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

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β. *Monoclinic Section.*

325. PYROXENE. Corneus pt. *Wall.*, 188, 1847. Basaltes pt. *Cronst.*, 68, 1758. Schorl noir *de Lisle*, Crist., 265, 1772; Schorl noir en prisme à huit pans terminé par une pyramide dièdre, etc. (fr. volc. Vivarais) *Faujas*, Volc. Viv., 89, fig. D, 1778. Schorl oct. obliquangle tronqué [made a distinct species] *Démeste*, Lett., 1, 382, 1779. Schorl opaque rhomboidal pt., Schorl opaque qui paroissent deriver d'un octaèdre rhomboidal (fr. volc. Auvergne, Vesuv., Viv., Etna), *de Lisle*, Crist., 2, 896, 407, 415, figs. 12, 13, 14 (twin), 17, 18, pl. v, 1783. Augit (fr. volc.) *Wern.*, Freiesleben in Bergm. J., 243, 1792. Volcanite *Delameth.*, Sciagr., 2, 401, 1792. Pyroxene (fr. Etna, Arendal, etc.) *H.*, J. Mines, 5, 269, 1799; Tr., 3, 1801. Pentaklasit *Hausm.*, Handb., 687, 1813. Pirosseno, Piroxena, *Ital.*

Diopside. Malacolit *Abildgaard*, Ann. Ch., 32, 1800; Delameth., J. Phys., 51, 249, 1800. Alalite, Mussite *Bonvoisin*, ib., 409, May, 1806. Diopside *H.*, J. Mines, 20, 65, 1806. Traversellit *Scheerer*, Pogg., 93, 109, 1854.

Lavrovite. Lawrowit, Vanadin-Augit, *Koksharov*, Bull. Ac. St. Pet., 11, 78, 1866. **Lavroffite.**

SALITE. Sahlit *d'Andrada*, Scherer's J., 4, 81, 1800; J. Phys., 51, 241, 1800. Sahlite. Baicalit *Renovanz*, Crell's Ann., 2, 21, 1798; Baikalit *Karst.*, Tab. 34, 74, 1800. Funkite, Dufr., Min., 3, 761, 1847. Violan *Breithaupt*, J. pr. Ch., 15, 321, 1838. Anthocoite *L. J. Igelström*, Jb. Min., 2, 86, 1889. Coccolit *d'Andrada*, Scherer's J., 4, 1800. Protheite *Ure.* Canaanite *Alger*, Min., 89, 1844.

DIALLAGE *H.*, Tr., 89, 1801. Hudsonite *Beck*, Min. N. Y., 405, 1842. Omphacite. Omphazit *Wern.*, Hoffm. Min., 2, 2, 802, 1812; *Breithaupt.* ib., 4, 2, 125, 1817.

Hedenbergite. Hedenbergit *Berz.*, Nouv. Syst. Min., 206, 269, 1819; Hedenberg, Afh., 2, 169. Lotalite *Severgin*, before 1814. Bolopherit *Breith.*, Handb., 582, 1847. Kalkeisenaugit *Germ.* Mauganhedenbergite *Weibull*, G. För. Förh., 6, 505, 1883. Asteroite *L. J. Igelström*, B. H. Ztg., Min., 29, 8, 1870.

Schefferite. Schefferit *J. A. Michaelson*, J. pr. Ch., 90, 107, 1863. Eisenschefferit *Flink*, Zs. Kr., 11, 495, 501, 1886.

JEFFERSONITE *Keating & Vanuxem*, J. Ac. Philad., 2, 194, 1822.

Augite. Leucaugite, *Dana*, 216, 1868. **FASSAITE**, Fassait *Wern.*, Hoffm., Min., 4, 2, 110, 1817. **AUGITE.** Basaltische Hornblende pt. *Wern.*, Bergm. J., 1792; Basaltine *Kirw.*, Min., 1, 219, 1794. Maclureite *Nuttall*, Am. J. Sc., 5, 246, 1822 = Amphibole *H. Seybert*, J. Ac. Philad., 2, 139, 1821. Pyrgom *Breith.*, Char., 140, 1832.

Monoclinic and hemihedral. Axes $\dot{a} : \dot{b} : \dot{c} = 1·09213 : 1 : 0·58932$; $\beta = 74°$ 10′ 9″ = 001 ∧ 100 Rath[1].

100 ∧ 110 = 46° 24′ 59″, 001 ∧ 101 = 24° 20′ 53″, 001 ∧ 011 = 29° 33′ 6″.

Forms[2]:

a (100, $i\text{-}\bar{\imath}$)	M (401, − 4-$\bar{\imath}$)[3]	v (221, − 2)	Γ (311, − 3-$\bar{3}$)	N (132, − $\frac{3}{2}$-$\bar{3}$)
b (010, $i\text{-}\bar{\imath}$)	ψ (501, − 5-$\bar{\imath}$)	r (552, − $\frac{5}{2}$)	E (10·4·1, − 10-$\frac{10}{4}$)[3]	l (241, − 4-$\frac{2}{4}$)
c (001, O)	n ($\bar{1}$02, $\frac{1}{2}$-$\bar{\imath}$)	w (331, − 3)	g (732, − $\frac{7}{2}$-$\frac{7}{2}$)	d (131, − 8-$\frac{3}{2}$)
	p ($\bar{1}$01, 1-$\bar{\imath}$)	h (441, − 4)	A (211, − 2-2)[3]	ϕ (152, − $\frac{5}{2}$-$\bar{5}$)
χ (510, $i\text{-}\bar{5}$)	H ($\bar{4}$08, $\frac{1}{2}$-$\bar{\imath}$)[4]	O ($\bar{1}$13, $\frac{1}{3}$)[2]	η (421, − 4-$\bar{2}$)	ε ($\bar{3}$47, $\frac{4}{3}$-$\frac{7}{3}$)[5]
Ψ (920, $i\text{-}\frac{9}{2}$)	Π ($\bar{3}$02, $\frac{1}{3}$-$\bar{\imath}$)[7]	τ ($\bar{1}$12, $\frac{1}{2}$)	Λ (483, − $\frac{4}{3}$-$\frac{4}{3}$)[5]	$\mathfrak{v}$ ($\bar{6}$87, $\frac{7}{6}$-$\frac{7}{6}$)[5]
f (810, $i\text{-}\bar{8}$)	G ($\bar{2}$01, 2-$\bar{\imath}$)[5]	ξ ($\bar{5}$35, $\frac{5}{3}$)	K ($\bar{4}$14, 1-$\bar{4}$)[7]	$\mathfrak{b}$ ($\bar{2}$35, $\frac{2}{3}$-$\frac{2}{3}$)[5]
g (210, $i\text{-}\bar{2}$)	q ($\bar{3}$01, 3-$\bar{\imath}$)	ν ($\bar{2}$23, $\frac{2}{3}$)[3]	Θ ($\bar{3}$13, 1-$\bar{3}$)	$\mathfrak{x}$ ($\bar{4}$65, $\frac{4}{5}$-$\frac{4}{5}$)[5]
m (110, I)	X (015, $\frac{1}{5}$-$\bar{\imath}$)[4]	s ($\bar{1}$11, 1)	k ($\bar{3}$12, $\frac{1}{3}$-$\bar{3}$)	$\mathfrak{c}$ ($\bar{3}$54, $\frac{4}{3}$-$\frac{4}{3}$)[5]
Ω (850, $i\text{-}\frac{8}{5}$)[6]	e (011, 1-$\bar{\imath}$)	ρ ($\bar{3}$32, $\frac{3}{2}$)	$\varDelta$ ($\bar{3}$11, 3-$\bar{3}$)	Ξ ($\bar{1}$·2·10, $\frac{1}{5}$-$\bar{2}$)[7]
ω (120, $i\text{-}\bar{2}$)	s (021, 2-$\bar{\imath}$)	β ($\bar{8}$85, $\frac{8}{5}$)	ι ($\bar{2}$11, 2-2)	W($\bar{1}$22, 1-$\bar{2}$), tw.pl.
i (180, $i\text{-}\bar{8}$)	π (041, 4-$\bar{\imath}$)	o ($\bar{2}$21, 2)	x (461, − 6-$\frac{4}{6}$)	ϵ ($\bar{1}$21, 2-$\bar{2}$)
$\mathcal{V}$ (150, $i\text{-}\bar{5}$)[4]	δ (061, 6-$\bar{\imath}$)	λ ($\bar{3}$31, 3)	t (351, − 5-$\frac{4}{3}$)	ζ ($\bar{4}$83, $\frac{4}{3}$-$\bar{2}$)
L (170, $i\text{-}\bar{7}$)[4]		κ (711, − 7-$\bar{7}$)	Σ (243, − $\frac{4}{3}$-$\bar{2}$)[3]	R ($\bar{1}$32, $\frac{3}{2}$-$\bar{3}$)[3]
	S (119, − $\frac{1}{9}$)[4]	D (922, − $\frac{9}{2}$-$\frac{9}{2}$)[3]	μ (121, − 2-$\bar{2}$)	Θ ($\bar{1}$42, 2-$\bar{4}$)
y (101, − 1-$\bar{\imath}$)	T (117, − $\frac{1}{7}$)[3]	B (411, − 4-$\bar{4}$)[3]	Q (136, − $\frac{1}{3}$-$\bar{3}$)[5]	U ($\bar{1}$52, $\frac{5}{2}$-$\bar{5}$)[5]
F (201, − 2-$\bar{\imath}$)[4]	σ (112, − $\frac{1}{2}$)	α (312, − $\frac{1}{3}$-$\bar{3}$)	P (134, − $\frac{4}{3}$-$\bar{3}$)[5]	γ ($\bar{1}$51, 5-5)
J (702, − $\frac{7}{2}$-$\bar{\imath}$)[5]	u (111, − 1)			
ς (801, − 8-$\bar{\imath}$)				

Also, reported by Götz[8] from Ala, 15·4·0, 15·0·4, 15·4·4.

|							
$\chi\chi'''$	=	23 °44'	ee'	=	59° 6'	cd = 57° 10¼'	$a'W$ = 90° 9'
f'''	=	38° 36'	zz'	=	97° 11'	cW = 33° 57'	
gg'''	=	55° 26'	xx'	=	132° 25'	$c\Delta$ = 71° 28'	uu' = 48° 29'
mm'''	=	92° 50'	$\delta\delta'$	=	147° 14'	ck = 46° 46'	vv' = 68° 42'
$\mu\mu'$	=	50° 54'					ww' = 77° 25'
$\ddot{u}''$	=	35° 12½'	$c\sigma$	=	19° 42'	au = 53° 58'	ps = *29° 35½'
			cu	=	83° 49½'	av = 47° 43½'	ss' = 59° 11'
cy	=	24° 21'	cv	=	49° 54'	$a's$ = 76° 34'	oo' = 84° 11'
$c5$	=	47° 13'	cw	=	57° 59½'	$a'o$ = 61° 32'	$\lambda\lambda'$ = 91° 35'
$c\psi$	=	56° 13½'	cm	=	79° 9¼'	$a'\lambda$ = 55° 26½'	kk' = 28° 52'
cn	=	15° 39'	cO	=	15° 5'	ue = 76° 16'	$\Delta\Delta'$ = 37° 50'
cp	=	31° 20'	$c\tau$	=	22° 32'	az = 79° 36'	$m'p$ = *79° 23'
$a'p$	=	*74° 30'	cs	=	42°· 2'	$a'k$ = 61° 51'	dd' = 106° 58'
cG	=	55° 48'	co	=	65° 21'	$a'\Delta$ = 39° 50'	bW = 59° 29'
cq	=	70° 16¼'	$c\lambda$	=	76° 28'		
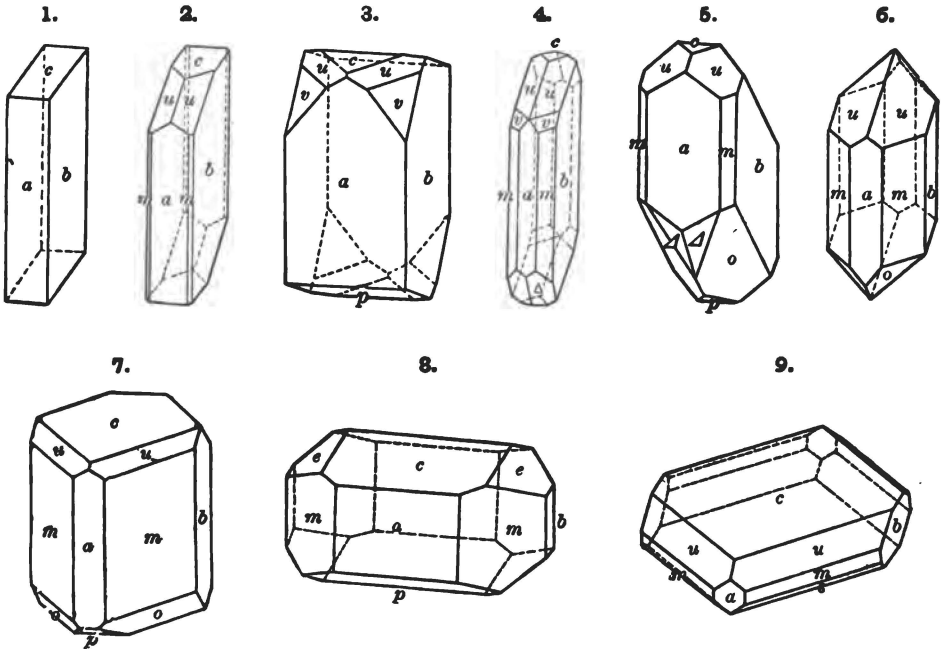
Figs 1, 2, Russell, N. Y.   3, Pierrepont, N. Y.   4, Gouverneur, N. Y.   5, 7, *Diopside*, De Kalb, N. Y.   6, Rossie, N. Y.   1–7, Pfd.   8, Monroe, N. Y.   9, Warwick, N. Y.

Twins[10]: tw. pl. (1) a, contact-twins, common (fig. 18), sometimes polysynthetic. (2) c, as twinning lamellæ producing striations and pseudo-cleavage or parting ∥ c; very common, often of unquestioned secondary origin; also capable of being produced artificially. (3) y (101) cruciform-twins, not common, f. 20.   (4) W ($\bar{1}22$) contact-twins or penetration- and cruciform-twins, the vertical axes crossing at angles of nearly 60° ($bW = 59°$ 29', and since $a'W = 90°$ 9', the faces a and $\underline{a}$ fall nearly in a plane; sometimes repeated as a six-rayed star (f. 21).

Crystals usually prismatic in habit, often short and thick, and either a square prism (a, b prominent), or nearly square (93°, 87°) with m predominating; sometimes a nearly symmetrical 8-sided prism with a, b, m.   Often coarsely lamellar, ∥ r or a.   Also granular, coarse or fine; rarely fibrous or columnar.
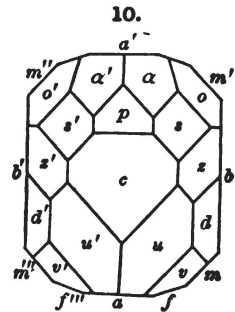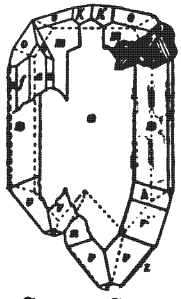
Occasionally hemihedral, only the planes at an extremity of the vertical axis being present, and the habit then apparently hemimorphic as in f. 22 and f. 19, the latter a twin.   Cf. G. H. Williams[5].
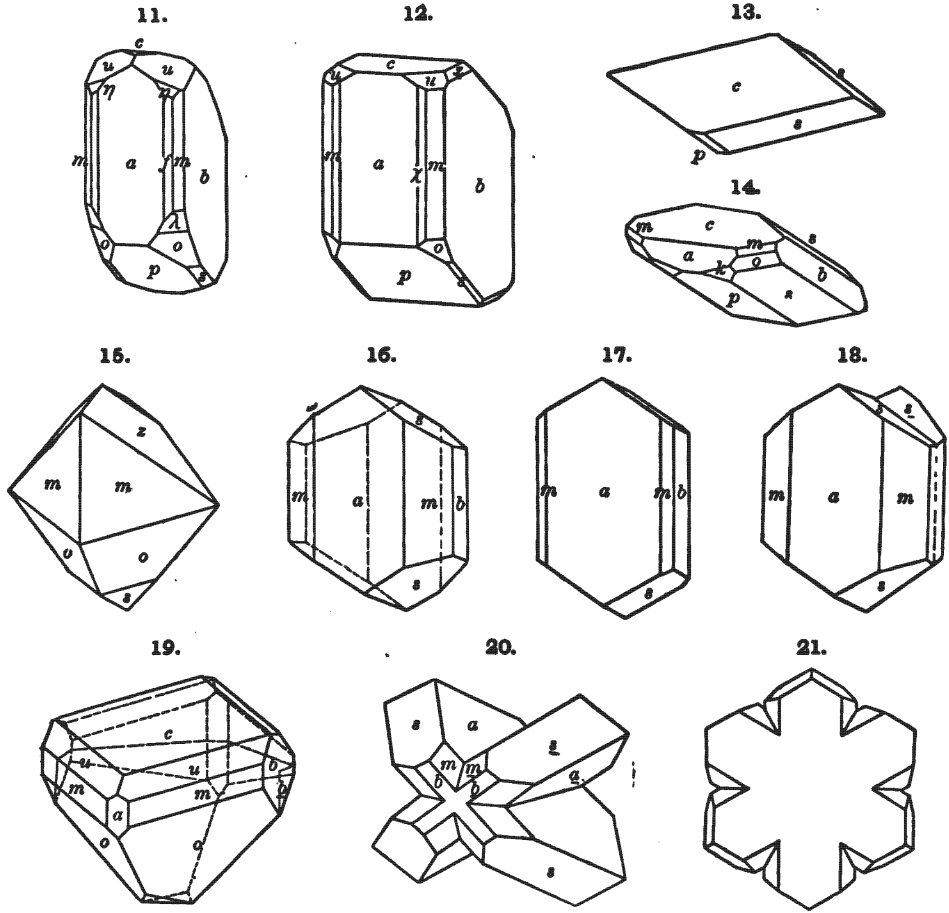
11, Ala, after Götz. 12,   Nordmark. 13, 14, *Schefferite*, Långban, Flink. 15, *Fassaite*, 16–18. *Augite*. 19, Orange Co., N. Y., G. H. Williams. 20, Schönhof, Zeph. 21, Sasbach.

Cleavage: *m* sometimes rather perfect, but interrupted, often only observed in thin sections ⊥ *c*.   Parting ∥ *c*, due to twinning, often very prominent, especially in large crystals and lamellar masses; also ∥ *a* less distinct and not so common.   Fracture uneven to conchoidal.   Brittle.   H. = 5–6.   G. = 3·2 –3·6, varying with the composition.   Luster vitreous inclining to resinous; often dull; sometimes pearly ∥ *c* in kinds showing parting.   Color usually green of various dull shades, varying from nearly colorless, white, or grayish white to brown and black; rarely bright green, as in kinds containing chromium.   Streak white to gray and grayish green.   Transparent to opaque.   Pleochroism usually weak, even in dark colored varieties; sometimes marked, especially in violet-brown kinds containing titanium.   Pyro-electrically + on *a* (cooling), and − on *b* for Ala crystals, but − on *a* and + on *b* for Tyrol; an indistinct opposite polarity between the extremities of the vertical axis was noted in one case, Hankel.

Canaan, Conn.

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Optically $+$. Double refraction strong. Ax. pl. $\parallel b$. $Bx_a \wedge \dot{c} = \mathfrak{c} \wedge \dot{c} = +36°$ to $+52°$, or $c\mathfrak{c} = 20°$ to $36°$, the angle in general increasing with amount of iron (see below). Axial angles for diopside from Ala, Dx.:

$$\alpha_y = 1·6727 \quad \beta_y = 1·6798 \quad \gamma_y = 1·7026 \quad \therefore 2V_y = 58° 59' \quad 2E_y = 111° 34'$$

Measured, $\qquad 2E_r = 111° 40' \qquad 2E_y = 111° 20' \qquad 2E_{bl} = 110° 51'$

Refractive indices, Heusser:

$$\beta_r = 1·67810 \qquad \beta_y = 1·68135 \qquad \beta_{gr} = 1·68567 \qquad \beta_{bl} = 1·69372$$

See also beyond under diopside, etc.

The connection between the position of the axes of elasticity and the composition (see further analyses beyond) is exhibited in the following tables, chiefly from Doelter, also Wiik.

	FeO	$Bx_a \wedge \dot{c}$		FeO	$Bx_a \wedge \dot{c}$
Ala	2·91	$+36° 5'$	Tavastby	5·52	41°
Zillerthal, *light*	3·29	36° 15'	Taberg	2·94[b]	41° 24'
" *dark*	3·09[a]	36° 50'	Stansvik	10·38	42° 30'
L. Baikal	3·49	37° 10'	Nordmark	17·34	46° 45'
Achmatovsk	3·81	37° 10'	Stansvik	20·44	46°
Arendal	4·5	39° 10'	Lojo, *blk.*	27·50	48°
Lojo	4·97	39° 30'	Tunaberg, *Hedenb.*	26·29	47° 50'

[a] Also Fe_2O_3 0·89. [b] Also Fe_2O_3 0·88.

	FeO	$FeO + Fe_2O_3$	$FeO + Fe_2O_3 + Al_2O_3$	$Bx_a \wedge \dot{c}$
Vesuvius, *green*	3·16	6·67	11·51	$+41°$
Greenwood Furnace	2·55	7·6	12·69	42° 20'
Aguas Caldeiras	4·81	8·32	16·21	43° 35'
P. Molar	5·43	11·61	17·28	45° 45'
S. Vincent	5·20	10·45	18·60	46° 45'
Vesuvius, *black*	4·09	8·56	18·31	46° 45'
Vesuvius, *yellow*	6·78	7·87	13·94	46° 57'
Bufaure	7·74	11·51	16·60	47°
Pesmeda	2·09	7·10	17·2	47° 10'
Sarza	5·48	10·38	20·04	47° 55'
Cuglieri	5·05	11·37	19·98	48°
Siderao	9·14	18·43	31·51	50°
Arendal	15·59	16·19	33·36	50° 35'
R. d. Patas	5·95	13·44	28·08	51°
Pico da Cruz	2·23	17·60	34·57	52°

Comp., Var.—For the most part a normal metasilicate, $RSiO_3$, of various bivalent or less frequently univalent metals, chiefly calcium and magnesium, also iron, less often manganese and zinc. The alkali metals potassium and sodium present rarely, except in very small amount. Also in certain varieties containing the trivalent metals aluminium, ferric iron, and manganese. These varieties may be most simply considered as molecular compounds of $Ca(Mg,Fe)Si_2O_6$ and $(Mg,Fe)(Al,Fe)_2SiO_6$, as suggested by Tschermak. Chromium is sometimes present in small amount; also titanium replacing silicon.

The name *Pyroxene* is from πῦρ, *fire*, and ξένος, *stranger*, and records Haüy's idea that the mineral was, as he expresses it, "a stranger in the domain of fire," whereas, in fact, it is, next to the feldspars, the most universal constituent of igneous rocks. This error, however, was more than counterbalanced by Haüy's discovery of the true crystallographic distinction of the species, which led him to bring together, under this one name, what Werner and others had regarded as distinct species. The name, therefore, is properly the name of the species as a whole, while *Augite* is only entitled to be used for one of its varieties.

The varieties are numerous and depend upon variations in composition chiefly; the more prominent of the varieties properly rank as sub-species.

I. *Containing little or no Aluminium.*

DIOPSIDE. Malacolite, Alalite. *Calcium-magnesium pyroxene.* Formula $CaMg(SiO_3)_2$ = Silica 55·6, lime 25·9, magnesia 18·5 = 100. Color white, yellow-

ish, grayish white to pale green, and finally to dark green and nearly black; sometimes transparent and colorless. In prismatic crystals, often slender; also granular and columnar to lamellar massive. G. = 3·2–3·38. $Bx_a \wedge c = +36°$ and upwards. Iron is present usually in small amount as noted below, and the amount increases as it graduates toward true hedenbergite, see further below.

Fliuk gives for the five varieties of diopside from Nordmark the following optical constants; see analyses 10–15 beyond, and for the axial ratios see Ref.[1].

$Bx_a \wedge c$	$2V_r$	$2V_y$	$2V_{gr}$	β_r	β_y	β_{gr}
+ 38° 3¼′	59° 9′	58° 52′	58° 40′	1·68978	1·69859	1·69869
38° 45′	59° 9′	58° 57′	58° 46′	1·69133	1·69593	1·69781
39° 1′	59° 6½′	58° 56½′	58° 47′	1·68889	1·69588	1·70029
41° 41′	59° 18′	59° 11′	59° 6′	1·70055	1·70467	1·71062
44° 38¼′	60° 44½′	60° 36′	60° 29′	1·71655	1·72428	1·72983

The following belong here:

Chrome-diopside, a variety containing chromium in small amount, often of a bright green; from the localities mentioned under analyses 38–40.

Malacolite, as originally used, included a bluish gray, grayish green, and whitish translucent variety from Sala, Sweden.

Alalite occurs in broad right-angled prisms, colorless to faint greenish or clear green, usually striated longitudinally, and came originally from the Mussa Alp in the Ala valley, Piedmont. *Mussite* is white, grayish white, and apple-green (according to Bonvoisin's original description), and occurs in prismatic implanted crystals, and also in masses made up of aggregated crystals. Named from the same locality, the Mussa Alp.

Traversellite, from Traversella, is in similar long glassy crystals, usually rectangular (*a, b*), much striated longitudinally, often clear green at one end and colorless at the other; prismatic cleavage perfect.

Canaanite is a grayish white or bluish white pyroxene rock occurring with dolomite at Canaan, Conn.; it has been referred to scapolite. Pyroxene in large white crystals is common in the region (f. 22); their composition, according to an analysis by M. D. Munn (priv. contr.) is: ⅓ SiO₂ 55·05, CaO 31·85, MgO 12·53, Al₂O₃,Fe₂O₃ 1·07 = 100; G. = 3·33. Cf. 5th Ed., p. 303.

Lavrovite is a pyroxene, colored green by vanadium, from the neighborhood of Lake Baikal in eastern Siberia. In coarse granular masses with quartz, and also in small imperfect crystals. Cleavage affords the prism 87° 7′; and there is the usual lamination from compound structure parallel to *c*. The color is fine emerald-green. Cf. anal. 50, and Kk., Min. Russl., **6**, 206.

Diopside is named from δις, *twice* or *double*, and όψις, *appearance*. *Malacolite* is from μαλακός, *soft*, because softer than feldspar, with which it was associated.

HEDENBERGITE. *Calcium-iron pyroxene.* Formula CaFe(SiO₃)₂, = Silica 48·4, iron protoxide 29·4, lime 22·2 = 100. Color black. In crystals, and also lamellar massive. G. = 3·5–3·58. $Bx_a \wedge c = +48°$. Manganese is present in *manganhedenbergite* to 6·5 p. c., see anal. 45, below. Color grayish green. G. = 3·55. Named after the Swedish chemist, Ludwig Hedenberg, who first analyzed and described the mineral.

Between the two extremes, diopside and hedenbergite, there are numerous transitions conforming to the formula Ca(Mg,Fe)Si₂O₆. As the amount of iron increases the color changes from light to dark green to nearly black, the specific gravity increases from 3·2 to 3·6, and the angle $Bx_a \wedge c$ also from 36° to 48°.

The following are varieties, coming under these two sub-species, based in part upon structure, in part on peculiarities of composition.

SALITE. Sahlite. Color grayish green to deep green and black; sometimes grayish and yellowish white. In crystals; also cleavable and granular massive G. = 3·25–3·4. Named from Sala in Sweden, one of its localities, where the mineral occurs in masses of a grayish green color, having a perfect parting ‖ *c*.

Baikalite is a dark dingy green variety, in crystals, with parting like the preceding. Named from Lake Baikal, in Siberia, near which it occurs.

Protheite is somber-green, in crystals, and approaches fassaite; from the Zillerthal in Tyrol.

Funkite is dark olive-green coccolite from Boksäter in Göthland, having a larger percentage of Fe than Mg.

Lotalite from Lotala, Finland, in black lamellar masses, is near hedenbergite.

VIOLAN *Breithaupt*, J. pr. Ch., **15** 321, 1838. Occasionally in prismatic crystals, affording (Dx , Min., **1**, 66, 1862, N. R., 183, 1867) the angles and the planes (in the prismatic zone) of pyroxene, also the prismatic cleavage. Usually lamellar massive, sometimes fibrous. H. = 6. G. = 3·233.

Luster waxy. Color dark violet-blue. Translucent, but in thin plates transparent. Optically $+$, and Bx_o inclined to a as in diopside. Anal.—1, Damour, Dx., Min., 1, 66, 1862 (impure material?). 2, Pisani, Dx., N. R., 184, 1867. 3, Schluttig, Inaug. Diss., Leipzig, Groitzsch, 17, 1884, as recalc. by Grünhut, Zs. Kr., 13, 74, 1887.

		SiO_2	Al_2O_3	FeO	MnO	CaO	MgO	Na_2O	
1.	G. = 3·283	56·11	9·04	2·46	2·54	13·62	10·40	5·63	= 99·80
2.	G. = 3·21	50·30	2·31	4·15	0·76	22·85	14·80	5·03 H_2O 0·30 = 100	
3.	G. = 3·231	‡ 52·02	2·60	1·19a	2·87	22·94	15·18	5·69b	= 102·49

a Incl. (Ni,Co)O 0·89.   b Incl. K_2O 0·75.

Occurs in small seams with white quartz, white fibrous tremolite spotted violet with manganese, greenovite and manganesian epidote, in the braunite of St. Marcel, in the valley of Aosta, Piedmont. Named from its color.

ANTHOCHROITE *L. J. Igelström*, Jb. Min., 2, 86, 1889. Probably identical with violan. Occurs in grains embedded in limestone and in thin veins. H. = 5–6. Color rose-red to pale violet. Analysis gave: SiO_2 51·6, MnO 3·4, MgO 18·5, CaO 23·8, Al_2O_3,Fe_2O_3 1·4, alk. [6·8] = 100. Occurs associated with braunite, manganesian garnet, epidote, vesuvianite at Jakobsberg, Wermland, Sweden. Named from ανθος, *flower*, and χροα, *color*.

Asteroite L. J. Igelström, B. H. Ztg., 29, 8, 1870, is a stellate radiated pyroxene, from Nordmark, in Sweden. Color ash-gray to white; luster silky; opaque, becoming bronze color on exposure. Anal.—SiO_2 48·48. FeO 22·24, MnO 4·12, CaO 17·00, MgO 4·18, ign. 2·83 = 98·85.

COCCOLITE. A granular variety, sometimes as indistinct crystals embedded in calcite, also forming loosely coherent to compact granular aggregates. Color varying from white to pale green to dark green, and then containing considerable iron; the latter the original coccolite. Named from κοκκος, *a grain*.

DIALLAGE. Lamellar or thin-foliated pyroxene, characterized by a fine lamellar structure and parting ǀ a, with also parting ǀ b, and less often ǀ c. Also a fibrous structure ǀ c. Twinning ǀ a, often polysynthetic; interlamination with an orthorhombic pyroxene common. Color grayish green to bright grass-green, and deep green; also brown. Luster of surface a often pearly, sometimes metalloidal or exhibiting schiller and resembling bronzite, from the presence of microscopic inclusions of secondary origin (cf. Judd, ref. see bastite, p. 351). $Bx_a \wedge c = +39$ to $40°$. H = 4; G. = 3·2–3·35. In composition near diopside, but often containing alumina and sometimes in considerable amount, then properly to be classed with the augites (cf. anal. 51–65). Often changed to amphibole; see smaragdite, p. 389, and uralite, p. 390.

Named from διαλλαγη, *difference*, in allusion to the dissimilar cleavages or planes of fracture. This is the characteristic pyroxene of gabbro, and other related rocks.

Hudsonite is a lamellar massive kind, color black, often with a bronze tarnish. G. = 3·5, Beck; 3·43–3·46, Brewer. Contains lime and ferrous iron, with but little magnesia. Named from the Hudson river, in the vicinity of which it occurs, in Cornwall, Orange Co., N. Y.

OMPHACITE. Omphazit [fr. Baireuth] *Wern.*. Hoffm. Min., 2, 2, 302, 1812; *Breith.*, ib., 4, 2, 125, 1817, Handb., 612, 1841, B. H. Ztg., 24, 365, 897, 1865. The granular to foliated pyroxenic constituent of the garnet-rock called eclogyte, often interlaminated with amphibole (smaragdite); cleavage as with pyroxene. H. = 5–6. G. = 3·2–3·3. Luster vitreous to silky. Color grass-green. Anal.—1–5, J. Fikenscher, B. H. Ztg., 24, 897, 1865. 6, Luedecke, Zs. G. Ges., 28, 259, 1876.

	G.	SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O	ign.	
1. Ober-Pferdt	3·263	52·57	9·12	5·32	13·75	17·41	1·11	0·28	0·32	= 99·98
2. Wustuben	3·270	52·35	9·69	4·08	12·85	18·05	1·73	0·32	0·62	= 99·69
3. Silberbach	3·243	52·77	9·19	4·81	13·60	18·11	1·22	—	0·41	= 100·11
4. Stumbach	3·201	52·16	8·71	11·63	10·77	14·16	0·87	0·14	0·50	= 99·94
5. Pacher, Styria		50·29	6·67	3·26	15·22	21·50	0·88	0·88	0·45 Cr_2O_3 2·07 =	
6. Syra		52·53	4·60	11·80	16·10	12·80	—	—	1·69 =	99·52[100·64

Occurs near Hof in Bavaria; at Pacher in Styria. Also a similar mineral (diallage) in the glaucoplane schists of the island Syra (Luedecke). Schrauf gives the name to the "chromdiopsid" of anal. 36, beyond. The name *Omphacite* is from ομφαξ, *an unripe grape*, alluding to the color; it is among the names of green stones mentioned by Pliny.

SCHEFFERITE. A manganese pyroxene, sometimes also containing much iron (iron-schefferite, Eisenschefferit *Flink*). Flink gives the composition of the Långban mineral (anal. 46) as corresponding to $6CaMgSi_2O_6.MgFeSi_2O_6.Mn_2Si_2O_6$.

In crystals, sometimes tabular ǀ c (f. 13), also with p (101) prominent, more often elongated in the direction of the zone $b : p$ (101), as in f 14; very rarely prismatic, ǀ c. Twins, with a as tw. pl., very common. Axial ratio as given beyond, Ref. [1]. Also crystalline, massive. Cleav-

age prismatic, very distinct. Color yellowish brown to reddish brown. Optically +. $Bx_a \wedge \dot{c}$ = $c \wedge \dot{c} = 44° 25\frac{1}{4}'$. $2V_y = 65° 8'$. Named after the Swedish chemist (1710–1759).

The iron-schefferite from Pajsberg (anal. 47) is black in color and has the axial ratio given beyond. $c \wedge \dot{c} = +49°$ to 59° for different zones in the same crystal. The brown iron-schefferite from Långban (anal. 48) has $c \wedge \dot{c} = 69° 8'$. It resembles garnet in appearance.

JEFFERSONITE. A manganese-zinc pyroxene (see anal. 49). In coarse crystals sometimes very large; they are like ordinary pyroxene in habit. Edges rounded and faces uneven and apparently corroded. G. = 8·63. Color greenish black, on the exposed surface chocolate-brown. $Bx_a \wedge \dot{c} = 53° 32'$. $2H_{a,y} = 84° 32'$ Dx., Min., **2**, XIX, 1874. Named after Mr. Jefferson.

According to the view of R. Fritz Gaertner the zinc shown in the analysis is to be explained as due to enclosed zincite and the manganese to franklinite, but this needs confirmation; Pisani's analysis (49) was made on the crystals examined optically by Dx.

II. *Aluminous.*

AUGITE. *Aluminous pyroxene.* Composition chiefly $CaMgSi_2O_6$ with $(Mg,Fe)(Al,Fe)_2SiO_6$, and occasionally also containing alkalies. Here belong:

a. **LEUCAUGITE.** Color white or grayish. Contains alumina, with lime and magnesia, and little or no iron. Looks like diopside. H. = 6·5; G. = 8·19, Hunt. Named from λευκός, *white.*

b. **FASSAITE,** or *Pyrgom.* Includes the pale to dark, sometimes deep-green crystals, or pistachio-green and then resembling epidote. The aluminous kinds of diallage also belong here. Named from the locality in the Fassathal, Tyrol. *Pyrgom* is from πύργωμα, *a tower.*

c. **AUGITE.** Includes the greenish or brownish black and black kinds, occurring mostly in eruptive rocks. It is usually in short prismatic crystals, thick and stout, or tabular ‖ *a*; often twins. Ferric iron is here present, in relatively large amount, and the angle $Bx_a \wedge \dot{c}$ becomes + 50° to 52°. Named from αὐγή, *luster.*

The *Augite* of Werner (and volcanite *Delameth.*) included only the black mineral of igneous rocks—the *volcanic schorl* of earlier authors.

Titaniferous augite. Containing 0·5 to 4·5 p. c. titanium dioxide; cf. anals. 108 to 121.

ALKALI-AUGITE. Here belong varieties of augite characterized by the presence of alkalies, especially soda; cf. anals., 108 to 121; they hence approximate to acmite and ægirite. They are known chiefly from rocks rich in alkalies, as elæolite-syenite, phonolyte, leucityte, etc. A pyroxene intermediate between diopside and ægirite has been described by Brögger from the elæolite-syenite of southern Norway, which has $c \wedge \dot{c} = +52°$, Zs. Kr., **16**, 655, 1890. Cf. also Cross, Am. J. Sc., **39**, 359, 1890.

Anal.—The following are analyses, chiefly recent, of the typical varieties; for other analyses see 5th Ed., pp. 217 to 219; also Rg., Min. Ch., pp. 386–392, 1875, and Erg., 20–81, 1886, further Heddle, Trans. R. Soc. Edinburgh, **28**, 1878, and many papers on pyroxene in rocks in Jb. Min., and elsewhere.

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DIOPSIDE.

	G.	SiO₂	Al₂O₃	Fe₂O₃	FeO	MnO	MgO	CaO	
1. Val d'Ala, *colorless*		54·28	0·51	0·98	1·91	—	17·30	25·04	= 100·02
2. " *dark green*	‡	54·74	—	—	2·91	—	17·02	26·03	= 100·70
3. Achmatovsk, *light green*	3·169	54·45	0·99	0·55	3·81	—	15·65	24·89	= 100·34
4. Zillerthal, *colorless*		54·85	0·25	0·15	3·29	—	16·02	24·99	= 99·55
" *dark green*	3·192	54·23	1·22	0·89	3·09	—	16·38	24·69	= 100·50
5. L. Baikal, *Baikalite*	3·242	‡53·95	0·78	0·97	3·49	—	16·40	25·14	= 100·73
6. Arendal	3·242	53·28	1·37	1·08	4·50	—	15·63	24·29	= 100·15
7. New York State	3·201	52·79	1·45	0·62	5·02	—	16·09	24·91	= 100·88
8. De Kalb, N. Y.	3·287	55·12	0·40	—	1·12	—	18·15	25·04	Na₂O 0·45, [K₂O 0·02, ign. 0·17 = 100·47
9. Taberg		53·71	0·40	0·88	2·94	0·20	15·67	25·09	ign. 0·30 = [99·19
10. Nordmark, *white*		54·59	—	0·11	2·49	0·14	17·42	25·70	= 100·45
11. " *yellow-green*		54·09	0·28	0·19	3·86	0·26	17·12	25·41	= 100·71
12. " *grass-green*		54·26	0·33	0·48	3·51	0·45	16·04	24·82	= 99·89
13. " *dark green*		53·03	0·75	0·32	7·34	1·18	13·65	22·98	= 99·20
14. " *black*	3·311	50·91	0·17	0·76	17·34	0·21	7·21	22·98	= 99·58
15. " *black*	3·367	51·05	1·10	0 95	17·31	0·60	5·92	22·44	= 99·37
16. Karis Lojo, *gray-green*		52·49	2·17	—	2·68	0·63	17·20	24·34	= 99·51
17. Ithis, *green*		50·31	6·46	—	4·81	—	14·48	24·87	= 100·98
18. Pälkäne, *green*		52·6	4·8	—	4·0	—	14·2	25·8	= 101·4
19. Hermala Lojo, *green*		53 03	—	—	4·97	0·22	15·88	25·48	= 99·58
20. Stansvik, *green*		52·76	—	—	10·38	1·34	9·95	23·90	ign. 0·27 = [98·60
21. Ojama, Lojo, *dark green*		46·37	4·15	—	27·50	0·14	3·00	20·58	= 101·74
22. Busti Meteorite		55·49	—	0·55 ·	—	—	23·33	19·98	Na₂O 0·55 = [99·83
23. Zermatt	3·11	54·22	—	—	1·84	—	18·25	24·80	ign. 0·41 = [99·52
24. Albrechtsberg	3·167	55 60	0·16	—	0·56	—	18·34	26·77	= 101·43
25. Nordmarksberg		53·20	0·08	—	2·38	0·20	16·89	24·06	Na₂O 0·34, [ign. 1·26 = 98·36
26. Gefrees	3·285	54·00	0·62	—	3·78	0·27	15·31	25·46	= 99 44
27. Mt. Somma	3·19	42·73	1·06	—	4·22	0·94ᵃ	17·80	24·18	= 100·93
28. Wampula, Finl.		51·88	1·19	—	4·32	0·89	17·09	23·88	= 99·25
29. Tavastby, "	3·045	52·80	6·10	—	5·52	—	18·31	19 08	= 101·81
30. Valpellina	3·329	54 02	0·20	—	8·07	—	12·52	24·88	= 100·69
31. Kriml	3·381	52·08	1·36	2·56	8·93	0·49	10·61	21·59	Na₂O 2 06 = [99·68
32. Edenville		51·05	2·02	1·30	12·28	0·12	10·02	22·07	ign. 0·34 = [99·10

ᵃ CuO

Chrome-diopside.

	G.	SiO₂	Al₂O₃	Cr₂O₃	FeO	MnO	MgO	CaO	
33. Diamond Fields, S. A., *green*	3·26	52·4	0·6	2·8	6·5	—	15·5	20·5	H₂O 1·5 = [99·8
34. " " (Jagerfontein)		54·97	1·50	2·08	4·71	—	14·30	21·52	= 99·08
35. Jan Mayen	3·313	51·86	1·56	0·73	3·46	*tr.*	17·40	22·15	Fe₂O₃ 2·44, [ign. 0·12 = 99·72
36. Křemže	3·259	53·67	2·45	1·49	3·84	*tr.*	13·57	20·34	Fe₂O₃ 2·07, [K₂O 1·48, Na₂O 1·29 = 100·20
37. Kaiserstuhl		51·89	4·76	1·09	4·40	0·54	15·47	19·73	insol. 2·30 = [100·18
38. Schw. Stein, Nassau	3·202	50·44	5·10	1·40	9·70	—	17·42	14·63	= 98 69
39. Lherz	3·28	53·63	4·07	1·30	8·52	—	12·48	20·37	= 100·37
40. Dreiser Weiher	3·28	49·71	7·42	2·61	5·08	—	17·84	17·39	= 100·0

HEDENBERGITE, *also above.*

	G.	SiO₂	Al₂O₃	Fe₂O₃	FeO	MnO	MgO	CaO	
41. Shergotty Meteorite	3·466	52·34	0·25	—	23·19	—	14·29	10·49	= 100·56
42. Dognacska	3·557	48·38	0·68	3·23	15·88	7·94	2·22	22·10	alk. 0·28 = [100·71
43. "	3·588	49·00	0·91	2·85	17·24	8·52	1·34	21·30	= 101·16
44. Tunaberg	3·492	47·62	1·88	0·10	26·29	—	2·76	21·53	= 100·18
45. Vester Silfberg	3·55	48·29	—	—	24·01	6·47	2·83	17·69	alk. 0·22 = [99 51

SCHEFFERITE.

	G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	
46. Långban		52·28	—	—	3·83	8·32	15·17	19·62	= 99·22
47. Pajsberg		50·88	1·97	—	17·48	6·67	9·08	12·72	= 98·80
48. Långban,									
Eisenschefferit, brn.		52·19	0·88	—	14·98	6·20	10·93	14·57	= 99·75

Jeffersonite.

49. Franklin Furnace, N. J. 3·63	45·95	0·85	—	8·91	10·20	3·61	21·55	ZnO 10·15, [ign. 0·35 = 101·57
50. *Lavrovite* 3·04	53·65	2·25	—	—	2·48	16·00	23·05	V_2O_3 2·57 [= 100

Diallage.

	G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	H_2O	
51. Le Prese, Veltlin	3·271	51·46	1·31	—	15·94	—	10·13	21·14	—	= 99·98
52. Buchberg, Silesia		51·23	1·21	—	11·57	1·26	16·11	17·07	1·81	= 99·76
53. Balta Is., Scotland	2·965	50·28	5·85	—	5·22	—	21·59	11·23	4·17	K_2O1·20, [Na_2O 0·58 = 100·07
54. Dun Mt., N. Zealand		52·23	4·71	—	8·48	—	16·85	20·15	2·53	= 99·95
55. Ehrsberg	3·178	51·27	6·24	—	5·60	—	14·18	21·08	0·65	= 99·02
56. Elba	3·185	49·60	5·05	—	6·78	—	16·49	20·34	1·49	Cr_2O_3 [0·55 = 100·25
57. Wildschönau	3·337	50·41	4·05	0·11	6·57	—	15·38	21·84	0·37	$TiO_2$0·88, [Cr_2O_3 0·60, Na_2O 1·55, K_2O 0·42 = 101·63
58. "	3·343	49·25	5·60	0·45	7·15	—	14·41	21·31	0·80	$TiO_2$0·70, [Cr_2O_3 0·20, Na_2O 1·86, K_2O 0·82 = 102·05
59. Ehrsberg	3·178	51·34	5·35	0·48	4·42	—	14·08	21·12	0·70	$TiO_2$0·58, [Cr_2O_3 0·43, Na_2O 0·84, K_2O 0·15 = 99·49
60. Syra		52·58	4·60	—	11·80	—	16·10	12·80	1·69	= 99·52
61. Mt. Marcy	3·386	46·28	7·88	2·21	14·80	—	8·91	18·78	1·12	TiO_2 0·59 [= 100·07
62. Gaddbo		50·20	6·53	4·04	4·35	—	11·75	19·04	1·26	alk., [1·05 = 98·22
63. Åkerö		47·10	4·55	—	15·20	0·17	18·65	11·83	1·33	insol. [0·34 = 98·67
64. Kyrkjö	3·010	44·12	11·90	6·45	4·04	0·26	20·34	8·73	4·72	= 100·56
65. "	3·162	43·22	12·98	5·21	7·92	0·36	16·17	9·70	3·98	= 99·54

AUGITE.

	G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	
66. Amity, *Leucaugite*	3·26	50·05	7·16	0·56	—	14·48	25·63	H_2O 1·66=99·54
66a. Grenville, Q.	3·35	51·27	4·00	0·10	—	17·46	25·27	Alk 0·76 ign 1·63 [=100·49
67. Vesuvius, *yellow*	3·233	53·2	1·5	—	2·3	19·3	23·4	ign.0·2 = 99·9
68. " *green*	3·252	48·4	5·6	—	9·5	18·7	22·9	ign.0·26=100·86
69. Monzoni	3·317	49·60	4·16	—	9·82	14·42	21·86	= 99·86
70. Vogelsgebirge		50·12	6·25	4·95	8·46	14·41	21·43	= 100·62
71. Kircheip	3·347	48·07	6·65	8·60	4·28	10·47	21·44	= 99·51
72. Naurod	3·379	48·49	6·91	9·20	4·17	11·81	20·57	= 101·15
73. Etna	2·935	48·48	7·02	—	13·52	11·08	19·08	ign. 0·17=99·35
74. Amherst Co., Va.	3·420	42·50	15·39	11·32	—	7·50	22·67	= 99·88
75. Rossberg	3·434	49·18	2·15	4·96	9·04	13·07	20·80	Na_2O 1·89, K_2O [0·30, TiO_2,MnO tr. = 100·89
76. Vesuvius, *black*	3·275	46·95	9·75	4·47	4·09	16·04	19·02	= 100·82
77. " *dark green*	3·208	51·01	4·84	3·51	3·16	16·58	20·80	= 99·90
78. " *yellow*	3·298	50·41	6·07	1·09	6·78	12·92	22·75	= 100·02
79. Lipari	3·225	48·45	6·68	3·57	6·94	14·35	20·80	= 100·29
80. Cuglieri, Sardinia	3·299	45·65	8·61	6·82	5·05	13·60	21·09	= 100·82
81. Greenwood Furnace	3·295	49·18	5·09	5·05	2·55	16·88	20·62	= 99·82
82. Mt. Bufaure, Tyrol	3·299	49·01	5·09	8·77	7·74	14·55	20·01	= 100·17

Fassaite.

	G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	
83. Fassathal, *Fassaite*	2·979	44·76	10·10	5·01	2·09	13·65	24·90	= 100·51
84. Toal della Foja, *cryst.*		43·81	9·97	7·01	1·52	12·51	25·10	H_2O 0·51 = [100·43
85. " *gran.-cryst.*	2·965	44·06	10·43	5·91	1·67	13·10	25·20	H_2O 0·15 = [100·52
86. Mal Inferno, *cryst. green*		41·97	10·63	7·36	0·55	10·29	26·60	H_2O 2·70 = [100·10
87. Arendal	3·291	45·50	7·17	0·60	15·59	8·45	22·25	= 99·56

Augite.

	SiO₂	Al₂O₃	Fe₂O₃	FeO	MgO	CaO	Na₂O
88. Rib. das Patas	40·81	14·24	7·89	5·95	14·35	16·01	0·61 = 99·86
89. Pico da Cruz	36·79	16·97	15·87	2·23	8·99	18·90	0·60 TiO₂, *tr.* = 99·85
90. Garza valley	44·11	9·66	4·95	5·48	14·06	21·92	*tr.* = 100·13
91. Aguas das Caldeiras	45·79	7·89	8·51	4·81	14·81	21·60	1·55 = 99·96
92. St. Vincent	45·14	8·15	5·25	5·20	14·76	19·57	1·46 = 99·53
93. Siderao	38·22	13·08	9·29	9·14	11·73	14·80	4·32 = 100·58
94. "	41·76	17·81	2·01	7·47	8·01	19·47	3·72 = 100·25
95. Praya, *large cryst.*	43·99	14·01	2·09	8·84	10·88	19·42	1·09 MnO 0·30 = 100·62
96. " " *small cryst.*	38·15	25·96	11·08	6·17	1·99	4·58	7·91 MnO 4·97 = 100·76
97. Pico da Cruz	37·20	16·93	15·07	8·55	6·89	14·81	5·06 = 99·51
98. Picos valley	42·15	21·51	3·79	9·43	7·55	12·28	2·98 = 99·69
99. St. Vincent	41·08	9·11	17·18	15·99	2·29	6·09	8·70 = 100·44
100. " "	47·99	18·30	11·32	10·39	6·16	5·14	6·60 = 100·90
101. Pedra Molar	46·94	5·67	6·18	5·43	14·18	17·88	1·83 = 98·06
102. St. Vincent	45·14	8·15	5·25	5·20	14·76	19·57	1·46 = 99·53

	SiO₂	TiO₂	Al₂O₃	Fe₂O₃	FeO	MgO	CaO	
103. Sasbach	44·15	4·57	6·90	6·02	3·49	12·28	22·79 = 100·20	
104. Burkheim	45·83	8·57	7·47	4·90	4·11	10·92	22·83 = 99·63	
105. Horberig	46·54	2·85	8·20	8·72	4·82	13·19	21·29 = 100·11	
106. Amoltern	47·20	2·70	5·80	3·17	4·76	12·79	23·02 = 99·44	[= 99·24
107. Oberschaffhausen	49·75	1·45	0·53	13·23	9·66	4·55	16·72 MnO 1·09,	Na₂O 2·26
109. Lützelberg	51·87	0·94	2·43	4·14	4·46	13·55	22·72 Na₂O 0·44,	K₂O 0·61 [= 100·66
110. Badloch	52·09	0·95	1·18	1·59	1·57	18·10	23·56 Na₂O 0·48,	K₂O 0·48 [= 100

	G.	SiO₂	TiO₂	Al₂O₃	Fe₂O₃	FeO	MgO	CaO	Na₂O	K₂O
111. Laveline, Vosges	3·372	50·63	0·79	0·87	3·33	8·39	13·01	21·30	1·02	0·50 = 99.84
112. Laurvik	3·401	50·33	0·66	0·30	—	12·37	10·98	22·01	2·14	0·94 = 99·73
113. Serra Monchique	3·473	42·27	0·92	8·67	13·93	6·24ᵃ	10·95	12·32	3·66	2·12 =101·08
114. Rieden	3·489	45·80	0·52	2·80	11·11	7·68ᵇ	6·63	20·06	2·88	1·00 = 98·48
115. Löbau	3·425	45·18	0·79	8·48	6·21	5·75ᵃ	11·63	23·26	1·20	*tr.* =102·50
116. Sasbach	3·411	44·65	2·93	6·62	5·02	3·87ᵃ	14·76	20·32	1·29	0·49 = 99·95
117. Halleberg	3·448	50·25	0·45	1·25	5·86	17·40ᵃ	15·72	8·73	0·82	0·47 =100·95
118. Hohentwiel	3·359	42·15	*tr.*	5·17	16·86	8·54	3·56	10·39	10·69	2·64 =100
119. Elfdalen	3·465	49·82	1·25	4·88	16·28	5·65	4·28	9·39	8·68	0·68 =100·41
120. Rieden	3·456	46·47	0·73	4·28	5·95	12·17	7·24	19·28	2·61	0·74 = 99·42
121. Melfi	3·416	44·55	1·36	7·27	6·06	5·91	10·44	22·83	1·47	0·52 =100·41

ᵃ Incl. some MnO.   ᵇ Incl. 0·27 MnO.

Pyr., etc.—Varying widely, owing to the wide variations in composition in the different varieties, and often by insensible gradations. Fusibility, 3·75 in diopside; 3·5 in salite, baikalite, and omphacite; 3 in jeffersonite and augite; 2·5 in hedenbergite. Varieties rich in iron afford a magnetic globule when fused on charcoal, and in general their fusibility varies with the amount of iron. Jeffersonite gives with soda on charcoal a reaction for zinc, and in O.F. on platinum wire for manganese; many others also give with the fluxes reactions for manganese. Most varieties are unacted upon by acids.

Obs.—Pyroxene is a common mineral in crystalline limestone and dolomite, in serpentine and in volcanic rocks: and occurs also, but less abundantly, in connection with granitic rocks and metamorphic schists; sometimes forms large beds or veins, especially in Archæan rocks. It occurs also in meteorites. The pyroxene of limestone is mostly white and light green or gray in color, falling under *diopside* (including malacolite, salite, coccolite); that of most other metamorphic rocks is sometimes white or colorless, but usually green of different shades, from pale green to greenish black, and occasionally black; that of serpentine is sometimes in fine crystals, but often of the foliated green kind called *diallage;* that of eruptive rocks is usually the black to greenish black *augite.*

In limestone the associations are often amphibole, scapolite, vesuvianite, garnet, orthoclase, titanite, apatite, phlogopite, and sometimes brown tourmaline, chlorite, talc, zircon, spinel, rutile, etc.; and in other metamorphic rocks mostly the same. In eruptive rocks it may be in distinct embedded crystals, or in grains without external crystalline form; it often occurs with similarly disseminated chrysolite (olivine), crystals of orthoclase, sanidine, labradorite, leucite, etc.; also with a rhombic pyroxene, amphibole, etc.

Pyroxene, as an essential rock-making mineral, is especially common in basic eruptive rocks. Thus, as augite, with a triclinic feldspar (usually labradorite), magnetite, often chrysolite, in basalt and basaltic lavas, diabase; in andesyte; also in trachyte; in peridotyte and pikryte; with nephelite in phonolyte. Further with elæolite, orthoclase, etc., in elæolite-syenite and augite-syenite, also as diallage in gabbro, in many peridotytes and the serpentines

formed from them; as diopside (malacolite) in crystalline schists. In limburgyte, augityte, and pyroxenyte, pyroxene is present as the most prominent constituent, while feldspar is absent; it may also form rock masses alone nearly free from associated minerals.

Some of the more prominent foreign localities of pyroxene in its various forms are the following; many others have been noted in connection with the descriptions of varieties and analyses already given:

Diopside (alalite, mussite) occurs in fine crystals on the Mussa alp in the Ala valley in Piedmont, associated with garnets (hessonite) and talc in veins traversing serpentine; in fine crystals also at Traversella; at Zermatt in Switzerland; Schwarzenstein in the Zillerthal; Ober-Sulzbachthal and elsewhere in Tyrol and the Salzburg Alps; Reichenstein; Rezbanya, Hungary; Achmatovsk in the Ural with almandite, clinochlore; L. Baikal (*baikalite*) in eastern Siberia; Pargas, Orijärvi, and elsewhere in Finland. At Nordmark, Sweden, in fine crystals of varied type of form (cf. Flink, l. c.), but often with a, b, c, p prominent, and varying in composition from a diopside nearly free from iron to one containing iron in large amount, approximating to hedenbergite.

Hedenbergite was originally described from Tunaberg, Sweden; also from Arendal. Manganhedenbergite is from Vester Silfberg. *Schefferite* is from Långban, Wermland, Sweden, where it occurs embedded in calcite, also enclosing hematite and richterite; rhodonite and hedyphane occur in the neighborhood. Also from the Harstig mine at Pajsberg, with crystallized rhodonite (pajsbergite).

Augite (incl. fassaite) on the Pesmeda alp. Mt. Monzoni. and elsewhere in the Fassathal, as a contact formation; Traversella, Piedmont; the Laacher See and the Eifel; Sasbach in the Kaiserstuhl; Vesuvius, white rare, green, brown, yellow to black; Frascati; Etna; the Azores and Cape Verde Islands; the Sandwich Islands, as at the base of the cinder cones at the summit of Haleakala on Maui, where deposits of perfect crystals are found with chrysolite grains and glassy crystals of labradorite. Also in Japan, as on Bonin island (cf. Y. Kikuchi, J. Coll. Sc., Japan, 3, 67, 1889, for an account of some forms).

In N. America, occurs in *Maine*, at Raymond and Rumford, diopside, salite, etc.; at Deer Isle. diallage in serpentine. In *Vermont*, at Thetford. black augite, with chrysolite, in boulders of basalt. In *Mass.*, in Berkshire, white crystals abundant; at the Bolton quarries, same, good; Westfield and Blanford, diallage in serpentine. In *Conn.*, at Canaan. white cryst. 2–3 in. long by 1–2 in. broad, often externally changed by uralitization to tremolite, in dolomite; also the pyroxenic rock, called *canaanite;* in Trumbull, large green cryst. in limestone; in Reading, on the turnpike near the line of Danbury, small transp. cryst., and granular; at Watertown. near the Naugatuck, white diopside. In *N. York*, in N. Y. Co., white cryst. in dolomite; at Warwick, fine cryst.; in Westchester Co.. white, at the Sing-Sing quarries; in Orange Co., in Monroe, at Two Ponds, cryst., often large, with scapolite, titanite, etc., in limestone; 3 m. S.E. of Greenwood furnace. salite with coccolite; ¼ m. E. of same, in cryst. with mica in limestone; 1 m. W. of Coffee's Hotel in Monroe, black coccolite; 2¼ m. N. of Edenville, gray cryst.; 1 m. N.W. of Edenville, black cryst. in limestone; in Cornwall, the var. *hudsonite;* near Amity and Fort Montgomery, good; in Forest-of-Dean, lamellar. green, and bronze-colored, with black coccolite; in Putnam Co., near Patterson. grayish white cryst., abundant; at Rogers' Rock, L. George, massive and granular (coccolite), gray, green, brown; near Oxbow, on Vrooman Lake; in Lewis Co., at Diana, white and black cryst.; in St. Lawrence Co., at Fine, in large cryst.; at De Kalb, fine diopside; also at Gouverneur, Rossie. Russell. Pitcairn; in Essex Co., near Long Pond, cryst., also beautiful green coccolite; at Willsboro', green coccolite with titanite and wollastonite; at Moriah, coccolite, in limestone mostly changed to serpentine forming a useful marble.

In *N. Jersey*, Franklin Furnace. Sussex Co., good cryst., also *jeffersonite*. In *Penn.*, near Attleboro'. cryst. and granular; in Pennsbury, at Burnett's quarry, diopside; at the French Creek mines. Chester Co.. chiefly altered to fibrous amphibole; at Bailey's quarry, East Marlborough. In *Maryland*, Harford Co., at Cooptown, diallage. In *Delaware*. at Wilmington, a hypersthene-like variety, Nuttal's *Maclureite*. In *Tennessee*, at the Ducktown mines.

In *Canada*, at Calumet I., grayish green cryst. in limestone with phlogopite; at the High Falls of the Madawaska, large crystals, having cryst. of hornblende attached; in Kildau as a rock; in Bathurst, colorless or white cryst.; near Ottawa, in large subtrp. cryst., in limestone; at Grenville, dark green cryst., and granular; at Montreal, Rougemont and Montarvelli Mts., black in dolerite; Burgess, Lanark Co.; Renfrew Co., with apatite, titanite, etc.; Orford, Sherbrooke Co., white crystals, also of a chrome-green color with chrome garnet; at Hull and Wakefield, white crystals with nearly colorless garnets, honey-yellow vesuvianite, etc. At many other points in the Archæan of Quebec and Ontario, especially in connection with the apatite deposits.

Alt.—Pyroxene undergoes alteration in different ways. A change of molecular constitution without essential change of composition, i.e., by *paramorphism* (using the word rather broadly), may result in the formation of some variety of amphibole. Thus, the white pyroxene crystals of Canaan, Conn., are often changed on the exterior to tremolite; similarly with other varieties at many localities. See URALITE, p. 390.

Further there may be alteration with chemical change in many ways, as has been explained by Bischof, and many species have been instituted on the material in different stages of change. In the simplest, there is only a taking up of water, producing a "hydrous augite." The water often found in analyses may be from this source. In many cases a loss of silica appears to

attend this hydration; and often, also, a loss of one or more of the bases (of which the lime and iron are the first to go), through the dissolving agency of waters holding carbon dioxide, or carbonates, in solution. A complete removal of the lime and iron produces *steatite* or *talc*, a common material of pseudomorphs. *Rensselaerite* is a variety of steatite, having sometimes the cleavage of pyroxene. Pyrallolite is also in part talc or steatite. *Saponite* and *serpentine* are other results of the same kind of alteration, the latter, especially, very common. *Hortonite* is a steatitic pseudomorph of pyroxene, found in Orange Co., N. Y., with chondrodite. See further under TALC, SERPENTINE. *Epidote* is another mineral resulting from the change involving oxidation of the iron. In the case of the aluminous pyroxene, when all the bases except the alumina are removed and water taken up, there may result *cimolite*, a whitish clay-like earth, which has been observed constituting pseudomorphs of augite at Bilin in Bohemia. Under the action of alkaline waters, alkalies may be introduced. Thus the hydrous mineral *glauconite* or *green earth* may result as a constituent of some augite pseudomorphs; or *mica*, which has been observed by Kjerulf as a pseudomorph after augite, in the Eifel.

Some of the substances formed by alteration are further mentioned below.

Artif.—Diopside has been observed as a furnace product at the iron-works of Philipsburg, N. Jersey (G. J. Brush. Am. J. Sc., **39**, 132, 1865); and dark-colored pyroxene at Gaspenberg; in an old furnace near Hackenburg; a copper furnace near Dillenburg; at Falun and Oldbury; a manganese-augite at Mägdesprung. Augite in small yellow crystals has been found in old fumaroles at Eiterkopfe, near Andernach (Rath).

Formed in crystals, as diopside, artificially by the action of silicon chloride on magnesia (Daubrée); also, a grayish-white var., by mixing the constituents and exposing to a high heat (Berthier); also, a variety of compounds (Lechartier) by fusing the constituents at a bright red heat with an excess of calcium chloride. in a carbon crucible enveloped in one of earthenware. See further, Fouqué & Lévy, Synth. Min., 102–110, 1882. Synthetic experiments have been also made by Doelter, Jb. Min., **2**, 51, 1884; also on the results of fusion, as in reforming pyroxene from the fused mass, by Becker, Zs. G. Ges., **37**, 10, 1885. See also Vogt. Ak. H. Stockh., Bihang. **9**, No. 1., 1884 ; Arch. Math. Nat., Christ., **30**, 34, *et seq.*, 1889, who describes various pyroxenic minerals formed from fusion in slags, etc., including augite, a monoclinic (or triclinic) $MgSiO_3$, a similarly crystallized $FeSiO_3$, also enstatite, rhodonite, an hexagonal $CaSiO_3$, etc.

Ref.—[1] Vesuvian augite, yellow variety, G. = 3·277, anal. 67, l. c. It is noteworthy that the angles vary but little even for a wide variation in composition. For a discussion of the change in form with varying amount of FeO and $(Al,Fe)_2O_3$, see Rath, Pogg., **6**, 345, 1873 ; Flink. Zs. Kr., **11**, 486, 1886. The following will serve for comparison, the axes being accepted as calculated by Kk., Rath, La Valle, Flink. etc., cf. anals. preceding and ref. below:

		$\check{a}$: $\check{b}$:	$\grave{c}$	β
Russian and other pyroxenes, mean value (Kk.)		1·09312 : 1 :	0·58946	74° 11¼'
Diopside, Val d'Ala	(cf. anal. 1, 2)	1·09126 : 1 :	0·58949	74° 8½'
" Nordmark	(" 10)	1·09197 : 1 :	0·58694	74° 12½'
" "	(" 11)	1·09220 : 1 :	0·58689	74° 13'
" "	(" 12)	1·09186 : 1 :	0·58659	74° 16'
" "	(" 13)	1·09175 : 1 :	0·58562	74° 19½'
" "	(" 14,15)	1·09123 : 1 :	0·58429	74° 34½'
Schefferite	(" 46)	1·1006 : 1 :	0·59264	73° 53'
Iron-schefferite	(" 47)	1·0990 : 1 :	0·59305	73° 58½'
Augite Vesuv., *dark green*		1·09547 : 1 :	0·59035	74° 18½'
" " *yellow*	(" 67)	1·09213 : 1 :	0·58931	74° 10½'

Since in pyroxene the angle *ac* differs but little from the angle *a'p*, it is possible so to select the axes as to make the angle of obliquity, β, nearly 90°. This method, proposed by Rath and later by Tschermak, and adopted by Groth (Tab Ueb., p. 130, 1889) has a certain advantage in that it exhibits clearly the morphological similarity between the orthorhombic and monoclinic pyroxenes. It is not to be recommended otherwise, however, since the resulting symbols of the commonly occurring planes are often highly complex; moreover, it is clear that the basal plane in the position of Naumann here, as ordinarily, adopted is naturally a *fundamental* plane since it is parallel to it that the common twinning lamellæ occur. with the resulting easy parting so often observed. Cf. also Flink, Zs. Kr., **16**, 299, 1890, who notes another objection.

[2] Cf. Kk., Min. Russl., **4**, 258. 1862; Mlr.. Min., p. 290, 1852; Dx. Min., **1**, 55 1862; Hbg.; Min. Not., **1**, 18, 1856, **5**, 21, 1863; Rath. Pogg., Erg., **6**, 338, 1873, Ber. nied. Ges. (311), July 7, 1886. A list of planes with authorities is given by Götz. Zs. Kr., **11**, 242, 1885; another by La Valle, Mem. Acc. Linc., **3**, 226, 1886; also a critical summary with literature by Gdt., Index, **2**, 528, 1890.

[3] Hj. Sj., Nordmark, G. För. Förh., **4**, 364, 1879. [3] Götz, l. c. [4] Flink, Nordmark, Zs. Kr., **11**, 449 *et seq.*, 1886, and Öfv. Ak. Stockh., **42**, No. 2, 29, 1885. [5] La Valle, Val d'Ala, l. c., also ib., **5**, 389. 1888. [6] Zeph, Ober-Sulzbachthal, Lotos, 1889. [7] Cathrein, Pinzgau, Ann. Mus. Wien, **4**, 181, 1889. [8] Götz, Mitth. Univ. Greifswald, 1886.

[9] *Hemihedrism:* Williams, Am. J. Sc.. **34**, 275. 1887, **38**, 115, 1889; cf. also observations by Hbg., Dx. (quoted by Williams), and. further, pyro-electrical observations by Hankel, l. c. [10] *Twins:* Rath. Zs. Kr., **5**, 495. 1881; Zeph., Jb. Min., 59, 1871; Becke, Min. Mitth., **7**, 93,

1885; Mgg., secondary and artificial twinning | *c*, Jb. Min., 1, 185. 1886, 1, 288, 1889, La Valle, polysynthetic twins, Val d'Ala, Mem. Accad. Linc., **19**, June 1, 1884. Association with amphibole, with analyses, Rath, Vesuvius, Pogg., Erg., **6**, 229, 337, 1873; also, Hawes, Edenville, Am. J. Sc., **16**, 397, 1878, and Rep. Min. New Hampshire, 63. 1878; see also p. 390.

Refractive indices, etc., Dx., Min., 1, 55 *et seq.*, 1862; Heusser, Pogg., **91**, 498, 1854; Taberg, A. E. Nd., l. c. ; also Flink *et al.*, as already quoted. Etching-figures, Baumh., Pogg., **153**, 75, 1874; Greim, Jb. Min., 1, 252. 1889. *Pyro-electricity*, Hankel, Wied., 1, 279, 1877. *Piezo-electricity*, P. Czermak, Ber. Ak. Wien, **96** (2), 1217, 1887.

Discussion of the *composition* of the group: Tschermak, Min. Mitth., 17, 1871; Doelter, ib., 65, 1877, 1, 49, 1878, 2, 193, 1879. See also Doelter, Knop, Merian, Mann, etc., references quoted under the analyses. On the relation between composition and optical characters, Doelter, Jb. Min., 1, 43, 1885; Wiik, Öfv. Finsk. Soc., **24**, 1882, **25**, 1883, **26**, 1884. Zs. Kr., **7**, 78, 1882, **11**, 313, 1885; Herwig [Programm Gymn. Saarbrücken 1884]. Zs. Kr., **11**, 67. 1885.

The following are more or less well-defined alteration products of various kinds of pyroxene; see further for analyses, etc., 5th Ed., pp. 220–223.

HECTORITE *S. Herbert Cox*, Trans. N. Z. Inst., **15**. 409, 1882. A hydrated pyroxenic mineral from the serpentine rocks of the Dun Mts., New Zealand. Occurs in radiating groups, of thin flexible laminæ. H. = 2–2·5. Color whitish green to dark green. Analysis by W. Skey:

SiO_2 57·89　Al_2O_3 4·74　FeO 18·46　MgO 13·94　CaO 1·99　H_2O 2·98　Fe_2O_3,MnO *tr.* = 100

HYDROUS DIALLAGE. Various forms have been described, 5th Ed., p. 221.

MONRADITE *Erdmann*, Ak. H. Stockh., 103. 1842. Probably a slightly altered pyroxene. Described as occurring granular massive, with two unequal cleavages mutually inclined about 50°; with H. = 6, G. = 3·267; color yellowish, honey-yellow, and luster vitreous. From Bergen in Norway. Named after Dr. Monrad.

PICROPHYLL *Svanberg*, Pogg., **50**, 662, 1839. From Sala, where it occurs both massive, with the cleavage of pyroxene, and fibrous, of a greenish gray color, with H. = 2·5 and G. = 2·75. Named from πικρός, *bitter*, and φύλλον, *leaf*, in allusion to the odor when moistened.

PITKÄRANTITE *Scheerer*, Pogg., **93**, 100, 1854. Pikärandite. Has a leek-green or dark green color, and looks like unaltered pyroxene. From Pitkäranta in Finland. Scheerer refers here part of pyrallolite.

PYRALLOLITE *N. Nordenskiöld*, Schw. J., **31**, 389, 1820. From Finland, where it occurs mostly in limestone, with pyroxene and scapolite. A pyrallolite from Sibbo in Finland has been named *Vargasite*, after Count Vargas, Huot Min., **2**, 676, 1841; Wargasit *Germ.* The crystalline structure is that of pyroxene. Named from πῦρ, *fire*, αλλος, *other*.

STRAKONITZITE *Zepharovich*, Jb. G. Reichs., **4**, 695, 1858. Approaches steatite. It occurs in greenish yellow crystals, soft and greasy in feel, with G. = 1·91.

URALITE *Rose*, Pogg., **22**, 321, 329, 1831; **27**, 97, 1833; **31**, 609, 1831. Pyroxene altered to amphibole. See further, p. 390.

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326. ACMITE. Achmit *Ström*, Ak. H. Stockh., 160, 1821, and Berz., ib., 168. Akmit *Germ.* Acmite.

AEGIRITE. Ægirin *Esmark*, Berzelius, Jb. Min., 184, 1835.

Monoclinic. Axes: $\dot{a} : \dot{b} : \dot{c} = 1{\cdot}09957 : 1 : 0{\cdot}60120$; $\beta = 73° 10\frac{1}{4}' = 001 \wedge 100$ Brögger[1].

$100 \wedge 110 = {}^*46° 28'$, $001 \wedge \bar{1}01 = 31° 52\frac{1}{4}'$, $001 \wedge 011 = 29° 55\frac{1}{8}'$.

Forms[1]:	*f* (810, *i*-3̄)	*H* (3̄02, ½-*i*)	*O* (6̄61, 6)	*S* (3̄11, 3-3̄)
a (100, *i*-ī)	*L* (730, *i*-$\frac{7}{3}$)	*s* (ī11, 1)	*Ω* (8̄81, 8)	*Q* (ī61, 6-6̄)
b (010, *i*-ī)	*m* (110, *I*)	*λ* (3̄31, 3)	*P* (261, −6-3̄)	*K* (ī91, 9-9)
χ (510, *i* 5)	*p* (ī01, 1-ī)			

ff''' = 38° 40'	*a'H* = 60° 59¼'	*a's* = 77° 1'	*ss'* = 60° 17'
mm''' = *92° 56'	*m's* = 58° 45¼'	*a'S* = *39° 35'	*OO'* = 95° 25¼'
a'p = 74° 57'	*m'O* = 12° 6¼'	*a'O* = 50° 8¼'	*SS'* = *38° 20'

On ÆGIRITE: Brögger has observed:

a, *b*, *c*, *V* (11·1·0, *i*-ī1̄), *χ*, *f*, *W* (16·15·0, *i*-$\frac{16}{15}$), *m*, *p*, *u* (111, −1), *v* (221, −2), *s*, *π* (5̄51, 5), *O*, *Ω*, *Λ* (451, −5-½), *Δ* (592, −$\frac{9}{5}$-½), *Z* (4̄·10·3, $\frac{10}{4}$-½), *k* (3̄12, ½-3̄).

The angles are sensibly the same as those of acmite; Brögger measured:

mm''' = 92° 49', *a'p* = 74° 56', *ss'* = 60° 15', *uu'* = 48° 41', *aΔ* = 58° 42', *mΔ* = 19° 53', also *ΔΔ'* = 107° 0¼' (calc., Bgr.), *Δ* is a characteristic form.

Twins: tw. pl. *a*, very common, f. 1; crystals often polysynthetic, with enclosed twinning lamellæ. Crystals long prismatic, vertically striated or channeled; the prisms bent, twisted or broken. Acute terminations very character-istic; faces often rough or rounded (*a, b, p, s*). In-clined hemihedrism, like pyroxene, probable.

1, *Acmite;* 2, *Ægirite,* Norway, Brögger.

The above applies to ordinary *acmite*.

For *ægirite*, the crystals are prismatic ∥ *c* with *m* prominent, also *a, b*, and usually terminated by *s* (111), or *p* (101), or with *Δ* (592) and *p* (101); again, prismatic by extension of (111) with *m* small. Twins not common. Also occurs in groups or tufts of slender acicular to capillary crystals, and in fibrous forms.
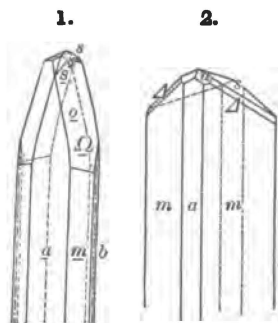
Cleavage: *m* distinct; *b* less so. Fracture uneven. Brittle. H. = 6–6.5. G. = 3.50–3.55 Bgr. Luster vitreous, inclining to resinous. Streak pale yellowish gray. Color brownish or reddish brown, green; in the fracture blackish green. Subtransparent to opaque.

Crystals of acmite often show a marked zonal structure, green within and brown on the exterior, particularly ∥ *a, b, p* (101), *s* (111). The brown portion (acmite, see below) is feebly pleochroic, the green (ægirite) strongly pleochroic. Both have absorption $\mathfrak{a} > \mathfrak{b} > c$, but the former has a light brown with tinge of green, $\mathfrak{b}$ greenish yellow with tinge of brown, *c* brownish yellow; the latter has a deep grass-green, $\mathfrak{b}$ lighter grass-green, *c* yellowish brown to yellowish.

Optically −. Ax. pl. ∥ *b*. $Bx_a \wedge c = \mathfrak{a} \wedge c = +2\frac{1}{2}°$ to 6°; for acmite $+5\frac{1}{4}°$ to 6°, for ægirite $+2\frac{1}{2}°$ to $3\frac{1}{4}°$. Axial angles large. For ægirite, Bgr.:

Na $2E = 134° 27'$ $2H_a = 63° 41'$ $2H_o = 117° 18'$ ∴ $2V_a = 68° 28'$ $\beta = 1.753$

Also, Låven, $\beta_y = 1.8084$ Na, Sanger (Rosenbusch).

Comp., Var.—Essentially $Na\overset{m}{Fe}(SiO_3)_2$ or $Na_2O.Fe_2O_3.4SiO_2$ = Silica 52.0, iron sesquioxide 34.6, soda 13.4 = 100. Ferrous iron is also present.

The analysis of Doelter as interpreted by him gives, with 89 p. c. of the characteristic $Na\overset{m}{Fe}(SiO_3)_2$, also 6 p. c. of $\overset{\text{n}}{Fe}\overset{\text{m}}{Fe}_2SiO_6$, 3.7 p. c. of $\overset{\text{n}}{Fe}AlSiO_6$ and 1.8 p. c. of $CaMn(SiO_3)_2$. Brögger, however, is inclined to assume the presence, with 85 p. c. of $Na_2Fe_2(SiO_3)_4$, of 15 p. c. of $FeFe_2(SiO_3)_4$.

The essential identity of acmite and ægirite was shown by Tschermak, Min. Mitth., 33, 1871; it had been earlier suggested by Rose. Kryst. Ch., 76, 1852.

Brögger regards the interior green, highly pleochroic, portion of the acmite crystals (noted above) as identical with the characteristic ægirite, while to the acmite proper belongs the feebly pleochroic brown exterior with greater angle of extinction (to + 6°). *Acmite* is characterized by the prevalence of twins, the acute terminations, the common occurrence of *S* (311), etc. With *ægirite* simple crystals are the rule and twins rare; the crystals are more often bluntly terminated, with *Δ* (592) prominent; also of quite distinct habit, prismatic ∥ 111. The color and higher angle of extinction of the acmite indicates greater iron percentage.

Anal.—1, Rg., Pogg., 103, 300. 1858. 2, Doelter, Min. Mitth., 1, 379, 1878. 3, Id., ib., p. 374. 4, 5, Id., ib., Zs. Kr., 4, 34, 1879. That these analyses are of ægirite and not arfvedsonite seems to be sufficiently shown by Rg., Min. Ch., Erg., 24, 1886, cf. Lorenzen. 6, Lorenzen, Min. Mag., 5, 55, 1882. 7, Forsberg, quoted by Ramsay, Fennia, 3, No 7, 1890 (Geol. Beob. Halbinsel Kola.) 8, J. L. Smith, Am. J. Sc., 10, 60, 1875.

Acmite.

	G.	SiO₂	Al₂O₃	Fe₂O₃	FeO	MnO	CaO	MgO	Na₂O	K₂O	
1. Rundemyr	3.53	51.66	—	28.28	5.23	0.69	—	—	12.46	0.43	TiO₂ 1.11, [ign. 0.89 = 100.25
2. "	3.520	51.35	1.59	32.11	2.59	0.37	*tr.*	—	11.39	*tr.*	= 99.40
Ægirite.											
3. Brevik	3.501	‡ 51.74	0.47	26.17	3.48	0.46	5.07	1.79	11.02	0.34	= 100.54
4. Kangerdluarsuk		52.22	0.64	28.15	5.35	0.54	2.19	1.45	10.11	0.34	= 100.99
5. "		‡ 49.91	1.24	22.83	13.95	0.42	1.72	0.21	9.49	0.32	= 100.09
6. "	3.63	49.04	1.80	29.54	4.82	*tr.*	2.70	*tr.*	13.31	*tr.*	= 101.21
7. Kola Peninsula	3.51	51.82	0.60	21.02	8.14	1.00	8.01	1.47	11.87	0.85	ign. 0.50 [= 100.28
8. Hot Springs, Ark.	3.53	51.41	1.82	23.30	9.45	—	2.03	0.81	11.88	*tr.*	TiO₂ 0.13 [= 100.33

Pyr., etc.—B.B. fuses at 2 to a lustrous black magnetic globule, coloring the flame deep yellow; with the fluxes reacts for iron and sometimes manganese. Slightly acted upon by acids.

Obs.—The original *acmite* occurs at Rundemyr, east of the little lake called Rökebergskjern, in the parish of Eker, near Kongsberg, Norway, in a pegmatyte vein; it is in slender crystals, sometimes a foot long, embedded in feldspar and quartz; the crystals are often bent or fractured and recemented, and are quite fragile.

Ægirite (and acmite) occurs with leucophanite, cancrinite, elæolite, etc., in the elæolite-syenite and augite-syenite of southern Norway, especially along the Langesund fiord in the "Brevik" region; also near Laurvik, Sande fiord, and Fredriksvärn. Also at Kangerdluarsuk, West Greenland, in a sodalite-syenite with eudialyte arfvedsonite, etc.; also at Ditró, Transylvania (acmite?), and similarly associated elsewhere; in the acid lavas of San Miguel, one of the Azores.

3.
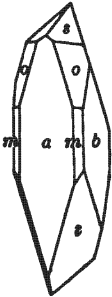
In the U. S., in minute crystals in a dike of elæolite-syenite in northwestern New Jersey. At the Hot Springs, Magnet Cove, Arkansas, in fine prismatic crystals, up to 8 inches or more in length, often bent and twisted and with tapering terminations. In Canada, at Montreal and Belœil in elæolite-syenite.

A green pyroxene occurring as an alteration product of a blue amphibole allied to arfvedsonite or riebeckite (see p 400. is referred to ægirite by Cross; it occurs in certain rocks forming dikes in Archæan gneisses in Custer Co., Colorado. Am. J. Sc., **39**, 359, 1890.

Brögger (l.c., p. 330) is inclined to regard the crocidolite of Stavern, Norway, and perhaps also that of S. Africa as a variety of ægirite (*ægirin-asbest*); but see crocidolite, p. 400)

Acmite is from ἀκμή, *a point.* in allusion to the pointed extremities of the crystals. *Ægirite* is from Ægir. the Icelandic god of the sea.

Alt.—Occurs altered to analcite in Norway (Bgr.). Williams suggests that manganpectolite at Magnet Cove may have been derived from the ægirite.

Schrauf.

Ref.—[1] Zs. Kr., **16**, 295, 1890; he describes in detail the acmite and ægirite of the islands in the Langesund fiord, Norway, gives the earlier literature for the species, etc. For early observations, see Mitscherlich, Ed. Phil. J., **9**, 55, 1823; Ph., Min., 151, 1837; Rath, Pogg., **111**, 254, 1860; Schrauf, Atlas, Tf. ii, 1864.

Note also that the *s* (ī11) of Brögger is *s* (011, T) of Rath, *p* = *c* (001), *S* (3̄11) = (211, m), *O* (6̄61) = *o* (5̄61), *P* (261) = *z* (3̄61); cf. f. 3. This change of position, which better exhibits the relation of form to pyroxene, is probably the reason why most authors have given Bx$_a$ ∧ *c* = − 8°, while Brögger makes the same angle positive, that is with him the bisectrix (a) falls in the front obtuse axial angle, instead of in the acute angle.

327. SPODUMENE. *D'Andrada.* Scherer's J., **4**, 30, 1800; J. Phys., **51**, 240, 1800. Triphane *Haüy*, Tr., **4**, 1801. Hiddenite *J. L. Smith*, Am. J. Sc., **21**, 128, 1881.

Monoclinic. Axes: *ă* : *b̆* : *c̆* = 1·1238 : 1 : 0·6355; β = *69° 40′ = 001 ∧ 100 J. D. Dana[1].

100 ∧ 110 = 46° 30′, 001 ∧ 1̄01 = 33° 25¼′, 001 ∧ 011 = 30° 47½′.

Forms[2]:

	k (230, *i*-⅔)⁴	*p* (ī11, 1)	ξ (181, − 3-⅓)⁴	*y* (5̄61, 6-⅙)³
a (100, *i*-ī)	μ (120, *i*-2)	*q* (3̄32, ⅔)³	*z* (261, − 6-⅓)³	*v* (5̄41, 4-⅘)⁴
b (010, *i*-ī)³	*n* (130, *i*-3)	*r* (2̄21, 2)	φ (3̄12, ⅓-5̄)⁴	*x* (2̄31, 3-¼)⁴
c (001, *O*)	*Z* (150, *i*-5)⁴	*s* (4̄41, 4)³	*f* (3̄11, 2-⅔)	*u* (2̄43, ⅓-2)³
l (320, *i*-³⁄₂)	*F* (011, 1-ī)⁴	*g* (681, − 8-½)³	*D* (4̄21, 4-2)⁴	*e* (2̄41, 4-2)³
m (110, *I*)	*d* (021, 2-ī)	*e* (241, − 4-2)³	*w* (3̄21, 3-³⁄₂)⁴	*t* (4̄81, 8-2)⁴

Also in etching-figures[3], Brazil, *v* (101, − 1-ī), *w* (201, − 2-ī).

ll‴	=	70° 11′	*cd*	= *50° 0′	*mg* = 10° 18′	*a'f* =	54° 48¼′
mm‴	=	*93° 0′	*m'p*	= 59° 3′	*me* = 21° 46′	*pp'* =	63° 31′
μμ'	=	50° 46′	*m'q*	= 44° 21′	*mp* = 75° 34′	*rr'* =	88° 34′
nn'	=	35° 6¼′	*m'r*	= 34° 40′	*a'p* = 78° 54′	*ss'* =	96° 28′
FF'	=	61° 35′	*m's*	= 17° 40¼′	*a'r* = 62° 40¼′	*ee'* =	107° 24′
dd'	=	100° 0′					

Twins: tw. pl. *a.* Crystals prismatic, often flattened ‖ *a*; the vertical planes striated and furrowed; crystals sometimes very large. Also massive, cleavable.

Cleavage: *m* perfect. A lamellar structure ‖ *a* sometimes very prominent, a crystal then separating into thin plates. Fracture uneven to subconchoidal. Brittle. H. = 6·5–7. G. = 3·13–3·20. Luster vitreous, on cleavage surfaces somewhat pearly. Color greenish white, grayish white, yellowish green, emerald-green, yellow, amethystine purple. Streak white. Transparent to translucent.

Pleochroism strong in deep green varieties. Optically +. Ax. pl. ‖ b. Bx$_a$ ∧ $c = + 26°$ Dx., $= 24°$ to $25\frac{1}{4}°$ Greim. Dispersion $\rho > v$, horizontal. Refractive indices and axial angles:

N. Carolina, Na	$\alpha = 1.651$	$\beta = 1.669$	$\gamma = 1.677$	Brazil $\beta_y = 1.669$ Dx.[5]
Brazil, red,	$\alpha = 1.660$	$\beta = 1.666$	$\gamma = 1.676$	Lévy-Lcx.[7]

Brazil $2H_{a,r} = 64° 47'$ $2H_{a,y} = 64° 58\frac{1}{4}'$ $2H_{a,bl} = 65° 4\frac{1}{4}$ Greim[6].

Var.—1. *Ordinary.* Color white or nearly white, yellowish, rarely amethystine; commonly in flattened prismatic crystals, often very large, up to 4 feet or more in length and 12 inches across.

2. *Hiddenite.* Color yellow-green to emerald-green, the latter used as a gem, resembling the emerald but showing more variety of color because of its pleochroism. In small ($\frac{1}{4}$ in. to 2 inches long) slender prismatic crystals, surfaces often etched as the result of the action of some natural solvent.

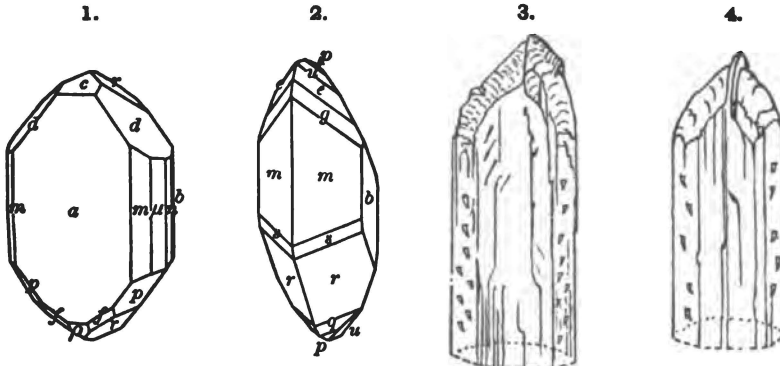Fig. 1, Norwich, Mass. 2–4, *Hiddenite*, Alexander Co., N. C. 3, 4, Sketches of natural crystals, W. E. Hidden.

Comp.—$LiAl(SiO_3)_2$ or $Li_2O.Al_2O_3.4SiO_2$ = Silica 64·5, alumina 27·4, lithia 8·4 = 100. Generally contains a little sodium; the variety hiddenite also chromium, to which the color may be due.

Anal.—1, 2, Rg., Pogg. Ann., **85**, 546, 1852. 3, Thomson, Min., 1, 302, 1836. 4, Pisani, C. R., **84**, 1509, 1877. 5, 6, Doelter, Min. Mitth., 1, 523, 526, 1878. 7, Jannasch, Jb. Min., 1, 196, 1888. 8, 9, Julien, Ann. N. Y. Ac. Sc., 1, 322, 1879. 10, Penfield, Am. J. Sc., **20**, 259, 1880. 11, J. L. Smith, ib., **21**, 128, 1881. 12, Genth, ib., **23**, 68, 1882.

	G.	SiO₂	Al₂O₃	FeO	CaO	MgO	Li₂O	K₂O	Na₂O	ign.	
1. Utö	3·133	65·02	29·14	tr.	0·50	0·15	5·47	0·14	0·46	—	= 100·88
2. Tyrol	3·137	65·53	29·04	1·42	0·97	0·07	4·49	0·07	0·07	—	= 101·66
3. Killiney		63·81	28·51	0·83	0·73	—	5·60	—	∤·36		= 99·84
4. Brazil	3·16	63·80	27·93	1·17[a]	0·46	—	6·75	—	0·89	—	= 101·00
5. Huntington		63·79	27·08	0·39	0·73	0·21	7·04	0·12	1·10	—	= 101·41
6. Brazil		63·34	27·66	1·15	0·69	—	7·09	—	0·98	—	= 100·91
7. "	3·174	64·32	27·79	0·67	0·17	—	7·45	—	0·55	∤·12	= 101·07
8. Goshen	3·19	63·27	23·73	1·17[b]	0·11	2·03	6·89	1·45	0·99	0·36 MnO0·64	[= 100 63
9. Chesterfield	3·196	61·86	23·43	2·78[b]	0·79	1·55	6·99	1·33	0·50	0·46 MnO1·04	[= 100·68
10. Branchville	3·193	‡ 64·25	27·20	0·20[b]	—	—	7·62	tr.	0·39	0·24	= 99·90
11. Alex. Co., *Hiddenite*	3·170	64·35	28·10	0·25[b]	—	—	7·05	—	0·50	0·15	= 100·40
12. " " "	3·166	63·95	26·58	1·11	—	—	6·82	0·07	1·54	—Cr₂O₃0·18	[= 100 45

[a] Incl. MnO 0·12. [b] Fe₂O₃.

The formula, as given above, was first correctly established by Doelter.

Pyr., etc.—B.B. becomes white and opaque, swells up, imparts a purple-red color (lithia) to the flame, and fuses at 3·5 to a clear or white glass. The powdered mineral, fused with a mixture of potassium bisulphate and fluorite on platinum wire, gives a more intense lithia reaction. Not acted upon by acids.

Obs.—Occurs on the island of Utö in Södermanland, Sweden, with magnetite, quartz, tourmaline, and feldspar; also near Sterzing and Lisens in Tyrol; of a pale green or yellowish color, embedded in granite, at Killiney Bay, near Dublin, and at Peterhead in Scotland; in small transparent crystals of a pale yellow in Brazil, province of Minas Geraës.

In the U. S., in granite at Goshen, Mass., associated at one locality with blue tourmaline and beryl; also at Chesterfield, Chester, Huntington (formerly Norwich), and Sterling, Mass.; at Windham, Maine, with garnet and staurolite; at Peru, with beryl, triphylite, petalite; at Winchester, N. H.; at Brookfield, Ct., a few rods north of Tomlinson's tavern, in small grayish or greenish white individuals looking like feldspar; at Branchville, Ct., in a vein of pegmatyte, with lithiophilite, uraninite, several manganesian phosphates, etc.; the crystals are often of immense size embedded in quartz; near Stony Point, Alexander Co., N. C., the variety *hiddenite* in cavities in a gneissoid rock with beryl (emerald), monazite, rutile, allanite, quartz, mica, etc.; near Ballground, Cherokee Co., Ga.; in South Dakota at the Etta tin mine in Pennington Co., in immense crystals.   At Huntington, Mass., it is associated with triphylite, mica, beryl, and albite; one crystal from this locality was 16¼ inches long, and 10 inches in girt.

The name spodumene is from $\sigma\pi o\delta\iota\delta\varsigma$, *ash-colored.* Named triphane by Haüy from $\tau\rho\iota\phi\alpha\nu\eta\varsigma$, *appearing threefold,* in allusion to his idea that the crystals are divided by three planes with nearly equal ease. *Hiddenite* is named for W. E. Hidden of New York.

Alt.—The spodumene at Goshen and Chesterfield is extensively altered; pseudomorphs occur of cymatolite (see below), killinite, muscovite, albite, quartz, and of "vein granite;" cf. Julien, Ann. N. Y. Acad., **1**, 318, 1879. Similar alteration-products at Branchville are described by Brush and Dana, Am. J. Sc., **20**, 257, 1880; the following is a summary of their results:

β Spodumene. The first product of the alteration (Branchville), resulting from the exchange of Na for one-half the Li, is "*β spodumene.*" It is compact, apparently homogeneous, with an indistinct fibrous to columnar structure. H. = 5·5-6. G. = 2·644-2·649. Color white, milky, or greenish white. Translucent. Fusibility = 2·25. Three analyses on material from different crystals gave nearly identical results. It is decomposed by HCl into two portions, one soluble and the other insoluble. Analyses by Penfield: 1, of the original material; 2, the soluble portion 32·10 p. c., calculated to 100; 3, insoluble portion, 67·56 p. c.:

	SiO_2	Al_2O_3	Li_2O	Na_2O	K_2O	ign.	
1. *β spodumene*	61·51	26·56	3·50	8·14	0·15	0·29	= 100·15
2. Soluble	48·13	40·50	10·90	—	0·47	—	= 100
3. Insoluble	68·18	20·07	—	11·75	—	—	= 100

The insoluble portion is albite, the soluble is eucryptite. Examined under the microscope in sections (1) parallel to fibers, the irregular interlacing fibers of eucryptite are seen embedded in albite; (2) transverse to fibers, the eucryptite is in bands with hexagonal outline, surrounded by albite, like quartz in a "graphic granite." See further *Eucryptite,* p. 426.

Cymatolite. A second stage in the alteration is the formation of cymatolite (C. U. Shepard, Dana, Min., p. 455, 1868). It has a fibrous to wavy structure, silky luster, white or slightly pinkish color; H. = 1·5-2; G. = 2·69-2·70.   The cymatolite from Goshen was earlier (Eng. Mng. J., **22**, 217) called *aglaite* by Julien. Analyses.—1, 2, 3, Julien, l. c. 4, Penfield, l. c.

	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Li_2O	Na_2O	K_2O	H_2O	
1. Goshen	58·51	21·80	0·85	0·29	1·44	0·84	0 19	6·88	6·68	2·40[a]	= 99·88
2. *Aglaite*	58·11	24·38	1·66	0·18	0·75	0·48	0·09	2·57	8·38	3·01[b]	= 99 61
3. Chesterfield	58·58	22·28	1·77	0 15	0·45	0·93	0·10	9·08	4·48	2·08[c]	= 99·90
4. Branchville	60·55	26·38	—	0·07	—	—	0·17	8·12	3·34	1·65	= 100·28

[a] With nitrogenous organic matter 0·44   [b] Do. 0·48.   [c] Do. undet.

This corresponds to: $(Na,K,H)AlSi_2O_6$ or $(K,H)AlSiO_4 + NaAlSi_2O_6$. The microscopic examination shows that cymatolite is not, as previously assumed, a simple mineral, but, corresponding to the formula, a very uniform mechanical mixture of *muscovite* and *albite.* In some sections the transitions from *β* spodumene to cymatolite, i.e. from eucryptite to muscovite, are clearly seen.   In other cases the muscovite and albite have each segregated together, so that they are distinct. For example, in figure 2, *s* = unaltered spodumene, *β* = *β* spodumene, *c* = cymatolite, *g* = mica, *a* = albite. Furthermore the successive stages of alteration may be seen in the same crystal, thus as shown in fig. 1, 1*a*, 1*b*, 1*c*, three sections at intervals of 3 to 6 inches in a large crystal 15 inches in length; *s*, *β*, *c* having the same meaning as in fig. 2.
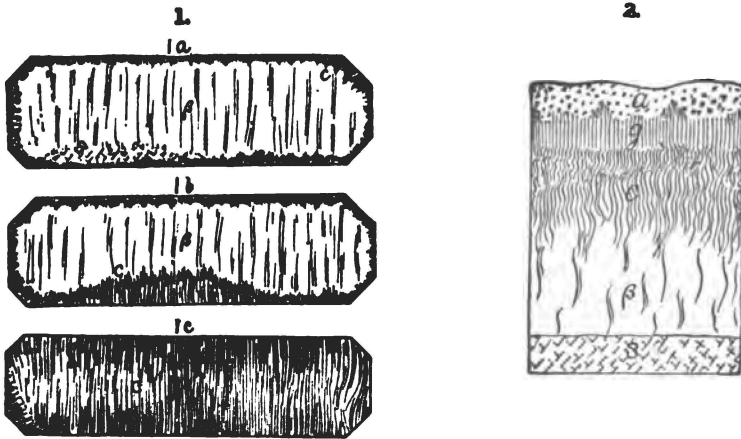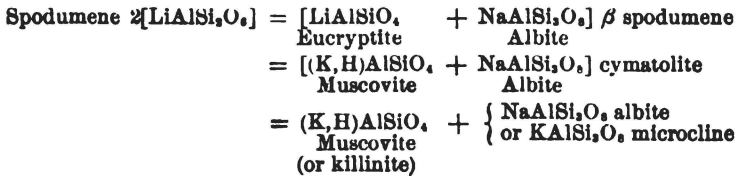
As further steps in the alteration there result: albite, often fibrous, like *β* spodumene; also muscovite, and granular microcline.

Killinite. Structure, if any, that of the original spodumene. Compact, crypto-crystalline. H. = 3·5; G. = 2·628-2·652. Luster dull and greasy to vitreous. Color bluish green, greenish gray to olive-green, oil-green, and greenish black. Analyses.—1, Julien. 2, Penfield, prismatic variety, l. c. 3, Dewey, compact, ibid.

	SiO$_2$	Al$_2$O$_3$	Fe$_2$O$_3$	FeO	MnO	CaO	K$_2$O	Na$_2$O	Li$_2$O	H$_2$O
1. Chesterfield	46·80	32·52	—	2·33	0·04	0·77	7·24	0·78	0·82	7·66 MgO 0·48, CoO
										[0·04, organic 1·14 = 100·12
2. Branchville	48·93	84·72	0·54	0·33	0·64	—	9·64	0·85	—	5·04 = 100·19
3. "	53·47	82·36	0·79	0·42	0·72	0·17	7·68	0·44	0·04	4·07 = 100·16

The original killinite (Thomson, Min., 1, 330, 1836) was from Killiney Bay, Ireland, where it is also an alteration-product of spodumene, see further 5th Ed., p. 480.

The following scheme explains the above changes of the spodumene, supposing an exchange of the alkali metal:

Spodumene 2[LiAlSi$_2$O$_6$] = [LiAlSiO$_4$ + NaAlSi$_2$O$_6$] β spodumene
Eucryptite   Albite

= [(K,H)AlSiO$_4$ + NaAlSi$_2$O$_6$] cymatolite
Muscovite   Albite

= (K,H)AlSiO$_4$ + { NaAlSi$_2$O$_6$ albite
Muscovite   { or KAlSi$_3$O$_8$ microcline
(or killinite)

Experiments showing the effect upon spodumene of solutions of potassium and sodium carbonates, see Lemberg, Zs. G. Ges., 39, 584, 1887.

Ref.—[1] Min., p. 693, 1850, 169, 1852: Rath obtained for Alexander Co., No. Carolina, spodumene, $\dot{a} : \dot{b} : \dot{c} = 1\cdot1283 : 1 : 0\cdot62345$; $\beta = 69° 32\frac{1}{4}'$; the crystals were measured with the help of attached glass plates, Ber. nied. Ges., May 3, 1886. The surface of the crystals of hiddenite are often extensively etched, and some of the planes noted, cf. [3] and [4] below, may be simply corrosion forms. [2] J. D. D., l. c. [3] E. S. D., Alex. Co., Am. J. Sc., 22, 179, 1881. [4] Rath, l. c. [5] Am. J. Sc., 32, 204, 1886. [6] Greim, Jb. Min., 1, 253, 1889. [7] Min. Roches, 266, 1888.

328. JADEITE. Nephrite or Jade pt. Jadeite *Damour*, C. R., 56, 861, 1863. Chloromelanite *Id.*, ibid., 61, 313, 357, 1865.

Monoclinic (or triclinic)[1], with cleavage and optical characters like pyroxene. Only known massive, with crystalline structure, sometimes granular, also obscurely columnar, fibrous foliated to closely compact.

Cleavage: prismatic, at angles of about 93° and 87°; also orthodiagonal, difficult. Fracture splintery. Extremely tough. H. = 6·5–7. G. = 3·33–3·35. Luster subvitreous, pearly on surfaces of cleavage. Color apple-green to nearly emerald-green, bluish green, leek-green, greenish white, and nearly white; sometimes white with spots of bright green. Optically biaxial, negative. Bx$_a$ $\wedge$ $\dot{c}$ = 30° to 40°, 2H$_{ay}$ = 82° 48′ Knr. Streak uncolored. Translucent to subtranslucent.

Comp.—Essentially a metasilicate of sodium and aluminium corresponding to spodumene, NaAl(SiO$_3$)$_2$ or Na$_2$O.Al$_2$O$_3$.4SiO$_2$ = Silica 59·4, alumina 25·2, soda 15·4 = 100

SILICATES.

Chloromelanite is a dark green to nearly black kind of jadeite, containing iron sesquioxide and not conforming exactly to the above formula. Named from χλωρός, *green*, and μέλας, *black*.

Anal.—1, Damour, C. R., **56**, 861, 1868.   2, Id., ibid., **61**, 360, 1865. 3–7, Bull. Soc. Min., **4**, 157, 1881.   8, Fellenberg, Mitth. Ges. Bern, 112, 1865.   9, 10, Id., Vh. Schweiz. Ges., Solothurn, **53**, 88, 1869.   11, Eckstein, quoted by Fischer, p. 375.   12, Frenzel, Jb. Min., **2**, 6 ref., 1885. 13, Dmr., l. c., 1881. 14–17, F. W. Clarke, Proc. U. S. Nat. Mus., **11**, 115, 1888. 18, Dmr., l. c., 1881. 19, 20, Id., l. c., 1865. 21, Id., l. c., 1881. 22, 23, G. W. Hawes. unpubl. contr., 1875. 24, 25, Id., l. c., 1881. 26, Id., l. c., 1881. 27, Fellenberg, quoted by Fischer, l. c., p. 381. 28, Cohen, Jb. Min., **1**, 71, 1884. 29–30, Frenzel, ib., **2**, 6 ref.. 1885. 31–33, 36–40, Dmr., l. c., 1881. 34, 35, Schoetensack, Inaug. Diss., **6**, 7, Berlin, 1885.

Worked Jadeite.

	G.	SiO$_2$	Al$_2$O$_3$	Fe$_2$O$_3$	FeO	MnO	CaO	MgO	Na$_2$O	
1. China	3·340	59·17	22·58	—	1·56	—	2·68	1·15	12·93	= 100·07
2. "	3·330	59·66	22·86	0·14[a]	0·42	—	2·27	2·41	12·87	= 100·68
3. Asia, *white*	3·33	59·27	25·33	0·71	—	—	0·62	0·48	13·82	= 100·23
4. " *green-gray*	3·27	59·12	22·21	2·72	—	—	1·03	0·99	13·66	= 99·78
5. China, *green spots*	3·34	58·28	23·11	0·64	—	—	1·62	0·91	13·94	= 98·50
6. " *green*	3·27	57·14	8·97	5·49	0·42[a]	—	14·57	8·62	5·35	= 100·56
7. "	3·32	55·34	8·40	5·60	0·66	—	14·80	8·41	6·38	= 99·59
8. Swiss Lake-hab.	3·32	‡58·89	22·40	—	1·66	0·78[b]	3·12	1·28	12·86	K$_2$O 0·49 [H$_2$O 0·20 = 101·63
9. China	3·346	60·22	22·85	—	1·59	0·65	1·53	1·15	12·60	H$_2$O 0·11 [= 100·70
10. Möhrigen-Steinberg	3·298	58·28	21·86	—	2·42	0·22	2·53	1·99	12·97	= 100·27
11. Thibet	3·25	58·28	23·00	—	4·94	*tr.*	3·06	1 04	9·23	= 99·55
12. L. Neuenburg	3·31	57·84	22·08	—	3·19	0·20	2·51	0·67	14·09	H$_2$O 0·38 [= 100·96
13. Mexico, *olive-green*	3·30	58·64	24·94	1·48	—	—	1·34	0·89	13·00	= 100·29
14. " *light gr. spots*	3·007	58·88	25·93	0·12[a]	0·24	—	0·40	0·86	11·64	K$_2$O 0·63 [H$_2$O 1·81 = 100 01
15. " *pale grn.*	3·190	58·18	23·53	—	1·67	—	2·85	1·72	11·81	K$_2$O 0·77 [H$_2$O 0·53 = 100·56
16. Sardinal, *pale green*	3·32	59·18	22·96	1·87		—	1·52	0·67	12·71	H$_2$O 0·90 [= 99·81
17. Culebra, *green*	3·27	58·33	21·63	1·71	0·73	—	4·92	3·09	8·13	K$_2$O 0·22 [H$_2$O 0·93 = 99·69
18. Mexico, *emerald-grn.*	3·26	58·20	19·54	1·97	0·34[a]	0·07	5·60	3·89	10·91	K$_2$O 0·27 [= 100·29
19. Morbihan	3·344	58·62	21·77	—	1·86	0·28	3·85	2·23	11·64	= 100·25
20. Sénart, *grass-green*	3·352	58·92	18 98	—	0·98	—	6·04	4·33	11·05	= 100·30
21. France, *green*	3·16	57·99	20·61	2·84	—	—	4·89	3·33	9·42	K$_2$O 1·50 [= 100·58
22. Mexico		‡60·99	22·20	—	0·65	—	1·28	0·96	13·04	K$_2$O 0·21 [H$_2$O 0·74 = 100·07
23. China		‡58·68	21·56	—	0·94	—	3·37	2·49	13·09	K$_2$O 0·49 [= 100·62

<p style="text-align:center">[a] Cr$_2$O$_3$.   [b] ZnO.</p>

Chloromelanite.

	G.	SiO$_2$	Al$_2$O$_3$	Fe$_2$O$_3$	FeO	MnO	CaO	MgO	Na$_2$O	K$_2$O
24. Dordogne	3·413	56·40	14·76	3·27	6·06	0·66	5·49	1·82	11·20	*tr.* = 99·66
25. Morbihan	3·410	56·12	14·96	3·34	6·54	0·47	5 17	2·79	10·99	*tr.* TiO$_2$ 0·19 [= 100·57
26. Mexico, *blk.-grn.* 3·36		57·90	14·64	8·89	—	0·76	5·16	2·21	10·77	*tr.* = 100·33
27. Swiss Lake-hab. 3·40		55·88	13·64	—	10·59	0·99	4·28	3·19	11·43	— = 100

Unworked jadeite (Rohjadeit); also (36-40) rocks approaching jadeite in composition.

	G.	SiO$_2$	Al$_2$O$_3$	Fe$_2$O$_3$	FeO	CaO	MgO	Na$_2$O	K$_2$O	H$_2$O
28. Thibet		59·17	22·58	—	1·56	2·68	1·15	12·93	—	=100·07
29. L. Neuenburg	3·42	52·42	26·00	—	2·02	9·05	3·56	7·44	—	0·20=100·69
30. "	3·36	50·30	25·68	—	2·79	11·00	4·45	6·30	—	0·40=100·92
31. Burma	2·97	58·24	24·47	1·01	—	0·69	0·45	14·70	1·55	— =101·11
32. "	3·06	61·51	22·53	—	—	*tr.*	4·25	11·00	1·29	— =100 58
33. "	3·07	53·95	21·96	0·76	—	2·42	7·17	9·37	3·70	— = 99·33
34. Burma	3·138	59·70	22·77	—	0·61	2·52	1·87	13·19	—	0·54=101·20
35. Thibet (?)	3·227	59 68	22 82	—	0·60	1·41	0·52	14·64	—	0·24= 99 09

	G	SiO₂	Al₂O₃ Fe₂O₃	FeO	CaO	MgO	Na₂O	K₂O	H₂O

	G	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	H_2O
36. M. Viso, Piedmont	3·35	58·51	21·98	1·10	—	5·05	1·70	11·84	tr.	— =100·18
37. Ouchy, L. Geneva	3·17	56·45	17·02	7·62	—	4·76	2·32	11·46	tr.	— = 99·68
38. St. Marcel	3·22	55·82	10·95	5·68	—	13·42	9·05	6·74	tr.	— =101·66
39. Val d'Aosta	3·32	56·74	10·02	4·69	0·08ᵃ	14·00	9·10	5·40	tr.	— = 99·98
40. Nantes	3·31	54·53	14·25	3·29	—	12·40	7·50	6·21	tr.	— = 98·18

ᵃ Cr_2O_3.

Pyr., etc.—B.B. fuses readily to a transparent blebby glass. Not attacked by acids after fusion, and thus differing from saussurite.

See Lemberg on the results of treatment of jadeite with alkaline carbonates; it is shown that, after fusion, jadeite behaves like fused analcite. Zs. G. Ges., 39, 586 *et seq.*, 1887.

Obs.—Occurs chiefly in Eastern Asia, thus in the Mogoung distr. in Upper Burma, in a valley 25 miles southwest of Meinkhoom; this jadeite is found in rolled masses in a reddish clay, and specimens gave a specific gravity of 3·34, 3·33, 3·24 ; easily fusible (Mallet[2]). Also in Yungchang, province of Yunnan, southern China (Pumpelly[3]) ; in Thibet. Much uncertainty prevails, however, as to the exact localities, since jadeite and nephrite have usually been confounded together. May occur also on the American continent, in Mexico and South America; perhaps also in Europe.

Analyses 29, 30 are of rolled masses of jadeite from the shores of L. Neuenburg in Switzerland, which may have come from a local source. Anal. 36–40 are of various soda-bearing rocks, approaching jadeite more or less closely in composition, and also believed to have been of European origin.

Jadeite has long been highly prized in the East, especially in China, where it is worked into ornaments and utensils of great variety and beauty. It is also found with the relics of early man, thus in the remains of the lake dwellers of Switzerland, at various points in France, in Mexico, Greece, Egypt, and Asia Minor. Mr. Pumpelly remarks that the *feitsui* (= kingfisher plumes) is perhaps the most prized of all stones among the Chinese. He also observes that the *chalchihuitl* of the ancient Mexicans, of which he had seen many specimens, is probably the same mineral; but W. P. Blake refers this name to the turquois from the vicinity of Santa Fé. See turquois. The question of the origin and distribution of jadeite is of great interest and has been much discussed. Cf. Fischer, "Nephrit und Jadeit nach ihren mineralogischen Eigenschaften, so wie nach ihrer urgeschichtlichen und ethnographischen Bedeutung," Stuttgart, 1875, 1880. Also Arzruni, Zs. Ethnol., 15, 163. 1883; Meyer, Mitth. Anthropol. Ges., Wien, 15, 1885; *et al.*, see further jade, below.

Ref.—[1] On the microscopic structure of jadeite, cf. Dx., l. c., 1881; Cohen, l. c.; Krenner, Jb. Min., 2, 173. 1883; Arzruni, Jb. Min., 2, 6 ref., 1885; Merrill, Proc. U. S. Mus., 11, 123, 1888. [2] Min. India, 94. 1887.

[3] Pumpelly, Geol. China, 1866 (Smithson. Contrib., 15, 118).

JADE. A general term used to include various mineral substances of tough compact texture and nearly white to dark green color used by early man for utensils and ornaments, and still highly valued in the East, especially in China, where it is called *Yu* or *Yu-shih* (yu-stone). It includes properly two species only: *nephrite*, a variety of amphibole (p. 389), either tremolite or actinolite, with G .= 2·95–3·0, and *jadeite*, which is classed with the pyroxene group and in composition is a soda-spodumene, with G. = 3·3–3·35; easily fusible.

The jade of China belongs to both species, so also that of the Swiss lake-habitations and of Mexico. Of the two, however, the former, nephrite, is the more common and makes the jade (ax-stone or Punamu stone) of the Maoris of New Zealand; also found in Alaska.

The name jade is also sometimes loosely used to embrace other minerals of more or less similar characters, and which have been or might be similarly used—thus sillimanite, pectolite, serpentine; also vesuvianite, garnet. Cf. remarks under these species. Bowenite is a jade-like variety of serpentine. The "jade tenace" of de Saussure is now called saussurite.

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329. WOLLASTONITE. Tafelspath *Stütz*, Neue Einr. Nat. samml. Wien, 144, 1793. Tabular Spar. Schaalstein *Wern.*, 1808, Ludwig's Min. Wern., 2, 212. 1804, Mohs, Null Kab., 2, 1, 1804. Wollastonite *H.*, Tr., 1822. Vilnite (fr. Vilna) *Horodeki*, Dx., Min., 1, 554, 1862.

Monoclinic. Axes $\dot{a} : \dot{b} : \dot{c} = 1·05312 : 1 : 0·96761$; $\beta = 84° 30' = 001 \wedge 100$ Rath[1].

$100 \wedge 110 = *46° 21'$, $001 \wedge \bar{1}01 = 45° 5'$, $001 \wedge 011 = 43° 55\frac{1}{2}'$.

Forms[2]:	s (820, i-$\frac{4}{5}$)	x (120, i-2)	k ($\bar{1}$08, $\frac{1}{4}$-$\bar{i}$)	l ($\bar{7}$05, $\frac{1}{7}$-$\bar{i}$)	f ($\bar{1}$11, 1)
a (100, i-$\bar{i}$)	h (540, i-$\frac{4}{5}$)	w (102, — $\frac{1}{2}$-i)	α ($\bar{1}$02, $\frac{1}{2}$-$\bar{i}$)	s ($\bar{2}$01, 2-$\bar{i}$)	n ($\bar{3}$22, $\frac{4}{3}$-$\frac{4}{3}$)
c (001, O)	m (110, I)	v (101, — 1-$\bar{i}$)	β ($\bar{3}$05, $\frac{3}{5}$ i)	r ($\bar{3}$01, 3-$\bar{i}$)	ρ (122, —1-2)
d (830, i-$\frac{4}{3}$)	q (340, i-$\frac{4}{3}$)		t ($\bar{1}$01, 1-$\bar{i}$)	g (011, 1-i)	μ ($\bar{1}$22, 1-2)