

and fuses at 2 to a dark green to black glass; with borax in O.F. gives an amethystine bead (manganese), which in R.F. becomes yellow (iron). Fused with a mixture of bisulphate of potash and fluor on the platinum loop colors the flame green (boric acid). Not decomposed by acids, but when previously ignited, gelatinizes with hydrochloric acid.

Obs.—Axinite occurs in clove-brown crystals, near Bourg d'Oisans in Dauphiné; at Andreasberg; Striegau, Silesia; on Mt. Skopi, in eastern Switzerland; Elba; at the silver mines of Kongsberg, Norway; Nordmark, Sweden; near Miask in the Ural; in Cornwall, of a dark color, at the Botallack mine near St. Just, etc.

In the U. S., at Phippsburg, Maine; Franklin Furnace, N. J., honey-yellow; at Bethlehem, Pa.

Named from *ἀξίτην*, an *axe*, in allusion to the form of the crystals.

#### PREHNITE.

Orthorhombic-hemimorphic. Axes  $\tilde{a} : \tilde{b} : \tilde{c} = 0.8401 : 1 : 0.5549$ .

Distinct individual crystals rare; usually tabular  $\parallel c$ ; sometimes prismatic  $mm''' = 80^\circ 4'$ ; again acute pyramidal. Commonly in groups of tabular crystals, united by  $c$  making broken forms, often barrel-shaped. Reniform, globular, and stalactitic with a crystalline surface. Structure imperfectly columnar or lamellar, strongly coherent; also compact granular or impalpable.

Cleavage:  $c$  distinct. Fracture uneven. Brittle.  $H. = 6-6.5$ .  $G. = 2.80-2.95$ . Luster vitreous;  $c$  weak pearly. Color light green, oil-green, passing into white and gray; often fading on exposure. Subtransparent to translucent. Streak uncolored.

Comp.—An acid orthosilicate,  $H_2Ca_2Al_2(SiO_4)_2 =$  Silica 43.7, alumina 24.8, lime 27.1, water 4.4 = 100.

Prehnite is sometimes classed with the zeolites, with which it is often associated; the water here, however, has been shown to go off only at a red heat, and hence plays a different part.

Fyr., etc.—In the closed tube yields water. B.B. fuses at 2 with intumescence to a blebby enamel-like glass. Decomposed slowly by hydrochloric acid without gelatinizing; after fusion dissolves readily with gelatinization.

Diff.—B.B. fuses readily, unlike beryl, green quartz, and chalcedony. Its hardness is greater than that of the zeolites.

Obs.—Occurs chiefly in basic eruptive rocks, basalt, diabase, etc., as a secondary mineral in veins and cavities, often associated with some of the zeolites, also datolite, pectolite, calcite, but commonly one of the first formed of the series; also less often in granite, gneiss, syenite, and then frequently associated with epidote; sometimes associated with native copper, as in the L. Superior region.

At St. Christophe, near Bourg d'Oisans in Dauphiné; Fassathal, Tyrol; the Ala valley in Piedmont; in the Harz, near Andreasberg; in granite at Striegau, Silesia; Arendal, Norway; Ædelfors in Sweden (*edelite*); at Corstorphine Hill, near Edinburgh; Mourne Mts., Ireland.

In the United States, finely crystallized at Farmington, Conn.; Paterson and Bergen Hill, N. J.; in syenite, at Somerville, Mass.; on north shore of Lake Superior, and the copper region.

Named (1790) after Col. Prehn, who brought the mineral from the Cape of Good Hope.

Harstigitite. An acid orthosilicate of manganese and calcium. In small colorless prismatic crystals.  $H. = 5.5$ .  $G. = 3.049$ . From the Harstig mine, near Pajsborg, Werm-land, Sweden.

Cuspidine. Contains silica, lime, fluorine, and from alteration carbon dioxide; formula doubtful. In minute spear-shaped crystals  $H. = 5-6$ .  $G. = 2.853-2.860$ . Color pale rose-red. From Vesuvius, in ejected masses in the tufa of Monte Somma.

#### IV. Subsilicates.

The species here included are basic salts, for the most part to be referred either to the metasilicates or orthosilicates, like many basic compounds already included in the preceding pages. Until their constitution is definitely settled, however, they are more conveniently grouped by themselves as SUBSILICATES.

It may be noted that those species having an oxygen ratio of silicon to bases of 2 : 3, like topaz, andalusite, sillimanite, datolite, etc., also calamine, carpholite, and perhaps tourmaline, are sometimes regarded as salts of the hypothetical parasilicic acid,  $H_2SiO_3$ .

The only prominent group in this subdivision is the HUMITE GROUP.

#### Humite Group.

			$\tilde{a} : \tilde{b} : \tilde{c}$	$\beta$
Prolectite	$[Mg(F,OH)]_2Mg[SiO_4]_2?$	Monoclinic	1.0803:1:1.8861	90°
Chondrodite	$[Mg(F,OH)]_2Mg_2[SiO_4]_2$	Monoclinic	1.0863:1:3.1447	90°
			$\tilde{b} : \tilde{a} : \tilde{c}$	
Humite	$[Mg(F,OH)]_2Mg_2[SiO_4]_2$	Orthorhombic	1.0802:1:4.4033	—
Clinohumite	$[Mg(F,OH)]_2Mg_2[SiO_4]_2$	Monoclinic	1.0803:1:5.6588	90°

The species here included form a remarkable series both as regards crystalline form and chemical composition. In crystallization they have sensibly the same ratio for the lateral axes, while the vertical axes are almost exactly in the ratio of the numbers 3:5:7:9 (see also below). Furthermore, though one species is orthorhombic, the others monoclinic, they here also correspond closely, since the axial angle  $\beta$  in the latter cases does not sensibly differ from 90°.

In composition, as shown by Penfield and Howe (also Sjögren), the last three species are basic orthosilicates in each of which the univalent group (MgF) or (MgOH) enters, while the Mg atoms present are in the ratio of 3:5:7. The composition given for Prolectite is theoretical only, being that which would be expected from its crystallization. In physical characters these species are very similar, and several of them may occur together at the same locality and even intercrystallized in parallel lamellæ.

The species of the group approximate closely in angle to chrysolite and chrysoberyl. The axial ratios may be compared as follows:

Prolectite.....	$\tilde{a} : \tilde{b} : \frac{1}{3}\tilde{c} = 1.0803 : 1 : 0.6287$
Chondrodite.....	$\tilde{a} : \tilde{b} : \frac{1}{3}\tilde{c} = 1.0863 : 1 : 0.6289$
Humite.....	$\tilde{a} : \tilde{b} : \frac{1}{3}\tilde{c} = 1.0802 : 1 : 0.6291$
Clinohumite.....	$\tilde{a} : \tilde{b} : \frac{1}{3}\tilde{c} = 1.0803 : 1 : 0.6288$
Chrysolite.....	$\tilde{b} : 2\tilde{a} : \tilde{c} = 1.0735 : 1 : 0.6296$
Chrysoberyl.....	$\tilde{b} : 2\tilde{a} : \tilde{c} = 1.0637 : 1 : 0.6170$

#### CHONDRODITE—HUMITE—CLINOHUMITE.

Axial ratios as given above. Habit varied, Figs. 858 to 866. Twins common, the twinning planes inclined 60°, also 30°, to  $c$  in the brachydome or clinodome zone, hence the axes crossing at angles near 60°; often repeated as trillings and as polysynthetic lamellæ (cf. Fig. 556, p. 226). Also twins, with  $c$  (001) as tw. plane. Two of the three species are often twinned together.

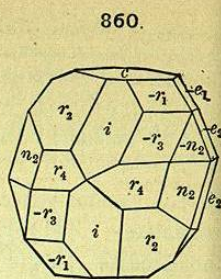
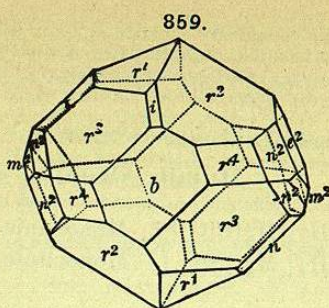
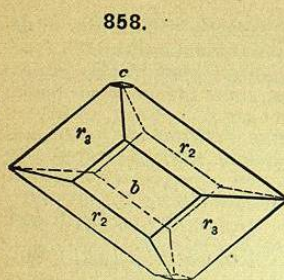
Cleavage:  $c$  sometimes distinct. Fracture subconchoidal to uneven. Brittle.  $H. = 6-6.5$ .  $G. = 3.1-3.2$ . Luster vitreous to resinous. Color white, light yellow, honey-yellow to chestnut-brown and garnet- or hyacinth-red. Pleochroism sometimes distinct. Optically +.

Chondrodite. Absorption  $a > c > b$ . Optically +. Ax. pl. and  $Bx_a \perp b$ .  $Bx_o \wedge \tilde{c} = a \wedge \tilde{b} = +25^\circ 52'$  Brewster;  $28^\circ 56'$  Kaveltorp;  $30^\circ$  approx., Mte. Somma.  $\beta = 1.619$ ;  $\gamma - \alpha = 0.032$ .  $2H_{a,r} = 86^\circ$  to  $89^\circ$ .

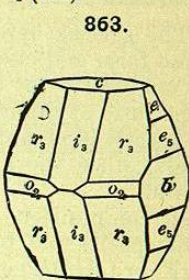
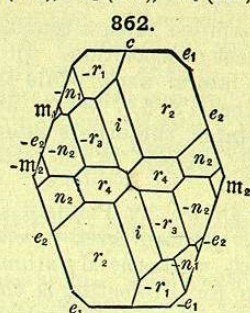
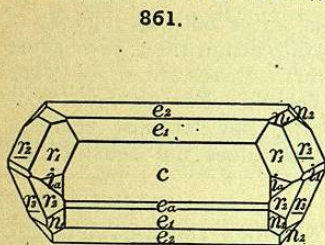
Humite. Ax. pl.  $\parallel c$ .  $Bx \perp a$ .  $\gamma - \alpha = 0.035$ .

Clinohumite. Ax. pl. and  $Bx_a \perp b$ .  $Bx_o \wedge \tilde{c} = a \wedge \tilde{b} = +11^\circ-12^\circ$ ;  $7\frac{1}{2}^\circ$  approx., Brewster.  $2H_{a,r} = 85^\circ$ .



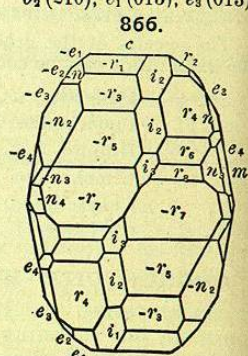
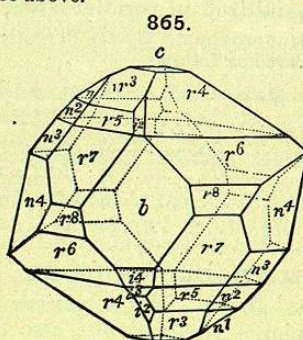
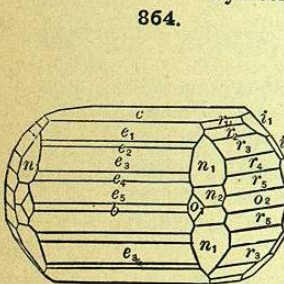


Figs. 858, 859, *Chondrodite*, Brewster, N. Y. *Chondrodite*, Sweden.  
 $i$  (012),  $e_1$  (103),  $e_2$  (101),  $r_1$  (127),  $r_3$  (123),  $r_2$  (125),  $r_4$  (121),  $n_2$  (111).



Figs. 861, 862, *Chondrodite*, Mte. Somma.  
 Symbols see above.

*Humite*, Sweden.  
 $o_2$  (210),  $e_1$  (015),  $e_3$  (013).



*Humite*, Vesuvius.  
 $e_3$  (011),  $r_1$  (2110),  $r_3$  (216),  
 $r_2$  (212),  $n_1$  (113),  $n_2$  (111).

*Clinohumite*, Brewster. *Clinohumite*, Mte. Somma.  
 $i_2$  (014),  $i_3$  (012),  $e_3$  (103),  $e_4$  (101),  $r_5$  (127),  $r_7$  (123),  
 $r_6$  (125),  $r_8$  (121).

**Comp.**—Basic fluosilicates of magnesium with related formulas as shown in the table above. Hydroxyl replaces part of the fluorine, and iron often takes the place of magnesium.

Analyses by Penfield:

	SiO <sub>2</sub>	MgO	FeO	F	H <sub>2</sub> O
<i>Chondrodite</i> , Brewster	33.67	54.79	5.94	5.30	2.55 = 102.25
" Mte. Somma	33.87	56.46	3.66	5.15	2.82 = 101.96
<i>Humite</i> , "	36.63	56.45	2.35	3.08	2.45 = 100.96
<i>Clinohumite</i> , "	38.03	54.00	4.83	2.06	1.94 = 100.86

**Pyr., etc.**—B.B. infusible; some varieties blacken and then burn white. Fused with potassium bisulphate in the closed tube gives a reaction for fluorine. With the fluxes a reaction for iron. Gelatinizes with acids. Heated with sulphuric acid gives off silicon fluoride.

**Obs.**—*Chondrodite*, *humite*, and *clinohumite* all occur at Vesuvius in the ejected masses both of limestone or feldspathic type found on Monte Somma. They are associated with chrysolite, biotite, pyroxene, magnetite, spinel, vesuvianite, calcite, etc.; also less often with sanidine, meionite, nephelite. Of the three species, *humite* is the rarest and *clinohumite* of most frequent occurrence. They seldom all occur together in the same mass, and only rarely two of the species (as *humite* and *clinohumite*) appear together. Occasionally *clinohumite* interpenetrates crystals of *humite*, and parallel intergrowths with *chrysolite* have also been observed.

*Chondrodite* occurs at Mte. Somma, as above noted; at Pargas, Finland, honey-yellow in limestone; at Kafveltorp, Nya-Kopparberg, Sweden, associated with chalcopryrite, galena, sphalerite. At Brewster, N. Y., at the Tilly Foster magnetic iron mine in deep garnet-red crystals. Also probably at numerous points where the occurrence of "*chondrodite*" has been reported.

*Humite* also occurs at the Ladu mine near Filipstad, Sweden, with magnetite in crystalline limestone. In crystalline limestone with *clinohumite* in Andalusia. Also in large, coarse, partly altered crystals at the Tilly Foster iron-mine at Brewster, N. Y.

*Clinohumite* occurs at Mte. Somma and in Andalusia; in crystalline limestone near L. Baikal in East Siberia; at Brewster, N. Y., in rare but highly modified crystals.

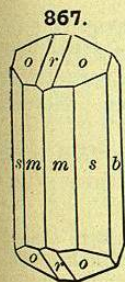
*Proectite* is from the Ko mine, Nordmark, Sweden; very rare; imperfectly known. Numerous other localities of "*chondrodite*" have been noted, chiefly in crystalline limestone; most of them are probably to be referred to the species *chondrodite*, but the identity in many cases is yet to be proved. At Brewster large quantities of massive "*chondrodite*" occur associated with magnetite, enstatite, ripidolite, and from its extensive alteration serpentine has been formed on a large scale. The granular mineral is common in limestone in Sussex Co., N. J., and Orange Co., N. Y., associated with spinel, and occasionally with pyroxene and corundum. Also in Mass., at Chelmsford, with scapolite; at South Lee, in limestone. In Canada, in limestone at St. Jerome, Grenville, etc., abundant.

The name *chondrodite* is from *χόνδρος*, a grain, alluding to the granular structure. *Humite* is from Sir Abraham Hume.

**ILVAITE.** Lievrite. Yenite.

Orthorhombic. Axes  $a:b:c = 0.6665:1:0.4427$ .

$mm'$ ,  $110 \wedge \bar{1}10 = 67^\circ 22'$ .  $rr'$ ,  $101 \wedge \bar{1}01 = 67^\circ 11'$ .  
 $ss'$ ,  $120 \wedge \bar{1}20 = 73^\circ 45'$ .  $oo'$ ,  $111 \wedge \bar{1}11 = 62^\circ 33'$ .



Commonly in prisms, with prismatic faces vertically striated. Columnar or compact massive.

Cleavage:  $b$ ,  $c$  rather distinct. Fracture uneven. Brittle.  $H. = 5.5-6$ .  $G. = 3.99-4.05$ . Luster submetallic. Color iron-black or dark grayish black. Streak black, inclining to green or brown. Opaque.

**Comp.**— $CaFe_2(FeOH)(SiO_3)_4$ , or  $H_2O.CaO.4FeO.Fe_2O_3.4SiO_2$  = Silica 29.3, iron sesquioxide 19.6, iron protoxide 35.2, lime 13.7, water 2.2 = 100. Manganese may replace part of the ferrous iron.

**Pyr., etc.**—B.B. fuses quietly at 2.5 to a black magnetic bead. With the fluxes reacts for iron. Some varieties give also a reaction for manganese. Gelatinizes with hydrochloric acid.

**Obs.**—Found on Elba in dolomite; on Mt. Mulatto near Predazzo, Tyrol, in granite; Schneeberg, Saxony; Fossum, in Norway. Reported as formerly found at Cumberland, R. I.; also at Milk Row quarry, Somerville, Mass. Named *Ilvaite* from the Latin name of the island (Elba).

**Ardennite.** Dewalquite. A vanadio-silicate of aluminium and manganese; also containing arsenic. In prismatic crystals resembling *ilvaite*.  $H. = 6-7$ .  $G. = 3.620$ . Yellow to yellowish brown. Found at Salm Chateau in the Ardennes, Belgium.



**Långbanite.** Manganese silicate with ferrous antimonate; formula doubtful. In iron-black hexagonal prismatic crystals.  $H. = 6.5$ .  $G. = 4.918$ . Luster metallic. From Långban, Sweden.

The following are rare lead silicates. See also p. 408.

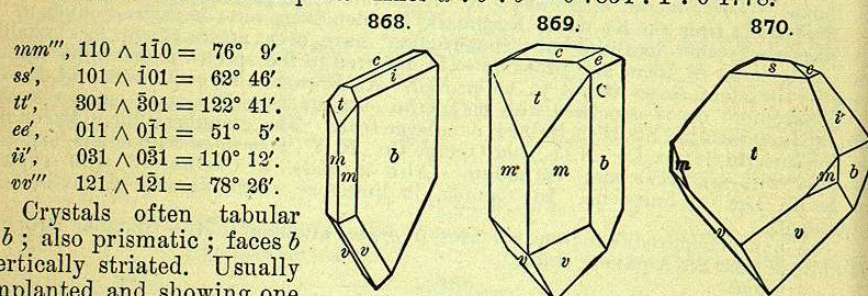
**Kentrolite.** Probably  $3PbO \cdot 2Mn_2O_3 \cdot 3SiO_2$ . In minute prismatic crystals; often in sheaf-like forms; also massive.  $H. = 5$ .  $G. = 6.19$ . Color dark reddish brown; black on the surface. From southern Chili; Långban, Sweden.

**Melanotekite.**  $3PbO \cdot 2Fe_2O_3 \cdot 3SiO_2$  or  $(Fe_2O_3)_2Pb_3(SiO_4)_2$  Warren. Orthorhombic; prismatic. Massive; cleavable.  $H. = 6.5$ .  $G. = 5.73$ . Luster metallic to greasy. Color black to blackish gray. Occurs with native lead at Långban, Sweden. Also in crystals resembling kentrolite at Hillsboro, New Mexico.

**Bertrandite.**  $H_2Be_4Si_2O_9$  or  $H_2O \cdot 4BeO \cdot 2SiO_2$ . Orthorhombic-hemimorphic. In small tabular or prismatic crystals.  $H. = 6-7$ .  $G. = 2.59-2.60$ . Colorless to pale yellow. Usually occurs in feldspathic veins, often with other beryllium minerals as a result of the alteration of beryl. At the quarries of Barbin near Nantes, France; Pisek, Bohemia; Mt. Antero, Chaffee Co., Colo., with phenacite; Stoneham, Me.; Amelia Court-House, Va.

**CALAMINE.** Smithsonite. Hemimorphite. Kieselzinkerz, Galmei *pt. Germ.*

Orthorhombic-hemimorphic. Axes  $a : b : c = 0.7834 : 1 : 0.4778$ .



Crystals often tabular  $\parallel b$ ; also prismatic; faces  $b$  vertically striated. Usually implanted and showing one extremity only. Often grouped in sheaf-like forms and forming drusy surfaces in cavities. Also stalactitic, mammillary, botryoidal, and fibrous forms; massive and granular.

Cleavage:  $m$  perfect;  $s$  (101) less so;  $c$  in traces. Fracture uneven to subconchoidal. Brittle.  $H. = 4.5-5$ , the latter when crystallized.  $G. = 3.40-3.50$ . Luster vitreous;  $c$  subpearly, sometimes adamantine. Color white; sometimes with a delicate bluish or greenish shade; also yellowish to brown. Streak white. Transparent to translucent. Strongly pyroelectric.

**Comp.**— $H_2ZnSiO_5$  or  $(ZnOH)_2SiO_3$  or  $H_2O \cdot 2ZnO \cdot SiO_2 =$  Silica 25.0, zinc oxide 67.5, water 7.5 = 100. The water goes off only at a red heat; unchanged at  $340^\circ C$ .

**Pyr., etc.**—In the closed tube decrepitates, whitens, and gives off water. B.B. almost infusible ( $F. = 6$ ). On charcoal with soda gives a coating which is yellow while hot, and white on cooling. Moistened with cobalt solution, and heated in O.F., this coating assumes a bright green color, but the ignited mineral itself becomes blue. Gelatinizes with acids even when previously ignited.

**Diff.**—Characterized by its infusibility; reaction for zinc; gelatinization with acids. Resembles some smithsonite (which effervesces with acid), also prehnite.

**Obs.**—Calamine and smithsonite are usually found associated in veins or beds in stratified calcareous rocks accompanying sulphides of zinc, iron and lead. Thus at Aix-la-Chapelle; Raibel and Bleiberg, in Carinthia; Moresnet in Belgium; Rezbánya, Schemnitz. At Roughten Gill, in Cumberland; at Alston Moor, white; near Matlock, in Derbyshire; Leadhills, Scotland; at Nerchinsk, in eastern Siberia.

In the United States occurs at Sterling Hill, near Ogdensburg, N. J., in fine clear crystalline masses. In Pennsylvania, at the Perkiomen and Phenixville lead mines; at

Friedensville. Abundant in Virginia, at Austin's mines in Wythe Co. With the zinc deposits of southwestern Missouri, especially about Granby, both as crystallized and massive calamine. At the Emma mine, Cottonwood Cañon, Utah.

The name *Calamine* (with *Galmei* of the Germans) is commonly supposed to be a corruption of *Cadmia*. Agricola says it is from *calamus*, a reed, in allusion to the slender forms (stalactitic) common in the *cadmia fornacum*.

**Clinohedrite.**  $H_2CaZnSiO_5$ . Monoclinic-clinohedral (see Figs. 331, 331a, p. 104).  $H. = 5.5$ .  $G. = 3.33$ . Colorless or white to amethystine. From Franklin Furnace, N. J.

**Carpholite.**  $H_4MnAl_2Si_2O_{10}$ . In radiated and stellated tufts.  $G. = 2.935$ . Color straw- to wax-yellow. Occurs at the tin mines of Schlackenwald; Wippra, in the Harz, on quartz, etc.

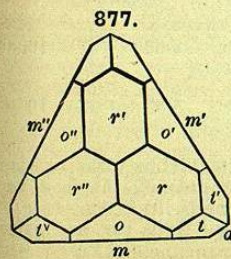
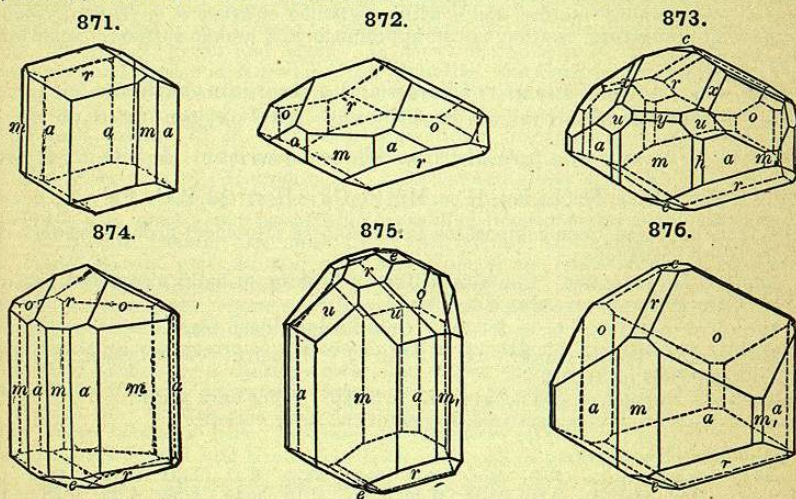
**Lawsonite.**  $H_4CaAl_2Si_2O_{10}$ . In prismatic orthorhombic crystals;  $mm''' = 67^\circ 16'$ .  $G. = 3.09$ . Luster vitreous to greasy. Colorless, pale blue to grayish blue. Occurs in crystalline schists of the Tiburn peninsula, Marin Co., California; also in the schists of Pontgibaud and New Caledonia.

**Cerite.** A silicate of the cerium metals chiefly, with water. Crystals rare; commonly massive; granular.  $H. = 5.5$ .  $G. = 4.86$ . Color between clove-brown and cherry-red to gray. Occurs at Bastnäs, near Riddarhyttan, Sweden.

**TOURMALINE.** Turmalin *Germ.*

Rhombohedral-hemimorphic. Axis  $c = 0.4477$ .

$cr, 0001 \wedge 10\bar{1}1 = 27^\circ 20'$ .  $rr', 10\bar{1}1 \wedge \bar{1}101 = 46^\circ 52'$ .  $uu', 32\bar{5}1 \wedge \bar{5}2\bar{1}1 = 66^\circ 1'$   
 $co, 0001 \wedge 02\bar{2}1 = 45^\circ 57'$ .  $oo', 02\bar{2}1 \wedge \bar{2}021 = 77^\circ 0'$ .  $uv', 32\bar{5}1 \wedge \bar{5}2\bar{3}1 = 42^\circ 36'$



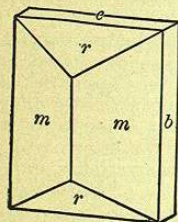
Crystals usually prismatic in habit, often slender to acicular; rarely flattened, the prism nearly wanting. Prismatic faces strongly striated vertically, and the crystals hence often much rounded to barrel-shaped. The cross-section of the prism three-sided ( $m$ , Fig. 877), six-sided ( $a$ ), or nine-sided ( $m$  and  $a$ ). Crystals commonly hemimorphic. Sometimes isolated, but more commonly in parallel or radiating groups. Sometimes massive compact; also columnar, coarse or fine, parallel or divergent.



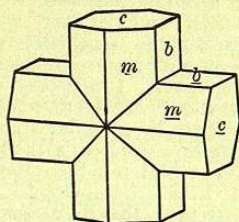
**STAUROLITE.** Staurotide.Orthorhombic. Axes  $\ddot{a} : \ddot{b} : \ddot{c} = 0.4734 : 1 : 0.6828$ . $mm''$ ,  $110 \wedge 1\bar{1}0 = 50^\circ 40'$ .  $cr$ ,  $001 \wedge 101 = 55^\circ 16'$ . $rr'$ ,  $101 \wedge \bar{1}01 = 110^\circ 32'$ .  $mr$ ,  $110 \wedge 101 = 42^\circ 2'$ .

Twins cruciform: tw. pl.  $x$  (032), the crystals crossing nearly at right angles; tw. pl.  $z$  (232), crossing at an angle of  $60^\circ$  approximately; tw. pl.  $y$  (230) rare, also in repeated twins (cf. Figs. 359, p. 122, 409, p. 128, 411, p. 129). Crystals commonly prismatic and flattened  $\parallel \ddot{b}$ ; often with rough surfaces.

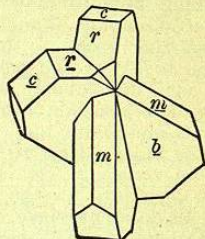
878.



879.

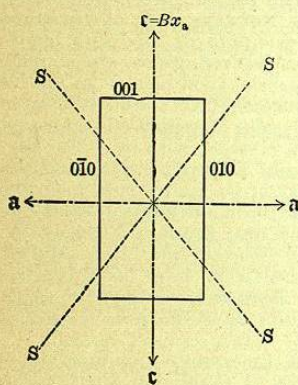


880.



Cleavage:  $\ddot{b}$  distinct, but interrupted;  $m$  in traces. Fracture subconchoidal.

881.



Brittle. H. = 7-7.5. G. = 3.65-3.77. Subvitreous, inclining to resinous. Color dark reddish brown to brownish black, and yellowish brown. Streak uncolored to grayish. Translucent to nearly or quite opaque. Pleochroism distinct:  $c$  (=  $\ddot{c}$ ) hyacinth-red to blood-red,  $a$ ,  $b$  yellowish red; or  $c$  gold-yellow,  $a$ ,  $b$  light yellow to colorless. Optically +. Ax. pl.  $\parallel a$ .  $Bx \perp c$ .  $2H_{ar} = 113^\circ 10'$ .  $\beta = 1.75$ ,  $\gamma - \alpha = 0.012$ .

Comp.— $HFeAl_2Si_2O_{13}$ , which may be written  $(AlO)_4(AlOH)Fe(SiO_4)_2$  or  $H_2O.2FeO.5Al_2O_3.4SiO_2$ , = Silica 26.3, alumina 55.9, iron protoxide 15.8, water 2.0 = 100 Penfield. Magnesium (also manganese) replaces a little of the ferrous iron; ferric iron part of the aluminium.

*Nordmarkite* from Nordmark, Sweden, contains manganese in large amounts.

**Pyr., etc.**—B.B. infusible, excepting the manganese variety, which fuses easily to a black magnetic glass. With the fluxes gives reactions for iron, and sometimes for manganese. Imperfectly decomposed by sulphuric acid.

**Diff.**—Characterized by the obtuse prism (unlike andalusite, which is nearly square); by the frequency of twinning forms; by hardness and infusibility.

Under the microscope, sections show a decided color (yellow to red or brown) and strong pleochroism (yellow and red); also characterized by strong refraction (high relief), rather bright interference-colors, parallel extinction and biaxial character (generally positive in the direction of elongation). Easily distinguished from rutile (p. 345) by its biaxial character and lower interference-colors.

**Obs.**—Usually found in crystalline schists, as mica schist, argillaceous schist, and gneiss, as a result of regional or contact metamorphism; often associated with garnet, sillimanite, cyanite, and tourmaline. Sometimes encloses symmetrically arranged carbonaceous impurities like andalusite (p. 433). Other impurities are also often present, especially silica, sometimes up to 30 to 40 p. c.; also garnet, mica, and perhaps magnetite, brookite.

Occurs with cyanite in paragonite schist, at Mt. Campione, Switzerland; in the Zillertal, Tyrol; Goldenstein in Moravia; Aschaffenburg, Bavaria; in large twin crystals in the mica schists of Brittany and Scotland. In the province of Minas Geraes, Brazil.

Abundant throughout the mica schists of New England. In *Maine*, at Windham. In *N. Hamp.*, brown at Franconia; at Lisbon; on the shores of Mink Pond, loose in the soil. In *Mass.*, at Chesterfield, in fine crystals. In *Conn.*, at Bolton, Vernon, etc.; Southbury with garnets; at Litchfield, black crystals. In *N. Carolina*, near Franklin, Macon Co.; also in Madison and Clay counties. In *Georgia*, in Fannin Co., loose in the soil in fine crystals. Named from  $\sigma\tau\alpha\upsilon\rho\acute{o}s$ , a cross.

**Kornerupine.**  $MgAl_2SiO_6$ . In fibrous to columnar aggregates, resembling sillimanite. H. = 6.5. G. = 3.273 kornerupine; 3.341 prismatine. Colorless to white, or brown.

*Kornerupine* occurs at Fiskernäs on the west coast of Greenland. *Prismatine* is from Waldheim, Saxony.

**Sapphirine.**  $Mg_5Al_{12}Si_2O_{27}$ . In indistinct tabular crystals. Usually in disseminated grains, or aggregations of grains. H. = 7.5. G. = 3.42-3.48. Color pale blue or green. From Fiskernäs, southwestern Greenland.

**SILICATES.****Section B. Chiefly Hydrous Species.**

The SILICATES of this second section include the true hydrous compounds, that is, those which contain water of crystallization, like the zeolites; also the hydrous amorphous species, as the clays, etc. There are also included certain species—as the Micas, Talc, Kaolinite—which, while they yield water upon ignition, are without doubt to be taken as acid or basic metasilicates, orthosilicates, etc. Their relation, however, is so close to other true hydrous species that it appears more natural to include them here than to have placed them in the preceding chapter with other acid and basic salts. Finally, some species are referred here about whose chemical constitution and the part played by the water present there is still much doubt. The divisions recognized are as follows:

## I. Zeolite Division.

## 1. Introductory Subdivision. 2. Zeolites.

## II. Mica Division.

## 1. Mica Group. 2. Clintonite Group. 3. Chlorite Group.

## III. Serpentine and Talc Division.

Chiefly Silicates of Magnesium.

## IV. Kaolin Division.

Chiefly Silicates of Aluminium; for the most part belonging to the group of the clays.

## V. Concluding Division.

Species not included in the preceding divisions; chiefly silicates of the heavy metals, iron, manganese, etc.

## I. Zeolite Division.

## 1. Introductory Subdivision.

Of the species here included, several, as Apophyllite, Okenite, etc., while not strictly ZEOLITES, are closely related to them in composition and method of occurrence. Pectolite (p. 395) and Prehnite (p. 442) are also sometimes classed here.