalt, and rather less lead and copper than belong to bournonite. Rammelsberg considers the nickel-bournonite a compound of ullmannite and bournonite.

Bragite.—*Forbes* and *Dahll.* In indistinct xls. contained in feldspar, from near Helle, Narestö, Alve and Askrö, in Norway. Fracture uneven. H.= 6·0 ... 6·5. G.=5·13 ... 5·36. Color brown. Streak yellowish-brown. Lustre semi-metallic. Translucent in thin splinters. Decrepitates strongly, and loses water. B. B., infusible; but becomes yellow. With borax, affords a glass which is brownish-yellow while hot, but green, or greenish-yellow when cold. In salt of phosphorus, it yields a skeleton of silica.

Carminite.—Carminspath, *Sandberger*. Globular, with a columnar structure, and in tufts of fine xls. Cleavage parallel to the faces of a rhombic prism. H.=2·5. Lustre vitreous: on the cleavage pearly. Powder reddish-yellow. Translucent. Brittle. B. B., fuses to a steel-grey globule, giving arsenical vapors. With soda, it yields a globule of lead; and with borax, the reaction of iron. Soluble in nitric acid. Supposed to be, an arsenate of lead and iron. From Horhausen in Saxony, where it is found with beudantite.

Carolathine.—*Sonnenschein*. Massive, or in rounded balls. Honey-, to wine-yellow. Subtranslucent. H.=2·5. G.=1·51. Fracture conchoidal.

Carphostilbite.—Massive, columnar, straw-yellow. H.=1·0 ... 2·5. G.=2·36. An altered comptonite. From Bernfiord, Iceland.

Chamoisite.—*Berthier*. Supposed to be a mixture of magnetite, argillite and limestone. Found in small deposits, or beds, in a limestone abounding with ammonites at Chamoisin in the Valais.

Chloropal.—*Bernhardi*. Compact, earthy. H.=2·0 ... 3·0. G.=1·72 ... 1·87 (the earthy), 2·10 (a conchoidal variety). Color yellowish-green. Opaque to sub-translucent. Fragile. Fracture sub-conchoidal. A hydrous silicate of perox. iron. Composition,

	Compact.	Earthy.
Silica,	46·00	45·00
Protox. iron,	33·00	32·00
Alumina,	1·00	0·75
Magnesia,	2·00	2·00
Water,	18·00	20·00

From Hungary.

Chlorophanerite.—*Jenzsch*. Resembles chlorophæite, or chlorite. Color blackish-green. Streak dirty apple-green. Soft. G.=2·68. B. B., melts to a magnetic glass. Soluble in hydrochloric acid, with separation of silica. Partial analysis by Jenzsch, gave, silica 59·4, protox. iron 12·3, water 5·7; the alumina, magnesia, lime and potash being undetermined. Found in the amygdaloid of Weissig.

Connellite.—*Connel*. In hexagonal prisms, with truncated edges. Lustre vitreous. Color blue. Translucent. Composition, believed to be a compound of sulphate and chloride of copper. Found with other copper-ores at Cornwall, England.

Cyclopite.—*Waltershausen*. Small xls. (found in dolerite near Catania), like anorthite. H.=6·0. Lustre vitreous. Color white. Transparent. Analysis, by Waltershausen.

Silica,	41·45
Alumina,	29·83
Protox. iron,	2·20
Lime,	20·83
Magnesia,	0·66
Soda,	2·32
Potash,	1·72
Water,	1·91
	100·92

Cyanochrome.—*Scacchi*. Clear blue xls. obtained by dissolving (and evaporating the solution obtained from) the crust of lava from Vesuvius (eruption of 1855). Xls. oblique rhombic prs. Composition, a sulphate of potash and copper.

Delanovite.—*Kenngott*. Reddish and amorphous. H.=1·0 ... 1·5. Fracture splintery to earthy. Adheres to the tongue. Streak reddish, a little shining. B. B., infusible. Analysis, by Hauer;—Silica 50·55, Alumina 19·15, Lime 0·63, Protox. mang. 4·40, Water 24·05=98·78.

From the department of Dordogne, France. Related to montromorillonite.

Delessite.—*Naumann.* Eisenchlorit. Massive: scaly, or fibrous. H.=2·5. G.=2·89. Olive to blackish-green. B. B., fuses with difficulty on the edges. Easily soluble in acids, depositing silica. Heated in a glass tube, affords water, and turns brown. Analysis, by Delesse;

Silica, - - - -	29·45
Alumina, - - - -	18·25
Perox. iron, - - - -	8·17
Protox. iron, - - - -	15·12
Magnesia, - - - -	15·32
Lime, - - - -	0·45
Water, - - - - -	12·57
	99·33

Related to the grengesite, p. 157.

Diallage.—Cleavage in two directions, making right angles with each other; the one perfect, the other less so; whence the name from διαλλαγη, *difference.* Color various shades of green, to grey and brown. Streak white. H.=4·0. G.=3·2 ... 3·3. Fracture uneven to splintery. Opaque: in very thin scales, translucent. B. B., melts readily into a grey and green enamel. It is not attacked by acids. Analysis; *a* from the Baste, *b* from Salzburg, *c* from Prato in Tuscany, all by Köhler; *d* from Traunstein, *e* from Piedmont, both by Regnault:

	a	*b*	*c*	*d*	*e*
Silica, - -	52·89	51·34	53·20	51·25	50·05
Alumina, -	2·70	4·39	2·47	3·98	2·58
Magnesia, -	17·68	15·69	14·91	22·88	17·24
Lime, -	17·40	18·28	14·09	11·18	15·63
Protox. iron,	8·41	8·23	8·67	6·75	11·98
Perox. iron,			0·38		
Water, -	1·06	2·11	1·77	3·32	2·13

A variety of diallage found in the Harzburg Forest and in the gneiss of the Guadarrama mts. in Spain, has a brass-yellowish color, a greenish-grey streak and a H.=3·5 ... 4·0, with a G.=3·05. It has received the name of *diaclasite.* According to Köhler, it consists of silica 53·74, magnesia 25·09, alumina 1·34, lime 4·73, protox. iron, 11·51, protox. mang. 0·23, water 3·76.

Emplektite, *Kenngott.* See Tannerite.

Dysodile, (Dusodile).—*Cordier.* Houille papyracée, *Lucas.* In laminated masses of a yellowish grey color. Very fragile; gives out an argillaceous odor when breathed upon. G.=1·146. Macerated in water, it becomes translucent, and its laminæ acquire flexibility. It burns with much flame and smoke, and an almost insupportably fetid odor, leaving a residue of almost half its weight, unaltered in form. Found at Meliti, near Syracuse in Sicily, in a bed of secondary limestone.

Ehrenbergite.—*Nöggenrath.* Amorphous. Pale rose-red. Contains, according to Bischof;

Silica, - - - -	64·54	56·77
Alumina, - - -	6·04	15·77
Perox. iron, - - -	4·56	1·65
Protox. mang., - -	4·61	0·80
Lime, - - - -	3·96	2·76
Magnesia, - - -	0·41	1·30
Potash and soda, - - -	8·11	3·78
Water, - - -	7·77	17·11

Found in trachyte, at Steinbruch.

Eisen-natrolite.—*Iron-natrolite.* In prismatic xls., and in crystalline plates. Color dull green. Opaque. H.=5·0. G.=2·35. Supposed to be natrolite, in which ¼th of the alumina is replaced by peroxide of iron. Analysis by Bergemann: silica 46·54, alumina 18·94, perox. iron 7·49, soda 14·04, protox. iron 2·40, water 14·04. Found at Brevig, Norway.

Enstatite.—*Kenngott.* In prisms, resembling pyroxene or scapolite: angle 87°. Cleavage parallel to M, with a pearly lustre. H.=5·5. G.=3·10. Greyish or yellowish. B. B., infusible,—from which property, it is named. Analysis, by Hauer: silica 56·91, alumina 2·50, protox. iron 2·76, magnesia 35·44, water 1·92.

Ephesite.—*Smith.* Lamellar. Cleavage difficult. H. above 5·5. G.=3·15 . . . 3·2. Color pearly white. Analysis, by Smith: silica 31·54, alumina 57·89, lime 1·89, protox. iron, 1·34, soda and potash 4·41, water 3·12. Found on magnetite, at the Emery locality of Gumuch-dagh, near Ephesus. Related to margarite.

Epiglaubite.—*Shepard.* In small, interlaced groups of minute xls. Colorless, and semi-transparent. Lustre vitreous. H.=2·5. Yields abundance of water, when heated in a closed tube. Insoluble in water, until after addition of hydrochloric acid; when it disappears without effervescence. Melts easily into a semi-transparent, colorless glass, tinging the flame green. It is chiefly a hydrated phosphate of lime. Found in cavities of glaubapatite, at Mong's Island in the Caribbean Sea.

Erdmannite.—*Berlin.* In imbedded uncrystalline grains, and folia. G.=3·1. Lustre vitreous. Color dark-brown. In thin splinters, translucent. Analysis, by Blomstrand: silica 31·85, oxides cerium and lanthanum 34·89, alumina 11·71, lime 6 46, protox. iron 8·52, protox. mang. 0·86, yttria 1·43, water, and loss 4·28. From the island Stokö, near Brevig.

Eukamptite.—*Kenngott.* G.=2·73. H. about 2·5. Hyacinth-red to reddish-yellow. Streak greyish-green. Resembles chlorite. In the flame of an alcoholic lamp, becomes pinchbeck-brown to white, semi-metallic and opaque. In a tube, exfoliates, and yields water. B. B., blackens. Thin leaves fuse on the edge, to a magnetic globule. With borax, fuses easily. With soda, swells up, and shows a manganese reaction. Analysis, by Hauer: silica 38·13, alumina 21·60, protox. iron 19·92, protox. mang. 2·61, magnesia 13·76, water 3·98. Found at Pressburg, Hungary.

Fuchsite.—A green mica from Schwarzenstein, in the Zillerthal. Analysis, by Schafhault; silica 47·95, alumina 34·45, perox. iron 3·85, magnesia 0 72, lime 9·37, potash 10·75, fluorine 0·35, calcium 0·42.

Galactite.—*Kenngott.* In needles, resembling natrolite. Cleavage parallel to a rhombic prism of 91°. Red-white. H.=4·5—5·0. G.=2·21. Vitreous. Heated in a tube, yields water and turns white and opaque. B. B., intumesces, and fuses easily to a clear, colorless glass. Gelatinizes in hydrochloric acid. Analysis, by Hauer: silica 46·99, alumina 26·84, lime 4·36, potash 0·45, soda 9 68, water 10·56. Kilpatrick, Scotland.

Gedrite.—A mineral from Gedre in the Pyrenees, which resembles anthophyllite.

Gyrolite.—*Anderson.* In spherical concretions, with a lamellar, radiated structure. White. Lustre pearly. H.=3·0 . . . 4·0. Resembles apophyllite, B. B., and with acids. Analysis, by Anderson: silica 40·70, alumina 1·48, lime 33·24, magnesia 0·08, water 18·18. Found at Skye. According to Sæmann, it is pectolite which has lost its alkali; and *okenite* is the same species, deprived of lime.

Heteroclin.—*Breithaupt.* An oblique rhombic prism of 128° 16′, having the acute, lateral edges truncated, two of the terminal edges replaced, together with the front, solid angle. Cleavage in one direction, and indistinct. H.=5·0. G.=4·95. Lustre submetallic. Color iron-black to steel-grey. Streak brownish-black. Fracture uneven, to small conchoidal. B. B., resembles pyrolusite. Analysis, by Evreinoff; silica 10·30, sesquiox. mang. 85·86, perox. iron 3·72, lime 0·52, potash 0·44. Found at St. Marcel, Piedmont.

Hudsonite.—According to Kenngott, has a cleavage like hornblende: but Dana finds it nearer to pyroxene.

Huronite.—*Thomson.* Massive, compact, yellowish-grey. Translucent on the edges. H.=3·25. G.=2·86. Infusible. Analysis, by Thomson: silica 45·89, alumina 33·92, protox. iron 4·32, lime 8·04, magnesia 1·72, water 4·16. Found in blocks, near Lake Huron.

Hydrobucholzite.—*Thomson.* Analysis, by Thomson; silica 41·35, alumina 49·55, water 4·85, gypsum 3·12. Probably from Sardinia.

Hydrohulite.—*Mitscherlich.* Hydrous salt. $NaCl+4HO$.

Hydrosilicite.—*Waltershausen.* Amorphous, or in crusts, associated with herschelite, phillipsite and calcite. Supposed to be a hydrous pyroxene. Found at Patagonia and Aci Castello, in Sicily.

Hypochlorite.—*Schüler.* Grüne Eisenerde. Minute crystalline grains. H.=6. G.=2·9 . . . 3·0. Lustre vitreous, color green. Brittle. Fracture even. to flat conchoidal. B. B., grows dark, without fusing, and deposits a yellow coating on the charcoal. Insoluble in acids. Analysis, by Schüler; silica 50·24, alumina 14·65, perox. bismuth 13·03, protox. iron 10·54, phosphoric acid 9·62. Found in minute xls. and prisms. Massive and earthy, at Schneeberg, Johanngeorgenstadt, and Braunsdorf, in Saxony.

Iberite.—*Svanbery.* In 6-sided prs., with basal cleavage, H.=2·5. G.=2·89. Vitreous to pearly. B. B., fuses to a pearl. Analysis, by Norlin; silica 40·90, alumina 30·74, protox. mang. 1·33, lime 0·40, magnesia 0·81, potash 4·57, soda 0·04, water 5·56=99·82. From Montalvan, near Toledo, Spain.

Jaulingite.—*Zepharovich.* A new resin, from lignite. Found at Jauling.

Kaneite.—*Haidinger.* Arsenical manganese. Massive, botryoidal and amorphous. Foliated and granular. H. above 5. G.=5·55. Color greyish-white, with a black tarnish. Lustre metallic. Opaque. Fracture uneven. Brittle. B. B., burns with a blue flame, and falls to a powder; at a higher temperature, the arsenic is volatilized, coating the charcoal white. Dissolves in aqua regia, without residue. Analysis, by Kane; manganese 45·5, arsenic 51·8, and a trace of iron. Found associated with galena, and supposed to be from Saxony.

Knebilite.—*Dobereiner.* Massive. H. above 5? G.=3·71. Color grey, spotted, dirty white, red, brown and green. Opaque. Lustre glistening. Fracture conchoidal. Brittle. B. B., infusible: with borax, fuses to a dark olive-green pearl. Analysis, by Dobereiner; silica 32·5, protox. iron 32·, protox. mang. 35·0. Locality unknown.

Kupferpecherz.—Tile-Ore. A mechanical mixture of chrysocolla and limonite, with some chalcanthite and malachite: rarely also, with pyrites and chalcopyrite. Found accompanying most copper-ores, especially near the outcrops of veins.

Lagonite.—Earthy incrustation. Color ochre-yellow. Analysis, by Bechi; minute oblique angled tables. Color white. Soluble, but without taste. Analysis, by Bechi; boric acid 68·55, ammonia 12·73, water 18·32. Found in the lagoons of Tuscany.

Lavendulan.—*Breithaupt.* Amorphous. Lustre vitreo-resinous. H.=2·5 . . . 3·0. G.=3·01. Color lavender-blue. Streak paler. Translucent. Fracture conchoidal. B. B., gives arsenical odor, and fuses; coloring the flame deep blue, and yielding a crystalline globule, on cooling. With fluxes, gives the reaction of cobalt. Contains oxide of cobalt, nickel and copper, with water. Found at Annaberg, Saxony.

Leber-Blende.—*Breithaupt.* Hepatic blende. Supposed to be blende with a mineral resin, or some other carbonaceous compound.

Leedsite.—*Thomson.* According to Thomson, contains sulphate of lime 71·9, sulphate baryta 28·1. From Leeds, Yorkshire.

Lindackerite.—*Vogl.* In oblong, rhombohedral tables and reniform. H.=2·0 . . . 2·5. G.=2·0 . . . 2·5. Verdigris,- to apple-green. Streak pale green, to white. Vitreous. B. B., on charcoal, emits odor of garlic, and fuses to a black mass. With borax and salt of phosphorus, gives a copper reaction. Analysis, by Lindacker; arsenous acid 28·58, sulphuric acid 6·44, protox. copper, 36·34, protox. nickel 16·15, protox. iron 2·9, water 9·32.

Mancinite.—Massive, with two unequal cleavages, meeting at 92°. Color brown: lustre shining. According to Jacquot, is a silicate of zinc. From Mancino, near Leghorn.

Manganvitriol.—*Glocker.* Announced, but not described.

Martinsite.—*Karsten.* Contains, beside chloride of sodium, 9·02 p. c. of sulphate magnesia. Found at Stassfurth.

Melinophane.—*Scheerer.* Massive, foliated. H.=5·0. G.=3·0. Color sulphur-, citron-, or honey-yellow. Lustre vitreous. Brittle. Analysis, by Richter; silica 44·8, glucina 2·2, alumina 12·4, protox. mang. 1·5, perox. iron 1·1, lime 31·5, magnesia 0·2, soda 2·0, fluorine 2·3. From the zircon-syenite of Fredericksvärn, Norway.

Melanchyme.—*Haidinger.* An earthy bitumen. Found at Zweufelsreuth in Eger, Bohemia.

Mencyhinite.—*Bechi.* Massive; compactly fibrous. Shining. H.=2·5. Analysis, by Bechi; sulphur 17·52, antimony 19·28, lead 59·21, copper 3·54, iron 0·34. Found with boulangerite and jamesonite at Bottino, Tuscany.

Mercury.—Found by *Hautefeuille*, in an alloy of copper and silver, from the Lake Superior mines. Copper 138·56, silver 10·90, mercury 0·03, gangue 50·00.

Metachlorite.—*List.* Resembles chlorite. H.=2·5. B. B., fuses on the edges, to a dark enamel. Gelatinizes in the cold, with hydrochloric acid. Analysis, by List; silica 23·77, alumina 16·43, protox. iron 40·36, magnesia 3·10, lime 0·74, potash 1·37, soda 0·08, water 13·75.

Middletonite.—*Johnston.* In rounded masses of the size of a pea. H.=1·6. Brittle. Lustre resinous. Color red-brown by reflected, but deep red, by transmitted light. In small fragments, transparent. Blackens on exposure. Without taste or smell. Not altered at 400° F. Burns like resin. Analysis by Johnston; $C^{20}H^{10}+HO$. Found about the middle of the main coal at Haigh Moor seam, in the Middleton mine, near Leeds, and at Newcastle.

Molybdate Iron?—In yellow tufts, and pulverulent. B. B., fuses easily. Analysis, by Owen:—molybdic acid 40·0, perox. iron 35·0, magnesia 2·0, alkali 8·0, water 15. Found near Nevada City, California.

Molybdine and Molybdenite.—Found at Westmoreland, N. Hampshire.

Morenosite.—*Casares.* In needles, or slender prisms. Soluble in water: solution green. Supposed to be a sulphate of nickel. Occurs in Spain.

Naphthadil. A black, copper-brown substance, derived from naphtha. Melts at the same temperature with wax, and burns with a clear flame.

Natrocalcite. Pseudomorphs of calcite, after gaylussite; found at Sangerhausen.

Nickel-Bournonite.—*Rammelsberg.* It gives about 5·4 p. c. of nickel and cobalt; and has only 35·52 p. c. of lead, in place of 42·, the usual proportion, present in bournonite.

Nickel-Gymnite.—*Genth.* Amorphous, reniform or stalactitic. H.=3·0 ...4·0. G.=2·40. Lustre resinous. Color pale apple-green, or yellowish. Opaque to translucent. Heated in a tube, yields water and blackens. Soluble in hydrochloric acid, with separation of silica. Analysis, by Genth: silica 35·36, oxide of nickel 30·64, protox. iron 0·24, magnesia 14·60, lime 0·26, water 19·09. In other analyses, the proportion of oxide of nickel was much higher. From Texas, Lancaster Co., Pa.

Notite.—*Waltershausen.* Analysis;—silica 36·96, alumina 6·36, perox. iron 21·66, lime 3·26, magnesia 11·64, soda 0·97, potash 0·99, water 18·16.

Onkosin.—*Kobell.* In rounded masses. Color apple-green, sometimes greyish, or brownish. Lustre feebly resinous. Translucent. H.=2·0. G=2·8. Fracture fine splintery. B. B, fuses, with intumescences, to a white blebby glass. Analysis, by Kobell: silica 52·52, alumina 30·88, magnesia 3·82, protox. iron 0·80, potash 6·38, water 4·60. Occurs at Salzburg.

Osteolite.—*Bromeis.* Compact, earthy, with a slaty fracture. Color white. Dull: adheres to the tongue. G.=2·89. Supposed to be apatite, which has lost its fluorine and chlorine. From near Hanau, and from Amberg, in the Erzgebirge. It occurs in dolomite.

Parophite.—*Hunt.* Massive; slaty. H.=2·5...3·0. G.=2·7...2·78. Color greenish, greyish or reddish. It is said to resemble both, talc and agalmatolite. Analysis, by Hunt: silica 48·5, alumina 27·6, protox. iron 5·67, lime 1·30, magnesia 2·24, potash 5·30, water 7·00, soda 1·71. Found in Canada.

Partschin.—*Haidinger.* In small, oblique rhombic prisms and grains. Resembles monazite. H.=6·0...6·5. G.=4·0...4·1. Color red-brown. Lustre greasy. Fracture splintery. Found in sand with rutile, ilmenite, zircon and kyanite. From Olahpian, in Hungary. Named for Prof. Partsch.

Peridot, p. 208. Found in basalt, with a greyish black, feldspathic species, at Thetford, Vermont.

Picropharmacolite.—*Stromeyer.* A pharmacolite? from Reichelsdorf which contains, lime 24·64, arsenic acid 46·97, magnesia 3·22, oxide of cobalt 0·99, water 23·97.

Picrothomsonite.—*Meneghini* and *Bechi.* Massive, radiated, with the cleavages of comptonite. H.=5·0. G.=2·27. Lustre pearly. White. Transparent in small fragments. Very fragile. B. B., fuses, with intumescence, to a white enamel. Dissolves in cold acid, and gelatinizes. Contains silica 40·36, alumina 31·25, lime 10·99, magnesia 6·26, alkalies 0·29, water 10·79. Found at Coporciano, Tuscany; and named, owing to the magnesia it contains, from *πικρος, bitter.*

Picromerid.—*Scacchi.* Obtained by solution, from the cyanochrome of Vesuvius. Crystalline form, the same as that of cyanochrome. Color white. Composition, sulphate of magnesia and copper.

Picrosmine.—Abundant in the marble of Roxbury, Vermont.

Pitkarandite.—*Scheerer.* A leek-green, hornblendic pyroxene, from Pitkaranda in Finland.

Polychroilite.—*Weibye.* In 6-sided prs. of about 120°; also massive and reniform. H.=3·0...3·5. Blue, green, brown, red and rarely white. Lustre greasy. Fracture splintery. Subconchoidal to even. Analysis by Dahl: silica 52·, alumina 37·, magnesia 7·, protox. iron 3·; according to Scheerer, it contains less alumina, and 6 p. c. of water. Found in gneiss at Krageroe, Norway.

Portite.—*Meneghini* and *Bechi.* Massive, radiated; cleavage distinct parallel to a rhombic prism of 120°. H.=5·0. G.=2·4. Vitreous. White. Opaque. B. B., intumesces, and melts, to a milk-white enamel. Dissolves in acids, followed by gelatinization. Analysis, by Bechi; silica 58·12, alumina 27·50, lime 1·76, magnesia 4·87, soda 0·16, potash 0·10, water 7·92. Found in the gabbro rosso of Tuscany; and named after M. Porte of Tuscany.

Prasochrome.—*Landerer.* A green incrustation on chromite, supposed to be merely calcite, stained by oxide of chromium. Found at Scyro, in the Grecian Archipelago.

Prosopite.—*Scheerer.* Pseudomorphs of fluor, (with some aluminum and water,) after datholite? Found in kaolin, in the tin-mines of Altenberg, Saxony.

Pseudophite.—*Kenngott.* Resembles serpentine. Greyish to pistachio-green. H.=2·5. G.=2·75–2·77. Fracture conchoidal. Feels somewhat greasy. B. B., infusible. Soluble in hydrochloric acid. Analysis: silica 33·51, alumina 15·42, protox. iron 2·58, magnesia 34·41, water 13·21.

Prehnitoid.—*Blomstrand.* Massive; columnar. Pale green. Vitreous. H.=7·0. G.=2·50. B. B., fuses easily to a white enamel, like prehnite. Analysis: silica 56·00, alumina 22·45, lime 7·79, soda 10·07, potash 0·46, magnesia 0·36, protox. iron 1·01, protox. mang. 0·18, water 1·04.

Remingtonite.—*Booth.* In rose-colored incrustations. Soft and earthy. Opaque. With borax, gives the reaction of cobalt. Dissolves with effervescence in hydrochloric acid. Supposed to be a hydrous carbonate of cobalt. From the copper-mine, near Finksburg, Carroll Co., Maryland.

Samoite.—*Dana.* Stalactitic, lamellar. Color whitish. Lustre somewhat pearly. H.=4·0...4·5. G.=1·7...1·9. Analysis, by Silliman: silica 31·25, alumina 37·21, magnesia 4·06, carb. lime 0·01, soda 0·06, water 30·45. Found in a cavern in lava, in the island of Upolu of the Navigator group.

Sanadin.—Tabular xls. of glassy feldspar, from Vesuvius.

Savite.—*Meneghini.* In radiating acicular xls. H.=3. G.=2·45. Vitreous. Colorless and transparent. B. B., fuses with difficulty. Soluble in the acids. Analysis, by Bechi: silica 49·17, alumina 19·66, magnesia 13·50, soda 10·52, potash 1·23, water 6·57. Found with picranalcime in the gabbro rosso of Tuscany.

Schneiderite.—*Meneghini.* Radiated, lamellar. White. Opaque. H.=3·0. B. B., fuses with intumescence, to a blue enamel. In a closed tube, yields water. Dissolves in the acids; and gelatinizes. Analysis, by Bechi: silica 47·79, alumina 19·38, lime 16·77, magnesia 11·03, potash and soda 1·62, water 3·41. Found with sloanite, in the gabbro rosso of Tuscany; and named after M. Schneider.

Scoulerite.—*Thomson.* A zeolitic mineral, allied to scolecite, found at Port Rush in Ireland.

Selenbleispath.–*Karsten.* Botryoidal. Cleavage in one direction. H.=3·0. ...4·0. Lustre greasy to vitreous. Sulphur-yellow. Brittle. B. B., on charcoal, fuses readily, giving off the odor of selenium, and is finally reduced to a metallic globule. According to Rose, it contains selenic acid and oxide of lead, with traces of copper. Found at the Friederichsglück mine, near Hilburghausen.

Sericite.—*List.* In undulated plates, with cleavage in one direction. Greenish or yellowish-white. Lustre silky. H.=1·0. G.=2·89. B. B., exfoliates strongly, and fuses on the edges with a bright light, to a greyish enamel. Decomposed slowly by hydrochloric acid. Related to Damourite. Found in a slate-rock with quartz, in the Taunus range in Western Germany.

Sismondine.—*Delesse.* Massive, foliated. Dark greyish, or blackish-green. G.=3·56. B. B., nearly infusible: with borax, affords the reaction of iron. Found in chlorite-slate at St. Marcel. Supposed to be near to chloritoid.

Skolopsite.—*Kobell.* Massive, granular. H.=5·0. G.=2·53. Greyish-white to pale red-grey. Fracture splintery. Rather brittle. B. B., fuses, with intumescence, to a shining, blebby, greenish glass. Gelatinizes in hydrochloric acid. Analysis, by Kobell: silica 41·13, alumina 15·42, oxides of iron 2·49 protox. mang. 0·86, lime 15·48, magnesia 2·23, potash 1·30, soda 10·16, sulphur 4·09, with 7·78 of sodalite. Found at Kaiserstahl in Brisgau, with calcite and magnetite.

Sloanite.—*Meneghini* and *Bechi.* In radiated masses, presenting a fracture, transverse to the radiation. H.=4·5. G.=2·44. White. Opaque. Lustre pearly. B. B., fuses without intumescence, to a white enamel. Dissolves in the acids, with the formation of a jelly. Analysis, by Bechi: silica 42·19, alumina 35·00, lime 8·12, magnesia 2·67, soda 0·25, potash 0·30, water 12·50. From the gabbro rosso of Tuscany.

Sordawalite—*Nordenskiöld.* Massive. H.=2·5. G.=2·53...2·58. Lustre vitreo-resinous. Greyish or bluish-black. Opaque. Fracture conchoidal. Brittle. B. B., fuses with difficulty, to a blackish globule. With borax, it forms a green glass. Analysis, by Nordenskiöld: silica 49·4, alumina 13·8, protox. iron 18·17, magnesia 10·67, phosphoric acid 2·68, water 4·38. Forms thin layers on trap, near Sordawala in Finland; and associated with pyrrhotine, at Bodenmais in Bavaria.

Stannite.—*Breithaupt.* Amorphous. Color pale yellow. Lustre faint. H.=6·5. G.=3·54. Fracture conchoidal. B. B., infusible. According to Plattner, contains, silica, alumina and 36·5 p. c. of oxide of tin. It is believed to be a mixture of cassiterite and schist. From Cornwall.

Stassfurtite.—*Rose.* The massive boracite of Stassfurt. It is more easily melted than the crystallized boracite, and more readily dissolved by acids.

Stibiconise.—*Beudant.* Massive, yellowish in color. H.=5·5. G.=5·28. Analysis, by Blum and Delffs: oxygen 19·54, antimony 75·83, water 4·63, arsenic, in traces. From Goldkronach in Bavaria.

Strakonitzite.—*Zepharovich.* Pseudomorphs, consisting of a green, steatitic mineral. G.=1·91. Soft, greasy. Associated with fluor, quartz, sphene and pyrites. The powder is pale yellow, and changes to dull brown, on heating. Analysis, by Zepharovich: silica 53·42, alumina 7·00, protox. iron 15·41, lime 1·37, magnesia 2·94, water 19·86. Found at Mutenitz in Bohemia.

Stratopeite.—*Igelström.* Amorphous, massive. H. below 4. G.=2·64. Pitch-black: brownish-red, in thin splinters. Fracture flat conchoidal. B. B., fuses to a black, translucent globule. With hydrochloric acid, evolves chlorine. Analysis, by Igelström: silica 35·43, protox. iron 10·27, perox. mang. 32·41, magnesia 8·04, water 13·75. Found at the Pajsberg mine, in Philipstadt.

Strontianocalcite.—*Genth.* Structure like calcite. H.=3·5. Affords some strontia.

Svanvergite.—*Igelström.* (This name was given to platinindium, p. 303,) without a knowledge of its previous bestowal on the following mineral. Massive. Cleavage, parallel with oblique rhombic prism. Pale-red. H.=5·0. G.=3·3. B. B., fuses on the thinnest edges. With soda, yields a red hepatic mass, in the reduction flame. It becomes green in water; and with dilute acid, develops sulphuretted hydrogen. In borax, affords an iron-stained glass. With cobalt solution, gives a fine blue. Analysis: sulphuric acid 17·32, phosphoric acid 17·80, alumina 37·84, lime 6·00, protox. iron 1·40, soda 12·84, water 6·80, chlorine, a trace. Found in Wermland, with kyanite, mica, quartz and hematite.

Susannite.—*Haidinger.* In rhomboids of 94°, with summits truncated; cleavage parallel with truncating planes. H.=2·5. G.=6·35. Color white, green, yellow and brownish-black. Lustre resinous. Streak uncolored. Composition, same as leadhillite; sulphate lead 27·5, carb. lead 72·5. Found at Leadhills, Scotland; and at Moldawa, Bannat.

Tabergite.—*Rose.* The blue talc of Werner, from Taberg in Wermland.

Tachydrite.—*Rammelsberg.* Found in the salt of Stassfurth. Composition $(\mathrm{Ca\,Cl}+2\mathrm{MgCl})+12\mathrm{HO}$.

Talc-apatite.—*Hermann.* In six-sided xls., grouped and single. G.=2·7...2·75. Contains lime 37·50, magnesia 7·74, phosphoric acid 39·02, sulphuric acid 2·10, chlorine 0·91, fluorine and loss 2·13, oxide iron 1·00, insoluble 9·50. From the chlorite slate in the Schischimskian Mts., near Slatoust.

Tannenite.—Kupferwismuthglanz, *Schneider.* In thin striated prs. Lustre metallic. Greyish to tin-white. In an open tube, yields sulphur. B. B., fuses easily, with intumescence; and gives with soda, a globule of copper. Gives, with nitric acid, a deep blue solution. Analysis by Schneider: sulphur 18·83, bismuth 62·16, copper 18·72. From Tannenbaum, in Johanngeorgenstadt.

Tauriscite.—*Volger.* In slender, white, glassy prisms, from Windgalle, St. Gothard. Form of crystal, near to that of epsomite. It proceeds from the decomposition of pyrites; and is supposed to be related to melanterite.

Tectizite.—*Breithaupt.* In pyramidal xls., acicular and massive. H.=1·5...2·0. Clove-brown. Attracts moisture. Supposed to be a hydrous sulphate of perox. iron. From near Schwarzenberg in Saxony; and at Braunsdorf, in the Erzgebirge.

Tephroite.—*Breithaupt.* Supposed to be a decomposing fowlerite.

Thierschite.—*Leidy.* A greyish, warty incrustation on the marble of the Parthenon at Athens, originating in the action of lichens upon the marble. Composition, oxalate of lime.

Trinacrite.—*Waltershausen.* Massive, cleavable, or micaceous. Dull brown. Contains silica 31·82, alumina 5·25, perox. iron 33·95, lime 2·57, magnesia 4·57, soda 4·19, potash 2·42, water 14·22.

Turnerite.—*Levy.* Oblique rhombic prisms of 86° 10′. P on M 99° 40′. Cleavage, parallel with both diagonals of the prisms; one more perfect than the other. H. above 4·0. Color yellow to brown. Lustre adamantine. Transparent to translucent. According to Children, it contains alumina, lime, magnesia, and a little iron. Found with albite, ilmenite and anatase, at Mount Sorel, Dauphiny.

Tyrite.—*Forbes.* Crystalline, but without distinct cleavage. H.=6·5. G.=5·30. Color and lustre, like euxenite. Heated in a glass tube, decrepitates strongly, evolves water and turns yellow. B. B., with borax, forms a glass of a reddish-yellow color when warm, but colorless when cool. With salt of phosphorus, it is soluble with difficulty; the glass is greenish-yellow while hot, but green, when cold. Analysis, by Forbes: columbic acid 44·90, alumina 5·66, lime 0·81, yttria 29·72, oxide of cerium 5·35, oxide of uranium 3·03, protox. iron 6·20, water 4·52. Found with euxenite, at Hampemyr, Norway. It has some resemblance, both to rutherfordite and to fergusonite.

Urangreen.—*Hartmann.* (Uranchalzit). A basic sulphate of copper and uranium, from Joachimstahl.

Urdite.—*Forbes* and *Dahll.* Has the crystalline form of monacite, and is believed by Zochau, to belong to that species. G.=5·1.—5·2. Found in granite, near Notero in Norway.

Varvacite.—*Phillips.* An altered manganite, consisting largely of pyrolusite.

Violan.—*Breithaupt.* Massive, with cleavage of a rhombic prism. H=6. G.=3·23. Color dark violet-blue. Lustre waxy. B. B., fuses to a clear glass. With borax, in the outer flame, gives a brownish-yellow glass, violet-red, when cold; and in the inner flame, a yellow glass, which is colorless, when cold. Found with manganesian epidote, at St. Marcel in Piedmont.

Voglite.—*Haidinger.* In crystalline scales, somewhat like gypsum, with angles of 100° and 80°. Emerald-, to grass-green. Possessed of dichroism. Lustre pearly. B. B., in a tube, yields water: on charcoal, does not fuse. Tinges the flame green, after being wet with hydrochloric acid. Dissolves in hydrochloric acid. Analysis, by Lindacker: carbonic acid 26·41, protox. uranium 37·00, lime 14·09, protox. copper 8·40, water 13·99. From the Elias mine, near Joachimstahl.

Voigtite.—*Schmid.* In long, thin plates. H.=2·0. G.=2·19. Brown. Opaque: lustre somewhat oily. B. B., melts to a black glass, and affords the reaction of iron. Analysis, by Schmid:—Silica 33·83, alumina 13·40, perox. iron 8·42, protox. iron 23·01, magnesia 7·54, lime 2·04, soda 1·96, water 9·87=99·07.

Found near Ilmenau, in granite; and is generally weathered. When fresh, is leek-green, and translucent.

Volgerite.—A white antimony from Algeria, found with cervantite, and resulting from its decompositon; it consists, according to Volger, of oxygen 18·8, antimony 60·3, and water 21·0.

Voltzite.—*Fournet.* In spherical globules. Structure, curved lamellar. H.=4·5. G.=3·66. Yellowish and brown: lustre vitreo-resinous. Subtranslucent. B. B., like blende. Analysis, by Fournet. Sulphuret of zinc 82·92, oxide of zinc 15·14, perox. iron 1·84, resinous matter, a trace. Found at Rosières in Puy de Dome; and at Elias mine, near Joachimstahl.

Wavellite.—Found at West Chester, Pa.

Wehrlite.—*Kobell.* Massive, granular. H.=6·0.—6·5. G.=3·90. B. B., fuses with difficulty on the edges. Analysis, by Wehrle, silica 34·64, perox. iron 42·38, perox. mang. 0·28, alumina 0·12, protox. iron 15·78, lime 5·84, water 1. From Szurraskö, Hungary.

Weissigite.—*Jenzsch.* Xls. minute, oblique rhombic prisms. Cleavage unequal in two directions, parallel to the vertical axis, and meeting under 118°. Sometimes macled: also massive. H.=6·5. G.=2·5. White to pale rose-red. B. B., fuses easily on the edges, to a white enamel, tinging the outer flame a pale red and yellow, at its extremity. With borax, affords a colorless glass; and with salt of phosphorus, a silica-skeleton. Composition, near to that of petalite. Found in a porpyritic amygdaloid, near Weissig.

Wilsonite.—*Hunt.* Massive. H.=3·5. G.=2·76. Color reddish-white. Subtranslucent. Lustre vitreous. Fracture uneven. B. B., evolves moisture, whitens and fuses with intumescence, to a white enamel. Analysis, by Hunt: silica 43·55, alumina 27·24, lime 6·50, magnesia 2·81, potash 8·37, soda 1·45, water 8·61. It resembles an altered scapolite. Found at Bathurst, Canada West.

Wissérite.—*Haidinger.* A hydrated diallogite, from Gonzen, Switzerland.

Xenolite.—This variety of fibrolite is abundant, at Mt. Monadnock, N. H.

Xylochlore.—*Waltershausen.* Form of xls., like apophyllite. Angle of pyramid about 96°. Cleavage basal, perfect. H.=6·0. G.=2·29. Olive-green. Analysis, by Waltershausen; silica 52·07, alumina 1·54, lime 20·57, magnesia 0·33, protox. iron 3·40, soda 0·55, potash 3·77, water and carbonic acid 17·14. From Iceland.

Zamtite.—*Casares.* Resembles texasite. B. B., infusible. Yields water when heated in a tube. From Spain. Supposed to have the same composition as Texasite.

Zincfahlerz.—Kupferblende of *Breithaupt.* Color brownish-red. G.=4·2—4·4. It has a part of the iron replaced by zinc. From Freiberg.

Zippeite.—*See uran-ochre*, p. 143.

ADDENDA.

MINERALS OMITTED IN THE CHEMICAL ARRANGEMENT OF THE SPECIES.

On p. 378 (after amalgam,) supply Bismuthaurite, Bi, Au.
" " 379 (after ilmenite,) " Cervantite, SbO^3+SbO^5.
" " " (" automalite), " Pechuran, $UO. U^2O^8$.
" " 380 (" quartz), " Valentinite, SbO^3.
" " " (" ") " Senarmontite, Sb, O^3.
" " 383 (" nagyagite) " Tetradymite, Bi^2Te^3, and $Bi^2 Te^3, Se^8, S^3$.
" " 384 (" zweieselite) " Triplite, $4Mn, FeO. P^3O^5$.
" " " (" pyroclasite,) " Lazulite, $4(HO. Al^2O^3)+5MGO. 4P^2O^5$.
" " " (" " " Struvite, $3(Mg, AmO. 3HO)+3HOP^2O^5$.
" " " (" " " Phosphammonite, $AmO. xHO+P^3O^5$.
" " " (" wavellite,) " Childrenite, $[3HO. Al^2O^3+5HOP^2O^5] +2[3HO. Al^2, Fe^2O^3+3Fe. MnOoP^2O^5$.
" " 390 (" stilbite,) " Heulandite. Formula same as stilbite.
" " 391 (" davyne,) " *Silicate with borate.* Datholite, $3(HO. Si BO^3)+2(3CaO^2SiBO^8.)$
" " 392 (" stolzite,) " Order Vanadates. Dechenite, $PbO. VO^3$.
" " " (" " Vanadinite, $3PbO, Cl. VO^3$.
" " " (" " Aræoxene, $Pb. ZnO ; VO^3$.
" " " (" " Chileite, $6Pb, CuO, VO^3$.
" " " (after polycrase) " Wöhlerite, $Ca, NaO; Zr^2O^3; SiO^3; Pe, NbO^3$.
" " 393 (after naphthadil, " Amber, $C^{10}H^8O$.

PLAN OF ARRANGEMENT

OF THE AUTHOR'S MINERALOGICAL COLLECTION;

IN THE WOOD'S CABINET, AT AMHERST COLLEGE.

THIS collection occupies the second floor of the edifice. The apartment is octagonal, and furnished with a gallery. It is forty feet in diameter, and lighted from above. The entrance is from a small ante-room, on the east. The cases holding the main collection are below, and entirely surround the walls, with exception only of the door. The arrangement, which is after the natural history system of the present work, commences to the left, on entering the museum, with the front side of the top shelf; the specimens proceeding in rows to the rear, and then returning, continue forward in the same order to the end of the case, (behind each glazed door, or pair of doors secured by a single lock): then it returns to the shelf below. The spectator is thus conducted nearly around the room, before reaching the completion of the system. The last three glazed doors, however, are devoted to a chemical classification of the species (after the arrangement of the preceding pages),—a single specimen being placed to represent each species. In this part of the arrangement, each specimen has a printed label, which gives not only the name, but the chemical formula for the composition. A third collection, arranged in three horizontal cases, placed upon cabinets in the room, illustrate the natural properties of minerals, as explained in this treatise. Each specimen has a printed label affixed, pointing attention to the particular property, intended for illustration. A fourth collection, in an upright cabinet on the western side of the room, contains polished and artificially wrought specimens. A fifth cabinet of still larger size, and placed directly in front of the entrance, is mostly devoted to imperfectly known species, and minerals, whose independent rank in the system is not yet fully admitted. Upon the opposite side of this case will be found the meteoric collection, with exception of two very ponderous masses of meteoric iron from Africa; to each of which a separate glazed case is devoted. These are situated to the right and left, of the lecture-table. A sixth upright cabinet contains the models of crystals, the goniometers, balances and other instruments of research, employed in mineralogy. Finally, it only requires to be stated, that the lower shelves of the wall-cases contain the large-sized specimens belonging to the species upon the upper shelves, together with a few geological specimens of more striking interest, such as the foot-prints and rain-drops of Turner's Falls, Massachusetts. The geological collection at large, is at present in drawers; with the exception of the coal-plants and fossil-fishes, which are displayed in two cases in the gallery.

CATALOGUE

OF

C. U. SHEPARD'S METEORIC COLLECTION.

I. METEORIC STONES.

1.	Ensisheim, Alsace, France.	Fell Nov. 7, 1492.
2.	Tabor, Taborer Circle, Bohemia.	Fell July 3, 1753.
3.	Lucé, Dep. de la Sarthe, France.	Fell Sept. 13, 1768.
4.	Mauerkirchen, Inn-circle, Bavaria.	Fell Nov. 20, 1768.
5.	Barbotan, Dep. des Landes, France.	Fell July 24, 1790.
6.	Wold Cottage, Yorkshire, England.	Fell Dec. 13, 1795.
7.	Sales, Dep. du Rhône, France.	Fell March 8, or 12, 1798.
8.	Benares, (Krakhut) India.	Fell Dec. 13, 1798.
9.	L'Aigle, Dep. de l'Orne, France.	Fell April 6, 1803.
10.	Apt, Dep. de Vauclase, France.	Fell Oct. 8, 1803.
11.	Doronisk, Government of Irkutsk, Siberia.	Fell March 25, 1805.
12.	Weston, Connecticut, U. S. A.	Fell Dec. 14, 1807.
13.	Parma (Casignano), near Borgo St. Domino, Italy.	Fell Apl.19, 1808.
14.	Stannern, Iglauer Circle, Moravia.	Fell May 22, 1808.
15.	Lissa, Bunzlauer Circle, Bohemia.	Fell Sept. 3, 1808.
16.	Tipperary (Mooresfort), Ireland.	Fell Aug. 1810.
17.	Charsonville, (Orleans) Dep. du Loiret, France.	Fell Nov. 23, 1810.
18.	Kuleschofka, Government of Poltawa, Russia.	Fell Mar. 16, 1811.
19.	Berlanguillas, Upper Castilia, Spain.	Fell July 8, 1811.
20.	Erxleben, Saxony.	Fell April 15, 1812.
21.	Chantonnay, Dep. de la Vendée, France.	Fell Aug. 5, 1812.
22.	Adare, County of Limerick, Ireland.	Fell Sept. 10, 1813.
23.	Bachmut, Ekatherinoslaw, Russia.	Fell Feb. 3, 1814.
24.	Agen, Dep. Lot et Garonne, France.	Fell Sept. 5, 1814.
25.	Chassigny, Dep. de la Haute Marne, France.	Fell Oct. 3, 1815.
26.	Zaborczika, Government of Volhynia, Russia.	Fell March 30, 1818.
27.	Seres, Macedonia, Turkey.	Fell June, 18

28.	Slobodka, Government of Smolensk, Russia.	Fell Aug. 10, 1818.
29.	Jonzac, Dep. de la Charente, inferieure, France.	Fell June 13, 1819.
30.	Politz, Principality of Reuss.	Fell Oct. 13, 1819.
31.	Lixna, Witepsk, Russia.	Fell July 12, 1820.
32.	Juvenas, Dep. de l'Ardèche, France.	Fell June 25, 1821.
33.	Futtehpore, near Allahabad, India.	Fell Nov. 30 1822.
34.	Nobleborough, Maine, U. S. A.	Fell Aug. 7, 1823.
35.	Renazzo, Ferrara, Italy.	Fell Jan. 15, 1824.
36.	Zebrak, Berauner Circle, Bohemia.	Fell Oct. 14, 1824.
37.	Nanjemoy, Maryland, U. S. A.	Fell Feb. 10, 1825.
38.	Owyhee (Hawaii), Sandwich Islands.	Fell Sept. 14, 1825.
39.	Nashville, Tennessee, U. S. A.	Fell May 9, 1827.
40.	Bialystok, Russia.	Fell Oct. 5, 1827.
41.	Richmond, Virginia, U. S. A.	Fell June 4, 1828.
42.	Forsyth, Georgia, U. S. A.	Fell May 8, 1829.
43.	Deal, near Long Branch, New Jersey, U. S. A.	Fell Aug. 15, 1829.
44.	Wessely, Hradischer Circle, Moravia.	Fell Sept. 9, 1831.
45.	Charwallas, near Hissar, India.	Fell June 12, 1834.
46.	Macao, Province Rio Grande do Norte, Brazil.	Fell Nov. 11, 1836.
47.	Esnaude, Dep. de la Charente, France.	Fell Aug. 1837.
48.	Chandakapore, Berar, India.	Fell June 6, 1838.
49.	Cold Bokkewelde, Cape of Good Hope.	Fell Oct. 13, 1838.
50.	Little Piney, Pulaski county, Missouri, U. S. A.	Fell Feb. 13, 1839.
51.	Grüneberg, Liegnitz, Silesia.	Fell March 22, 1841.
52.	Château Renard, Dep. du Loiret, France.	Fell June 12, 1841.
53.	Milena, Warasdiner Comitat, Croatia.	Fell April 26, 1842.
54.	Aumières, Canton St. Georges, France.	Fell June 4, 1842.
55.	Bishopsville, South Carolina, U. S. A.	Fell March 25, 1843.
56.	Utrecht, Holland.	Fell June 2, 1843.
57.	Kleinwenden (Nordhausen) Saxony.	Fell Sept. 16, 1043.
58.	Killeter, County of Tyrone, Ireland.	Fell April 29, 1844.
59.	Favars, Canton de Laissac, France.	Fell Oct 21, 1844.
60.	Macerata, (Monte Milone) Italy.	Fell May 10, 1846.
61.	Linn county, Iowa, U. S. A.	Fell Feb. 25, 1847.
62.	Castine, Maine, U. S. A.	Fell May 20, 1848.
63.	Cabarras county, (North Carolina), U. S. A.	Fell Oct. 31, 1849.
64.	Gutersloh, Westphalia.	Fell April 17, 1851.
65.	Mezö-Madaras (Fekete) Maroscher Stuhl, Transylvania.	Fell Sept. 4, 1852.
66.	Girgenti, Sicily.	Fell Feb. 10, 1853.
67.	Boemerford, Hanover.	Fell July, 1855.

II. METEORIC IRONS.

1.	Senegal, Africa.	Found 1717.
2.	Krasnojarsk, Government of Jeniseisk, Siberia.	Found 1749.
3.	Saxony (Steinbach, near Eibenstock).	Found 1751.
4.	Agram, Croatia.	Fell May 26, 1751.
5.	Tecuman, Otumpa, Argentine Rep., S. America.	Found 1783.
6.	Bahia (Bemdego), Brazil.	Found 1784.
7.	Xiquipilco, Toluca, Mexico.	Found 1784.
8.	Zacatecas, Mexico.	Found 1792.
9.	Cape of Good Hope.	Found 1793.
10.	Bitberg, in the Eifel, Rhenish Prussia.	Found 1805.
11.	Texas (Red River), U. S. A.	Found 1808.
12.	Rasgata, New Grenada, South America.	Found 1810.
13.	Elbogen, Bohemia.	Found 1811.
14.	Durango, Mexico.	Found 1811.
15.	Lenarto, Saroscher Comitat, Hungary.	Found 1814.
16.	Lockport, New York, U. S. A.	Found 1818.
17.	Burlington, Otsego county, New York, U. S. A.	Found 1819.
18.	Guildford, North Carolina, U. S. A.	Found 1820.
19.	Atacama, Bolivia.	Fonnd 1827.
20.	Caille, Dep. du Var, France.	Found 1828.
21.	Bohumilitz, Prachiner Circle, Bohemia.	Found 1829.
22.	Claiborne county, Alabama, U. S. A.	Found 1834.
23.	Dickson county, Tennessee, U. S. A.	Fell July 30, 1835.
24.	Black Mountain, Buncombe Co., N. Carolina, U. S. A.	Found 1835.
25.	Asherville, Buncombe county, North Carolina.	Found 1839.
26.	Putnam county, Georgia, U. S. A.	Found 1839.
27.	Cocke county (and Sevier county), Tennessee.	Found 1840.
28.	Newberry (Ruff's Mountain), South Carolina, U. S. A.	Found 1841.
29.	Green county (Babb's Mills), Tennessee, U. S. A.	Found 1842.
30.	St. Augustine's Bay, Madagascar.	Found 1843.
31.	Arva, (Szlanicza) Arváer Comitat, Hungary.	Found 1843.
32.	Otsego county, New York, U. S. A.	Found 1845.
33.	De Kalb county, Tennessee, U. S. A.	Found 1845.
34.	Carthage, Tennessee, U. S. A.	Found 1846.
35.	Chester county, South Carolina, U. S. A.	Found 1847.
36.	Braunau, Königgrätzer Circle, Bohemia.	Fell July 14, 1847.
37.	Seeläsgen, Neumark, Brandenberg.	Found 1847.
38.	Schwetz, Prussia.	Found 1850.

39. Salt River, Kentucky, U. S. A.	Found 1850.
40. Pittsburg, Pennsylvania, U. S. A.	Found 1850.
41. Seneca Falls, Cayuga county, U. S. A.	Found since 1850.
42. Lion River, Namaqua Land, South Africa.	" " "
43. Union county, Georgia, U. S. A.	" " "
44. Tazewell, Claiborne county, Tennessee, U. S. A.	" " "
45. Santa Rosa, New Mexico.	" " "
46. Tuczon, Sonora.	" " "
47. Chili.	" " "
48. Haywood county, North Carolina, U. S. A.	" " "
49. Orange River, South Africa.	" " "
50. Madoc, Canada West.	Found 1854.

APPENDIX TO METEORIC COLLECTION.

I. Doubtful Meteoric Stones (*several of which, however, are known to have fallen from the atmosphere*).

Alais, Dep. du Gard, France, March 15, 1806.

Waterville, Maine, U. S. A., Sept. 1826.

Waterloo, New York, U. S. A., 1826 or 1827.

Concord, New Hampshire, U. S. A., 1840.

Iwan, Hungary, Aug. 1841.

Las Canas, St. Andrews, Cuba, Oct. 2, 1844.

Elizabethtown, Essex county, New York, U. S. A., winter of 1844 and 1845.

Moreton Bay, Australia, July, 1845.

Richland, South Carolina, U. S. A., summer of 1846 or 1847.

Near Columbia, South Carolina. U. S. A., (containing globules of metallic lead,) 1852.

II. Doubtful Meteoric Irons, *(several of which are destitute of nickel, chromium and cobalt, and do not afford the true Widmannstaattian figures ; or if containing the usual meteoric metals, the masses have been altered and disguised by a strong artificial heat).*

Randolph county, North Carolina, U. S. A., 1822.
Sterlitamal, Orenberg, Russia, 1825.
Bedford county, Pennsylvania, U. S. A., 1828.
Scriba, New York, U. S. A., 1830.
St. Matthews, South Carolina, U. S. A.
Walker county, Alabama, U. S. A., 1839.
Homony Creek, Buncombe county, North Carolina, U. S. A., 1845.
Montgomery, Vermont, U. S. A.
Achen, (Aix-La-Chapelle), France.
Collina, de Brianza, Brazil.
Long Creek, Jefferson county, Tennessee, U. S. A., 1853.
Poictiers, France.

INDEX.

ERRATA.

Page 12, 11 lines from bottom, for 40°, read 60°.
" 43, 15 " " top, omit *iron-pyrites.*
" 161, 29 " " " " line beginning "3. *Phyllite,*" &c.
" 191, 13 and 31 lines from top, for cowzeranite, read *couseranite.*
" 230, in note at foot of page, for aqua-marine, read *quartz.*
" 253, under anatase, supply G. = 3 8 . . . 4·1.
" 303, 9 lines from bottom, omit *Svanbergite.*
" 339, 19 " " " for Plumbostite, read Plumbosite.
" 340, 21 " " top, for *Bleiglanz*, read Bleiglanz.

Storage