J C Branner
1905

THE SYSTEM

OF

MINERALOGY

OF

JAMES DWIGHT DANA

1837–1868

DESCRIPTIVE MINERALOGY

SIXTH EDITION

FOURTH THOUSAND

BY

EDWARD SALISBURY DANA

PROFESSOR OF PHYSICS AND CURATOR OF THE MINERAL COLLECTION, YALE UNIVERSITY

ENTIRELY REWRITTEN AND MUCH ENLARGED

Illustrated with over 1400 Figures

"Hæc studia nobiscum peregrinantur—rusticantur"

WITH APPENDIX I, COMPLETING THE WORK TO 1899

NEW YORK
JOHN WILEY & SONS
LONDON: CHAPMAN & HALL, LIMITED
1904.

524. SIPYLITE. *J. W. Mallet*, Am. J. Sc., **14**, 397, 1877; **22**, 52, 1881.

Tetragonal. Axis $\dot{c}$ = 1·4767; 001 ∧ 101 = 55° 53⅔′ Mallet.

Rarely in octahedral crystals; pp' = *79° 15′, pp'' = 128° 50′ (127° meas.). Usually imperfectly crystalline, or in irregular masses.

Cleavage: p (111), distinct. Fracture small conchoidal and uneven. Brittle. H. = 6 nearly. G. = 4·89. Luster resinous and pseudo-metallic. Color brownish black to brownish orange; in splinters red-brown. Streak light cinnamon-brown to pale gray. Translucent.

Comp.—A niobate of erbium chiefly, also the cerium metals, etc.

Anal.—W. G. Brown, l. c.

Nb_2O_5	WO_3	SnO_2	ZrO_2	Er_2O_3	Ce_2O_3	La_2O_3	Di_2O_3	UO	FeO	BeO	MgO	CaO	Na_2O	K_2O	H_2O
48·66[a]	0·16	0·08	2·09	27·94[b]	1·37	3·92[c]	4·06[d]	3·47	2·04	0·62	0·05	2·61	0·16	0·06	3·19

[MnO, Li_2O, F *tr.* = 100·48

[a] With Ta_2O_5 about 2 p. c. [b] With Y_2O_3 about 1 p. c. [c] Di_2O_3 *tr.* [d] Ce_2O_3 *tr.*

Taking together the acid oxides of niobium, tantalum, tungsten, tin, and zirconium as Nb_2O_5, and reducing all the basic elements to the form RO, and neglecting the water, the ratio RO : Nb_2O_5 = 221 : 100 is obtained, which corresponds to the formula: $R_3Nb_2O_8 + 4R_2Nb_2O_7$. Mallet prefers to include the water, making the hydrogen basic, and deduces on this supposition the formula: $R_3Nb_2O_8$. This view is supported by the fact that in form sipylite is very near fergusonite.

Pyr.—B.B. decrepitates, and glows brilliantly, becomes pale greenish yellow and opaque; infusible. In the closed tube gives off acid water. With borax in O.F. gives a yellow bead, pale on cooling; in R.F. assumes a greener tint. Boiled in strong HCl partially dissolves, the solution reacting for zirconium with turmeric paper; when metallic tin is added and the solution diluted, a sapphire-blue color is obtained (niobium). Decomposed completely, though slowly, in boiling concentrated sulphuric acid.

Obs.—Occurs sparingly, embedded in, or more commonly adherent to, masses of allanite and magnetite, at the northwest slope of Little Friar Mountain, Amherst Co., Virginia. Named from *Sipylus*, one of the children of Niobe, in allusion to the names niobium and tantalum.

Delafontaine (C. R., **87**, 933, 1878) states that sipylite contains yttrium, erbium (in small quantities), philippium (see samarskite), and also the ytterbium of Marignac (see gadolinite, p. 510).

Adelpholite. Adelfolit *N. Nordenskiöld*, Beskrifn. Finl. Min., 1855, Jb. Min., 313, 1858; *A. E. Nd.*, Öfv. Ak. Stockh., **20**, 452, 1863, Pogg., **122**, 615, 1864.

Tetragonal. Angles undetermined. H. = 3·5–4·5. G. = 3·8. Luster greasy. Color brownish yellow to brown and black. Streak white or yellowish white. Subtranslucent. A niobate of iron and manganese, containing 41·8 p. c. of metallic acids, and 9·7 p. c. of water. From Laurinmäki, in Tammela, Finland, with columbite.

---

3. Columbite Group. Orthorhombic.

525, 526. COLUMBITE—TANTALITE.

525. Columbite. Ore of Columbium (fr. Conn.) *Hatchett*, Phil. Tr., 1802. Columbite *Jameson*, Min., **2**, 582, 1805. Columbate of Iron. Columbeisen *Germ.* Baierine (fr. Bavaria) *Beud.*, Tr., **2**, 655, 1832. Torrelite *Thom.*, Rec. Gen. Sc., **4**, 408, 1836. Niobite *Haid.*, Handb., 549, 1845. Greenlandite *Breith.*, B. H. Ztg., **17**, 61, 1858. Dianite *Kbl.*, Ber. Ak. München, Mar. 10, 1860.

Mangantantalite *A. E. Nordenskiöld*, G För. Förh., **3**, 284, 1877. Manganotantalite *A. Arzruni*, Vh. Min. Ges., **23**, 181, 1887.

526. Tantalite. Tantalit *Ekeberg*, Ak. H. Stockh., **23**, 80, 1802. Ferrotantalite *Thom.*, Rec. Gen. Sc., **4**, 416, 1836. Siderotantal *Hausm.*, Handb., **2**, 960, 1847. Ildefonsit *Haid.*, Handb. 548, 1845; = Harttantalerz *Breith.*, Char., 230, 1832, Handb., 874, 1847. See also below.

Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c}$ = 0·82850 : 1 : 0·88976 E. S. Dana[1].
100 ∧ 110 = 39° 38½′, 001 ∧ 101 = 47° 2⅓′, 001 ∧ 011 = 41° 39⅔′.

Forms[9]:	*z* (530, *i*-$\breve{\frac{5}{3}}$)[2,8]	*f* (102, ½-ī)[5]	*α* (113, ⅓)[7]	*π* (121, 2-$\breve{2}$)[5]
a (100, *i*-ī)	*m* (110, *I*)	*h* (203, ⅔-ī)[4]	*o* (111, 1)	*u* (133, 1-$\breve{3}$)
b (010, *i*-ĭ)	*g* (130, *i*-$\breve{3}$)	*q* (023, ⅔-ĭ) tw. pl.	*σ* (213, ⅔-$\bar{2}$)[7]	*s* (263, 2-$\breve{3}$)[5]
c (001, *O*)	*l* (106, ⅙-ī)[4]	*i* (011, 1-ĭ)[6]	*x* (211, 2-$\bar{2}$)[7]	*r* (391, 9-$\breve{3}$)[5]
d (730, *i*-$\frac{7}{3}$)[9]	*k* (103, ⅓-ī)	*e* (021, 2-ĭ)	*β* (233, 1-$\frac{3}{2}$)[5]	*n* (163, 2-$\breve{6}$)
y (210, *i*-$\bar{2}$)			*t* (463, 2-$\frac{4}{3}$)[6]	*φ* (1·12·3, 4-$\breve{12}$)[7]

The form of columbite bears a rather close relation to that of wolframite (p. 982) as early pointed out by Rose.

1. 2. 3.

4. 5. 6.

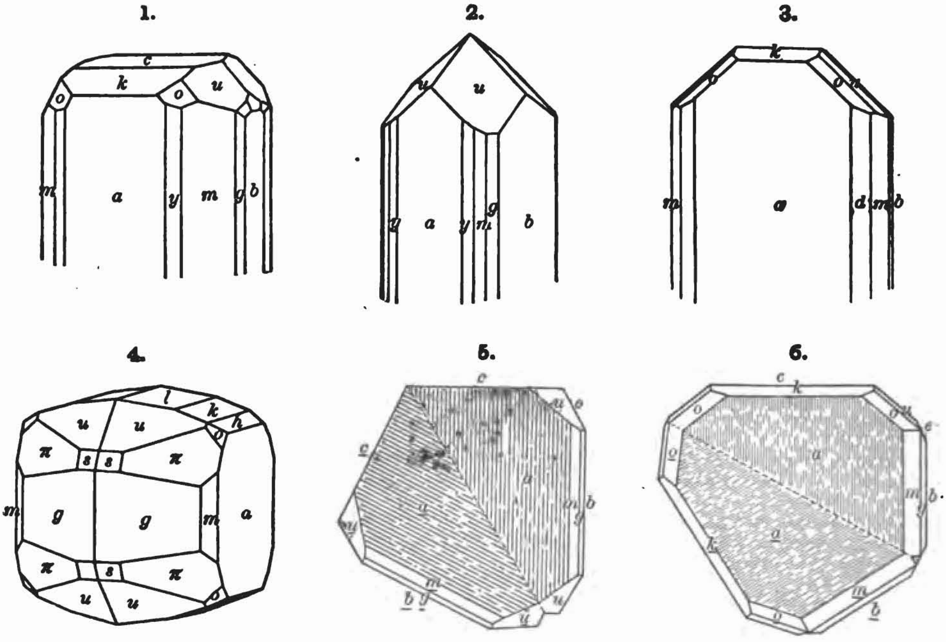
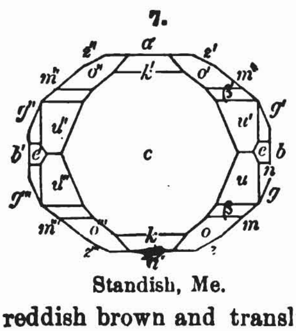


Fig. 1, Middletown. 2, Haddam. 3, Black Hills, Pfd. 4, Greenland, after Schrauf (*b* (010) in front). 5, Standish, Bodenmais. 6, Standish, Me.

dd'''	= 39° 6'	*cα*	= 24° 56'	*oo'*	= 77° 29'	*σσ'''*	= 27° 7'
yy'''	= 45° 0'	*co*	= 54° 21½'	*nn'*	= 19° 54'	*ββ'''*	= 71° 46'
zz'''	= 52° 52'	*cσ*	= 37° 46½'	*ss'*	= 38° 39'	*ss'''*	= 110° 42'
mm'''	= 79° 17'	*cx*	= 66° 48½'	*tt'*	= 70° 6'	*xx'''*	= 41° 10'
gg'''	= *136° 10'	*cπ*	= 64° 18'	*ππ'*	= 55° 30'	*ao*	= 51° 15½'
gg'	= 43° 50'	*cu*	= 43° 48'	*oo''*	= *108° 43'	*aβ*	= 61° 51½'
ll'	= 20° 18'	*cs*	= 62° 28'	*uu''*	= 87° 36'	*au*	= 75° 2'
kk'	= 39° 28½'	*cn*	= 61° 9'	*αα'''*	= 81° 12'	*aπ*	= 62° 15'
ff'	= 56° 28'	*αα'*	= 37° 53'	*uu'''*	= 79° 54'	*as*	= 70° 40'
hh'	= 71° 12'	*σσ'*	= 68° 56'	*nn'''*	= 118° 20'	*bo*	= 58° 46'
qq'	= 61° 21'	*uu'*	= 29° 57'	*oo'''*	= 62° 27½'	*bn*	= 30° 50'
ii'	= 83° 19'	*ββ'*	= 56° 17'	*ππ'''*	= 100° 59'	*bu*	= 50° 3'
ee'	= 121° 20'						

Twins[3]: tw. pl. *e* common, usually contact-twins, heart-shaped and showing a delicate feather-like striation on *a* (f. 5), here *cc̲* = 58° 40′ and *bb̲* = 121° 20′; also penetration-twins. Further tw. pl. *q* (023) rare (f. 6), here *cc̲* = 118° 39′, *bb̲* = 61° 21′. Crystals short prismatic, often rectangular prisms with the pinacoids, *abc*, prominent; also thin tabular ∥ *a*; the pyramids often but slightly developed, sometimes, however, acutely terminated by *u* (133) alone (f. 2). Also in large groups of parallel crystals, and massive.

7.



Standish, Me.

Cleavage: *a* rather distinct; *b* less so. Fracture subconchoidal to uneven. Brittle. H. = 6. G. = 5·3–7·3, varying with the composition (see below). Luster submetallic, often very brilliant, sub-resinous. Color iron-black, grayish and brownish black, opaque; rarely reddish brown and translucent; frequently iridescent. Streak dark red to black.

Comp., Var.—Niobate and tantalate of iron and manganese, $(Fe,Mn)(Nb,Ta)_2O_6$, passing by insensible gradations from normal COLUMBITE, the nearly pure niobate, to normal TANTALITE, the nearly pure tantalate. The iron and manganese also vary widely. Tin and wolfram are present in small amount. The percentage composition for $FeNb_2O_6$ = Niobium pentoxide 82·7, iron protoxide 17·3 = 100; for $FeTa_2O_6$ = Tantalum pentoxide 86·1, iron protoxide 13·9 = 100.

In some varieties, *manganocolumbite* or *manganotantalite*, the iron is largely replaced by manganese. The variety from Branchville, anal. 10, corresponds to $MnNb_2O_6.MnTa_2O_6$; cf. also anal. 33. The manganotantalite of Sanarka (anal. 13) is essentially $MnTa_2O_6$.

The connection between the specific gravity and the percentage of metallic acids is shown in the following table from Marignac, Bibl. Univ., **25**, 25, 1866. See also analyses below.

	G.	Ta_2O_5		G.	Ta_2O_5
Greenland	5·36	3·3	Bodenmais	5·92	27·1
Acworth, N. H.	5·65	15·8	Haddam	6·05	30·4
Limoges	5·70	13·8	Bodenmais	6·06	35·4
Bodenmais (*Dianite*)	5·74	13·4	Haddam	6·13	31·5
Haddam	5·85	10·0			
			Tantalite	7·03	65·6

CRYST. COLUMBITE and TANTALITE.

Anal.—1, Blomstrand, J. pr. Ch., **99**, 44, 1866. 2, Genth, Proc. Ac. Philad., 51, 1889. 3, O. D. Allen, Dana Min., App. III, 30, 1882. 4, Cossa, Rend. Acc. Linc., 3, 111, 1887. 5, Janovsky, Ber. Ak. Wien, **80** (1), 34, 1879. 6, T. B. Osborne, Am. J. Sc., **30**, 336, 1885. 7–9, Blomstrand, l. c. 10, Comstock, Am. J. Sc., **19**, 131, 1880. 11, Dunnington, Am. Ch. J., **4**, 138, 1882. 12, Comstock, l. c. 13, Blomstrand, Vh. Min. Ges., **23**, 188, 1887.

	G.	Nb_2O_5	Ta_2O_5	SnO_2	WO_3	FeO	MnO	CaO	MgO	
1. Greenland	5·395	77·97	—	0·78	0·13	17·33	3·28	—	0·23	PbO 0·12, [ZrO_2 0·13 = 99·92
2 Mineral Hill, Pa.	5·26	76·26	0·83	0·16	*tr.?*	7·65	11·29	0·66	0·07	UO_2 0·18, [Y_2O_3 1·78, Ce_2O_3 0·34, ZrO_2 0·67, ign. 0·33 = 100·22
3. Standish, Me.	5·65	68·99	9·22	1·61		16·80	3·65	—	—	= 100·27
4. Craveggia	5·68	65·17	13·35	0·23	—	9·84	8·98	1·17	*tr.*	= 98·74
5. Isergebirge	5·74	62·64	16·25ª	0·41	1·01	13·06	6·11	—	—	ZrO_2 0·48, [H_2O 0·34 = 100·30
6 Branchville	5·73	½ 60·70	19·20	—	—	12·91	7·03	—	—	= 99·84
7. Bodenmais	5·75	56·43	23·79	0·58	1·07	15·82	2·39	—	0·40	ZrO_2 0·28, [H_2O 0·85 = 100·11
8. Haddam	6·15	51·53	28·55	0·34	0·76	13·54	4·55	—	0·42	ZrO_2 0·34, [H_2O 0·16 = 100·19
9. Bodenmais	6·26	48·87	30·58	0·91		15·70	2·95	—	0·14	H_2O 0·40 = [99·55
10. Branchville	6·59	30·16	52·29	—	—	0·48	15·58	0·37	—	= 98·88
11. Amelia Co., Va.	6·48	31·40	53·41	*tr.*	—	5·07	8·05	1·27	0·20	Y_2O_3? 0·82 [= 100·22
12. Northfield	6·84	¼ 26·81	56·90	—	—	10·05	5·88	—	—	= 99·64
13. Sanarka *Manganotantalite*	7·301	4·47	79·81	0·67		1·17	13·88	0·17	—	ign. 0·16 = [100·33

ª Other determinations gave: Nb_2O_5 62·25, 61·98, 62·03; Ta_2O_5 16·31, 17·12, 16·55, respectively.

The following are analyses by W. P. Headden (Am. J. Sc., **41**, 89, 1891) chiefly of columbite from the Black Hills, S. Dakota. Anals. 14–21 are all from the Etta mine, and show well the variation in the metallic acids, even in specimens from a single locality (also shown in specimens from Haddam and Bodenmais); further the accompanying variation in specific gravity.

		G.	Nb_2O_5	Ta_2O_5	SnO_2	FeO	MnO	
14. Etta Mine,	Black Hills	5·890	54·09	18·20	0·10	11·21	7·07	CaO 0·21 = 100·88
15. "	"	6·181	47·05	34·04	0·30	11·15	7·80	= 100·34
16. "	"	6·245	46·59	35·14	0·18	7·44	10·94	= 100·29
17. "	"	6·376	40·37	41·14	0·13	8·28	9·09	CaO 0·78, MgO 0·10 [= 99·89
18. "	"	6·515	39·94	42·96	*tr.*	8·59	8·82	= 100·31
19. "	"	6·612	35·11	47·11	0·35	8·37	9·26	= 100·20
20. "	"	6·707	31·31	52·49	0·09	6·10	10·71	= 100·70
21. "	"	6·750	29·78	53·28	0·13	6·11	10·40	= 99·70

	G.	Nb_2O_5	Ta_2O_5	SnO_2	FeO	MnO
22. Peerless M., Black Hills,	6·378	37·29	44·87	0·09	6·87	11·02 = 100·14
23. " "	6·445	40·28	42·09	0·19	6·70	11·23 = 100·49
24. Bob Ingersoll M., "	5·901	57·32	23·43	0·09	6·29	13·55 = 100·68
25. Sarah M., "	5·804	61·72	18·93	0·25	11·21	8·67 = 100·79
26. "	6·565	40·07	42·92	0·20	9·73	7·24 = 100·16
27. Mallory Gulch "	6·282	41·69	40·19	0·11	9·88	8·70 = 100·57
28. " " "	6·469	37·28	44·48	0·16	9·29	8·68 = 99·89
29. Yolo M., Nigger Hill Distr.	6·592	24·40	57·60	0·41	14·46	2·55 CaO 0·73 = 100·15[b]
30. Turkey Creek, Col.	5·383	73·45	2·74	1·35[a]	11·32	9·70 CaO 0·61 = 99·17
31. Haddam, Conn.	5·780	60·52	19·71	0·09	12·64	7·51 = 100·47
32. Mitchell Co., N. C.	—	70·98	9·27	0·17	12·21	7·30 CaO 0·80 = 100·73
33. Elk Creek, S. D.	6·170	47·22	34·27	0·32	1·89	16·25 = 99·95

[a] Incl. 1·14 WO_3. [b] 4·46 of admixed SnO_2 deducted.

For other earlier analyses, see 5th Ed., p. 517; also (incomplete as regards separation of metallic acids) Colorado, G. = 5·15, and Yancey Co., N. C., G. = 5·6, Smith, Am. J. Sc., **13**, 359, 1877; San Roque, Argentine Rep., G. = 5·625, Siewert, Min. Mitth., 224, 1873; Middletown, G. = 6·14, Hallock, Am. J. Sc., **21**, 412, 1881; Turkey Creek, Jefferson Co., Colorado, G. = 5·48, MnO 11·23, Proc. Col. Sc. Soc., **2**, 31, 1886.

Nordenskiöld (l. c.) obtained for the mangantalite from Utö: G. = 6·3, Nb_2O_5,Ta_2O_5 85·5, FeO 3·6, MnO 9·5, CaO 1·2 = 99·8.

MASSIVE TANTALITE.

The following are analyses of tantalite, chiefly massive, in part belonging with normal columbite-tantalite above, in part with skogbölite (and ixiolite) below. The analyses of the crystallized skogbölite and ixiolite are also included.

Anal.—1, 2, Rg., Ber. Ak. Berlin, 164, 1871. 3, Comstock, Am. J. Sc., **19**, 131, 1880. 4, Mgc., Bibl. Univ., **25**, 26, 1866. 5, 6, Rg., l. c. 7, A. Nd., Pogg., **101**, 629, 1857. 8–10, W. P. Headden, Am. J. Sc., **41**, 98, 1891; also earlier Schaeffer, ibid., **28**, 430, 1884. 11, 12, Rg., l. c.

	G.	Nb_2O_5	Ta_2O_5	SnO_2	FeO	MnO
1. Broddbo?	6·082	40·21	42·15	0·18	16·00	1·07[a] = 99·61
2. Broddbo	6·311	29·27	49·64	2·49[b]	13·77	2·88 ign. 0·75 = 98·80
3. Yancey Co., N. C.	6·88	[illegible] 23·63	59·92	—	12·86	3·06 MgO 0·34 = 99·81
4. Broddbo	7·03	10·88	65·60	6·10	8·95	6·61 = 98·14
5. Rosendal, Kimito	7·277	13·14	70·53	0·82	14·30	1·20 = 99·99
6. Härkäsaari, Tammela	7·384	7·54	76·34	0·70	13·90	1·42 = 99·90
7. Skogböle, *Skogbölite*	7·85	—	84·44	1·26	13·41	0·96 CuO 0·14, CaO 0·15 = [100·36
8. Grizzly-Bear Gulch, S. D.	7·773	6·23	78·20	0·68	14·00	0·81 = 99·92
9. " " "	8·200	3·57	82·23	0·32	12·67	1·33 = 100·12
10. Coosa Co., Ala.		8·78	71·37	5·38	8·44	5·37 = 99·34[c]
11. Skogböle, *Ixiolite*	7·232	19·24	63·58	1·70	9·19	5·97 ign. 0·23 = 99·91
12. "	7·272	12·26[d]	69·97	2·94	14·83	= 100

[a] Incl. CaO. [b] With trace WO_3. [c] Ign. 0·20 deducted. [d] Incl. 1 p. c. TiO_2.

Pyr., etc.—For *tantalite* B.B. unaltered. With borax slowly dissolved, yielding an iron glass, which, at a certain point of saturation, gives, when treated in R.F. and subsequently flamed, a grayish white bead; if completely saturated becomes of itself cloudy on cooling. With salt of phosphorus dissolves slowly, giving an iron glass, which in R.F., if free from tungsten, is pale yellow on cooling; treated with tin on charcoal it becomes green. If tungsten is present the bead is dark red, and is unchanged in color when treated with tin on charcoal. With soda and niter gives a greenish blue manganese reaction. On charcoal, with soda and sufficient borax to dissolve the oxide of iron, gives in R.F. metallic tin. Decomposed on fusion with potassium bisulphate in the platinum spoon, and gives on treatment with dilute hydrochloric acid a yellow solution and a heavy white powder, which, on addition of metallic zinc, assumes a smalt-blue color; on dilution with water the blue color soon disappears (Kbl.).

For *columbite* nearly as with tantalite. Von Kobell states that when decomposed by fusion with caustic potash, and treated with hydrochloric and sulphuric acids, it gives, on the addition of zinc, a blue color much more lasting than with tantalite; and the variety dianite, when similarly treated, gives, on boiling with tin-foil, and dilution with its volume of water, a sapphire-blue fluid, while, with tantalite and ordinary columbite, the metallic acid remains undissolved. The variety from Haddam, Ct., is partially decomposed when the powdered mineral is evaporated to dryness with concentrated sulphuric acid, its color is changed to white, light gray, or yellow, and when boiled with hydrochloric acid and metallic zinc it gives a beautiful blue. The remarkably pure and unaltered columbite from Arksut-fiord in Greenland is also partially decomposed by sulphuric acid, and the product gives the reaction test with zinc, as above.

Obs.—Occurs at Rabenstein, near Zwiesel, and Bodenmais, Bavaria, in granite, with iolite and magnetite; at Tirschenreuth, Bavaria; at Craveggia, Italy; at Tammela, in Finland; at Chanteloube, near Limoges, in pegmatyte with tantalite; near Miask, in the Ilmen Mts., with samarskite; in the gold-washings of the Sanarka region in the Ural; at Hermanskär, near Björskär, in Finland; in Greenland, in cryolite, at Ivigtut (or Evigtok), in brilliant crystals; disseminated through or among the wolframite of Auvergne, and detected by acting with aqua-regia, which dissolves the wolframite and leaves untouched the columbite (Phipson, Ch. News, 160, 1867); at Montevideo, S. A.; San Roque, Argentine Republic.

In the United States, in *Maine*, at Standish, in splendent crystals in granite; also at Stoneham with cassiterite, etc. In *N. Hampshire*, at Plymouth, with beryl; at Acworth, at the mica mine. In *Mass.*, at Chesterfield, some fine crystals, associated with blue and green tourmaline and beryl, in a vein of albitic granite; also Beverly; Northfield, Mass. (anal. 12), with beryl. In *Connecticut*, at Haddam, 2 m. from the village, in a granite vein, some of the crystals several pounds in weight; also at the chrysoberyl locality, but not now accessible; also at the iolite locality, Haddam; near Middletown, in a feldspar vein in fine crystals, some very large; at Branchville, Fairfield Co., in a vein of albitic granite, in large crystals and aggregates of crystals, sometimes weighing many pounds, also in minute thin tabular crystals translucent (*manganocolumbite*, anal. 10) implanted upon spodumene; also at other points in the neighborhood of Branchville in granite veins. In *N. York*, at Greenfield, with chrysoberyl. In *Penn.*, Mineral Hill, Delaware Co. In *Virginia*, Amelia Co., in fine splendent crystals with microlite, monazite (p. 728), etc. In *N. Carolina*, with samarskite crystals in parallel position at the Wiseman's mica mines of Mitchell Co.; also at the Deake mine and other points; Ray's mine in Yancey Co.; Balsam Gap in Buncombe Co.; near Franklin, Macon Co.; White Plains, Alexander Co. In *Colorado*, on microcline at the Pike's Peak region; Turkey Creek, Jefferson Co. (11·23 MnO). In *S. Dakota*, in the Black Hills region, common in the granite veins associated with cassiterite, beryl, etc.; the crystals and crystalline groups are often large, one mass is estimated to have weighed 2000 lbs.; most abundant at the Etta and Bob Ingersoll mines; also at other points in Pennington Co; also in Nigger Hill distr., in Lawrence Co., sometimes associated with stream tin. Cf. Headden, l. c., also W. P. Blake, Am. J. Sc., **28**, 340, 1884, **41**, 403, 1891 (figures and measurements, Pfd.). In *California*, King's Creek distr., Fresno Co.

Mangantantalite of Nordenskiöld is from Utö, Sweden, where it occurs with petalite, lepidolite, microlite, etc. *Manganotantalite* of Arzruni is from the gold-washings in the Sanarka region in the Ural.

Massive tantalite occurs in Yancey Co., N. C.; Coosa Co., Ala.; also in the Black Hills, S. Dakota.

Also occurs in Finland, in Tammela, at Härkäsaari near Torro, associated with gigantolite and rose quartz; in Kimito, at Skogböle, in Somero at Kaidasuo, and in Kuortane at Katiala, with lepidolite, tourmaline, and beryl; in Sweden, near Falun, at Broddbo and Finbo; in France, at Chanteloube near Limoges, in pegmatyte. *Ildefonsite* is from Ildefonso, Spain, and has G. = 7·416, H. = 6–7.

The occurrence of columbite in America was first made known by Mr. Hatchett's examination of a specimen sent by Governor Winthrop to Sir Hans Sloane, then President of the Royal Society, which was labeled as found at Neatneague (better Naumeag). Dr. S. L. Mitchill stated (Med. Repos., vol. 8) that it was taken at a spring at New London, Conn. No locality has since been detected at that place. But the rediscovery of it at Haddam, first published by Dr. Torrey (Am. J. Sc., **4**, 52, 1822), and since near Middletown, about 7 m. distant, has led to the belief that the original locality was at one of these places, which are about 30 m. N.W. of New London. Mr. J. Hammond Trumbull in a letter to Prof. Brush (July 16, 1882) discussing this subject, remarks: "The name of Namueg or Naumeag, originally given to the plantation at New London, may have been extended—as were the bounds of the plantation—east of the Thames, to the Mystic, including what is now Groton. I conjectured that the columbite was found near Winthrop's mill a short distance above the head of Mystic, and there used to be a local tradition to that effect; though it had no definite value."

The metal of columbite was named columbium by Hatchett in 1802, from Columbia, a name of America, whence his specimen was received, and thus came the name *columbite* given by Jameson and Thomson (see further below). Rose, after investigating the metal and its compounds, named it anew, calling it *niobium*, and this gave rise to the name *niobite*. *Baierite* is from the German name of Bavaria. *Torrelite* Thomson, named after Dr. J. Torrey, is the ordinary Middletown columbite; and *Greenlandite* Breith. is that from Greenland; both names originated partly in erroneous views of the crystals of the minerals. *Dianite* is the Bodenmais columbite, in which v. Kobell supposed he had discovered the acid of a new metal, which he called *dianium*.

No good reason has been given for substituting *niobium* for *columbium*, and it is contrary to the scientific law of priority; but as it is now accepted by most chemists the common usage is here followed.

Tantalite was named by Ekeberg, from the mythic Tantalus, in playful allusion to the difficulties (tantalizing) he encountered in his attempts to make a solution of the Finland mineral in acids. The name was afterward extended to the American mineral *columbite*, and to the same from other localities; while the name columbite, the metal columbium having been discovered a little prior to tantalum, received a similar extension, so as to include all tantalite.

The subsequent discovery that tantalum and columbium were distinct elements finally established them as independent species.

Ref.—[1] On splendent crystals from Standish, Me., Zs. Kr., **12**, 266, 1886; these results differ but little from those of J. D. D. (1837) on the Haddam mineral. The form seems to vary but little with change of composition. Analyses 1-13 (also most and probably all of 14–33) belong to minerals having the *columbite habit and angles;* even the crystals of *manganotantalite* of Arzruni (anal. 13, a manganese tantalate) show the planes *a*, *b*, *c*, *l*, *k*, *u*, *n*, and affords nearly the same ratio (below, from *ck* = *19° 19′, *bu* = *50° 30½′). It is plain, therefore, that skogbölite and ixiolite cannot be included in this series; their relation to normal columbite-tantalite needs further investigation (cf. below, p. 737).

The following axial ratios are interesting for comparison, although it is to be noted that the crystals seldom allow of accurate measurements. The axes of Schrauf, ref. [7] below, are based upon angles (only approximate) from crystals of different localities and are hence of no value for comparison. Schrauf made *u* = 111, *g* = 110, etc., see list, p. 737. Cf. also Kk., Min. Russl., **10**, 261, 1891.

	G.	Ta_2O_5	$\breve{a} : \bar{b} : \dot{c}$	
Greenland	5·39	—	0·8292 : 1 : 0·8776	Dx.
Ilmen Mts.	5·57	?	0·8302 : 1 : 0·8822	Kk.
Standish	5·65	9·2	0·8285 : 1 : 0·8898	E. S. D.
Haddam	5·95	29?	0·8292 : 1 : 0·8778	J. D. D.
Sanarka	7·3	79·8	0·8304 : 1 : 0·8732	Arz.

[2] J. D. D., Am. J. Sc., **32**, 149, 1837, and Min., p. 370, 1837, and App., p. 65; in Min., p. 354, 1854, the forms, 530, 740, 035, are added as doubtful.

[3] Rose, twins, Bodenmais, Pogg., **64**, 171, 1845. [4] Mlr., Min., p. 471, 1852. [5] Dx., Greenland, Ann. Mines, **8**, 398, 1855. [7] Schrauf, Greenland, Ber. Ak. Wien, **44** (1), 445, 1861. [8] Maskelyne, Montevideo, Phil. Mag., **25**, 41, 1863. [9] Penfield, quoted by W. P. Blake, Am. J. Sc., **41**, 403, 1891.

526A. Skogbölite. *A. E. Nordenskiöld*, Beskr. Finl. Min., 30, 1855. Tantalit mit zimmtbraunem Pulver, *Berzelius*. Tammela-tantalit *N. Nordenskiöld*, Act. Soc. Fenn., **1**, 119, read April 25, 1832, Pogg., **50**, 656, 1840.

Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c}$ = 0·81696 : 1 : 0·65106.

100 ∧ 110 = 39° 14¾′, 001 ∧ 101 = 38° 33¼′, 001 ∧ 011 = 33° 4′, N. Nordenskiöld.

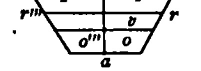
Forms: *a* (100, *i*-ĭ), *b* (010, *i*-ī), *r* (490, *i*-$\frac{9}{4}$), *n* (016, $\frac{1}{6}$-ī), *μ* (011, 1-ī), *q* (031, 3-ī), *p* (111, 1), *v* (322, $\frac{3}{2}$-$\frac{3}{2}$), *o* (211, 2-$\bar{2}$). Also *x* (131, 3-$\breve{3}$)?

Angles: *rr′* = 57° 6′, *nn′* = 12° 23′, *μμ′* = 66° 8′, *qq′* = 125° 47′, *pp′* = *67° 28½′ *pp″* = 91° 38½, *pp‴* = *53° 58′, *vv′* = 90° 6′, *oo′* = 106° 21½′.

Measured: *pp″* = 91° 45′, *rr′* = 57° 3′, *bq* = 29½° (27° 7′ calc.), *nn′* = 12°, *vv′* = 90°, *oo′* = 110°.

1.

2.



Figs. 1, 3, *Skogbölite*, N. Nd.

In prismatic crystals (f. 1) the angle of the prism near that of yttrotantalite and samarskite.

Cleavage indistinct. Fracture uneven. H. = 6·0–6·5. G. = 7·8–8·0. Luster metallic. Color black. Opaque. Streak blackish brown to cinnamon-brown.

Comp.—Essentially $FeTa_2O_6$, a nearly pure iron tantalate. Cf. anal. 7, p. 734.

Obs.—From Härkäsaari in Tammela, Finland, associated with rose quartz and gigantolite, in albitic granite. Also with ixiolite at Skogböle in Kimito. This is the mineral ordinarily called tantalite, and regarded as isomorphous with columbite (Rose, Rg. et al.), but in fact as shown by the author having quite a different though related form. Cf. ref. [1].

A mineral from Pisek, Bohemia, referred to tantalite by Vrba (Zs. Kr., **15**, 201, 1889), is later stated to be only rutile, cf. Gdt., Index, **3**, 185, 1891.

Ixiolite *A. E. Nordenskiöld*, Pogg., **101**, 632, 1857. Kimito-tantalit *N. Nordenskiöld*. Ixionolit *F. J. Wiik*. Kassiterotantal *Hausm.* Cassitero-tantalite.

Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c}$ = 0·5508 . 1 . 1 2460 A. E. Nordenskiöld.

100 ∧ 110 = 28° 50¾′, 001 ∧ 101 = 66° 9½′, 001 ∧ 011 = *51° 15′.

Forms: *a* (100, *i-ī*), *b* (010, *i-ĭ*), *c* (001, *O*); *m* (110, *I*), *s* (103, $\frac{1}{3}$-ī)? tw. pl.; *n* (011, 1-ĭ), *t* (031, 3-ĭ), *p* (111, 1). Angles: *mm'''* = 57° 41½', *cs* = 37° 1', *nn'* = 102° 30', *tt'* = 150° 3', *cp* = *68° 50', *pp'* = 109° 32', *pp'''* = 53° 28'.

Crystals rectangular prisms (*a b c*), sometimes twins with *s* (103) as tw. pl. Fracture uneven to subconchoidal. Brittle. H. = 6–6·5. G. = 7·0–7·1. Luster submetallic. Color blackish gray to steel-gray. Powder brown.

In composition a niobo-tantalate of iron and manganese, containing also a small amount of tin (anal. 11, p. 734). An analysis by Nordenskiöld gave 13 p. c. tin dioxide, but this is not confirmed by Rg. (Min. Ch., 357, 1875).

From Skogböle in Kimito, Finland. Named from *Ixion*, a mythological person related to Tantalus.

Relation of Skogbölite and Ixiolite to Columbite-tantalite. That there is a certain relation between the forms of columbite and the above two kinds of tantalite has been shown by various authors; it is exhibited in the following axial ratios starting from the axes of each given above:

Columbite		$\breve{a} : \bar{b} : \dot{c} = 0·8285 : 1 : 0·8898$
Skogbölite	1.	$a : b : \frac{4}{3}c = 0·8170 : 1 : 0·8681$
	or	
	2.	$\frac{2}{3}b : a : c = 0·8160 : 1 : 0·7969$
Ixiolite	1.	$\frac{2}{3}b : a : \frac{1}{2}c = 0·8069 : 1 : 0·7541$
	or	
	2.	$\frac{1}{2}a : b : \frac{2}{3}c = 0·8262 : 1 : 0·8307$

In 1 under both skogbölite and ixiolite the occurring prism (like samarskite in angle) has the symbol (490), in 2 the symbol (320) of columbite—the symbols of the other planes are in general less simple, and the value of this comparison is doubtful.

Groth proposes to retain Schrauf's position for columbite, while doubling the $\breve{a}$ and $\dot{c}$ axes, giving for columbite (Standish) and tantalite-skogbölite:

Columbite	$\breve{a} : \bar{b} : \dot{c} = 0·8047 : 1 : 0·7159$
Tantalite-skogbölite	$\breve{a} : \bar{b} : \dot{c} = 0·8170 : 1 : 0·6511$

The similarity, however, is more apparent than real; for nearly all the prominent planes of each species are wanting on the other, and the habit is very different—moreover, true tantalite corresponds exactly with columbite in both habit and angle.

The following table shows the planes of tantalite-skogbölite common to columbite with the symbols in the positions of Dana, Schrauf and Groth; also the prominent planes of each species (those in parentheses not having been observed).

	Dana.	Columbite Schrauf.	Groth.		Tantalite-skogbölite N. Nd.
a	100	010	010	*b*	010
b	010	100	100	*a*	100
h	203	021	011	*μ*	011
σ	213	163	133		
β	233	121	111	*p*	111
s	263	221	211	*o*	211
Also					
m	110	130	230		(230)
g	130	110	120		(120)
k	103	011	012		(012)
o	111	131	232		(232)
u	133	111	212		(212)
π	121	231	432		(432)
Also					
	(320)	(290)	(490)	*r*	490
	(109)	(013)	(016)	*n*	016
	(201)	(061)	(031)	*q*	031
	(496)	(342)	(322)	*v*	322

Mengite. Ilmenite *Brooke*, Phil. Mag., **10**, 187, 1831. Mengit *G. Rose*, Reis. Ural, **2**, 83, 1842.

Occurs in short prisms terminated by a pyramid. The angles are nearly those of columbite and Des Cloizeaux states (priv. contr.) that there can be no doubt that it is really that species. The planes are then *a*, *m*, *g*, *u*; angles *gg'* = 43° 40', *uu'* = 78° 50', *uu'''* = 29° 28' Brooke

G. = 5·43. Color black. Occurs in small crystals embedded in the albite of the granite veins in the Ilmen mountains. Named *mengite*, after Menge, the discoverer of the mineral. The mengite of Brooke is monazite.

HERMANNOLITE *C. U. Shepard*, Am. J. Sc., **50**, 90, 1870; **11**, 140, 1°76. A mineral from Haddam, Conn., probably identical with columbite. Cf. Hermann, who found in it "hypotantalic acid," hypoilmenic acid, etc., J. pr. Ch., **13**, 386, 1876; further Delafontaine, Am. J. Sc., **13**, 390, 1877, also Min., 5th Ed., 3d App., p. 30.

FERRO-ILMENITE *Hermann*, J. pr. Ch., **2**, 118, 1870. A kind of columbite from Haddam, Connecticut.

---

527. TAPIOLITE. Tapiolit *A. E. Nordenskiöld*, Öfv. Ak. Stockh., **20**, 445, 1863. Tantalite (fr. Sukula) *Arppe*, Act. Soc. Fenn., **6**, 590, 1861.

Tetragonal. Axis $\dot{c}$ = 0·6464; 001 ∧ 101 = 32° 52¾′ Nordenskiöld.

Forms: *a* (100, *i-i*); *m* (110, *I*); *e* (101, 1-*i*); *p* (111, 1), *c* (001, *O*)

Angles: *ee′* = 45° 9′, *pp′* = 56° 59½′ *pp″* = *84° 52′. The form is very near that of rutile, cassiterite, and zircon.

In square octahedrons, often monoclinic in appearance by distortion.

Cleavage not distinct. H. = 6. G. = 7·36 Nd.; 7·496 Rg. Luster strong adamantine, approaching metallic. Color pure black. Opaque.

Comp.—A tantalate and niobate of iron, having the same composition as tantalite, $Fe(Ta,Nb)_2O_6$ = (Ta : Nb = 4 : 1), Tantalum pentoxide 73·9, niobium pentoxide 11·1, iron protoxide 15·0 = 100.

Anal.—Rg., Ber. Ak. Berlin, 181, 1871. For earlier analyses see 5th Ed., p. 519.

	Ta_2O_5	Nb_2O_5	SnO_2	FeO	MnO
G. = 7·496	73·91	11·22	0·48	14·47	0·81 = 100·89

Pyr., **etc.**—B.B. behaves like tantalite, but gives no reaction for manganese.

Obs.—Occurs near the Kulmala farm, in the village of Sukula, in the parish of Tammela, Finland, in white pegmatyte granite, with beryl, tourmaline, and arsenopyrite.

Named from an ancient Finnish divinity.

---

4. Samarskite Group. Orthorhombic.

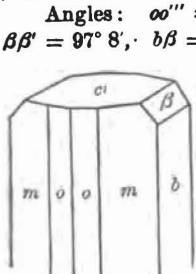
528. YTTROTANTALITE. Yttrotantal *Ekeberg*, Ak. H. Stockh., **23**, 80, 1802. Tantale oxidé yttrifère *H.*, Tr., 1822. Yttroilmenit *Herm.*, J. pr. Ch., **38**, 119, 1846. Schwarzer Yttrotantalit.

Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c}$ = 0·54115 : 1 : 1·1330 A. E. Nordenskiöld[1].

100 ∧ 110 = 28° 25¼′, 001 ∧ 101 = 64° 28⅛′, 001 ∧ 011 = 48° 34′.

Forms: *b* (010, *i-ĭ*), *c* (001, *O*); *o* (210, *i-2̄*), *m* (110, *I*), *p* (120, *i-2̆*), *q* (150, *i-5̆*); *s* (201, 2-*ī*); *β* (011, 1-*ĭ*).

Angles: *oo‴* = 30° 17′, *mm‴* = 56° 50′, *pp′* = 85° 28′, *bq* = *20° 17′, *ss′* = 153° 8′, *ββ′* = 97° 8′, *bβ* = *41° 26′.



Crystals prismatic, often six-sided with *m*, *b* prominent; also tabular ∥ *b*.

Cleavage: *b* very indistinct. Fracture small conchoidal. H. = 5–5·5. G. = 5·5–5·9. Luster submetallic to vitreous and greasy. Color black, brown, brownish yellow, straw-yellow. Streak gray to colorless. Opaque to subtranslucent.

Comp.—Essentially $\overset{II}{R}\overset{III}{R}_2(Ta,Nb)_4O_{15} + 4H_2O$, according to Rammelsberg, with $\overset{II}{R}$ = Fe,Ca, $\overset{III}{R}$ = Y,Er,Ce, etc. The water may be secondary.

The so-called yellow yttrotantalite of Ytterby and Kårarfvet belongs to fergusonite (p. 729) as shown by Rammelsberg.

Anal.—1, A. Nd., l. c. 2, Rg., Min. Ch., 360, 1875, also Pogg., **150**, 200, 1873.