

Jeffersonite is a manganese-zinc pyroxene from Franklin Furnace, N. J. (but the zinc may be due to impurity). In large, coarse crystals with edges rounded and faces uneven. Color greenish black, on the exposed surface chocolate-brown.

II. Aluminous.

4. AUGITE. *Aluminous pyroxene*. Composition chiefly $\text{CaMgSi}_2\text{O}_6$, with $(\text{Mg,Fe})(\text{Al,Fe})_2\text{SiO}_6$, and occasionally also containing alkalies and then grading toward *ægirite*. Titanium is also sometimes present. Here belong:

a. LEUCAUGITE. Color white or grayish. Contains alumina, with lime and magnesia, and little or no iron. Looks like diopside. $H. = 6.5$; $G. = 3.19$. Named from $\lambda\epsilon\upsilon\kappa\acute{o}\varsigma$, white.

b. FASSAITE. Includes the pale to dark, sometimes deep green crystals, or pistachio-green and then resembling epidote (Fig. 766). The aluminous kinds of diallage also belong here. Named from the locality in the Fassathal, Tyrol. *Pyrgom* is from $\pi\upsilon\rho\gamma\omega\mu\alpha$, 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 $\parallel a$; often twins (Figs. 767-769). Ferric iron is here present, in relatively large amount, and the angle $Bx_a \wedge c$ becomes $+50^\circ$ to 52° . $\beta = 1.717$; $\gamma - \alpha = 0.022$. TiO_2 is present in some kinds, which are then pleochroic. Named from $\alpha\upsilon\gamma\eta$, luster.

d. ALKALI-AUGITE. Here belong varieties of augite characterized by the presence of alkalies, especially soda; they approximate in composition and optically to acmite and *ægirite* ($Bx_a \wedge c = 60^\circ$, Fig. 773), and are sometimes called *ægirite-augite* (cf. Fig. 776, p. 392). Known chiefly from rocks rich in alkalies, as *clæolite-syenite*, *phonolite*, *leucitite*, etc.

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 the fusibility varies with the amount of iron. Many varieties give with the fluxes reactions for manganese. Most varieties are unacted upon by acids.

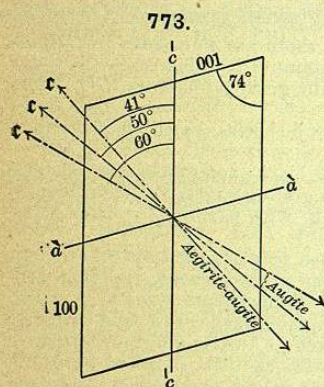
Diff.—Characterized by monoclinic crystallization and the prismatic angle of 87° and 93° , hence yielding nearly square prisms; these may be mistaken for *scapolite* if terminal faces are wanting or indistinct (but

scapolite fuses easily B.B. with intumescence). The oblique parting ($\parallel c$, Fig. 770) often distinctive, also the common dull green to gray and brown colors. *Amphibole* differs in prismatic angle ($55\frac{1}{2}^\circ$ and $124\frac{1}{2}^\circ$) and cleavage, and in having common columnar to fibrous varieties, which are rare with pyroxene. See also p. 398.

The common rock-forming pyroxenes are distinguished in thin sections by their high relief; usually greenish to olive tones of color; distinct system of interrupted cleavage-cracks crossing one another at nearly right angles in sections $\perp c$ (Fig. 771); high interference-colors; general lack of pleochroism; large extinction-angle, 35° to 50° and higher, for sections $\parallel b$ (010). The last-named sections are easily recognized by showing the highest interference-colors; yielding no optical figures in convergent light and having parallel cleavage-cracks, the latter in the direction of the vertical axis. See also *ægirite*, p. 392.

A zonal banding is common, the successive laminae sometimes differing in extinction-angle and pleochroism; also the hour-glass structure occasionally distinct (Fig. 774, from Lacroix).

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 Archaean rocks. It occurs also in meteorites. The pyroxene of limestone is mostly white and light green or gray in color, falling under *diopside* (*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* (*sandine*), *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*, *basaltic lavas* and *diabase*; in *andesite*; also in *trachyte*; in *peridotite* and *pikrite*; with *nephelite* in *phonolite*. Further with *clæolite*, *orthoclase*, etc., in *clæolite-syenite* and *augite-syenite*; also as *diallage* in *gabbro*; in many *peridotites* and the *serpentines* formed from them; as *diopside* (*malacolite*) in crystalline schists. In *limburgite*, *augite* and *pyroxenite*, pyroxene is present as the prominent constituent, while *feldspar* is absent; it may also form rock masses alone nearly free from associated minerals.

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 at *Traversella*; at *Zermatt* in *Switzerland*; *Schwarzenstein* in the *Zillertal*; *Ober-Sulzbachthal* and elsewhere in *Tyrol* and in the *Salzburg Alps*; *Reichenstein*; *Rezbánya*, *Hungary*; *Achmatovsk* in the *Ural* with *almandite*, *clinocllore*; *L. Baikal* (*baikalite*) in eastern *Siberia*; *Pargas* in *Finland*; at *Nordmark*, *Sweden*.

Hedenbergite is from *Tunaberg*, *Sweden*; *Arendal*, *Norway*. *Manganhedenbergite* from *Vester Silfberg*; *schefferite* from *Långban*, *Sweden*.

Augite (incl. *fassaite*) occurs 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*, and many other regions of volcanic rocks.

In *N. America*, occurs in *Maine*, at *Raymond* and *Rumford*, *diopside*, *salite*, etc. In *Vermont*, at *Thetford*, black *augite*, with *chrysolite*, in boulders of *basalt*. In *Conn.*, at *Canaan*, white *cryst.*, often externally changed to *tremolite*, in *dolomite*; also the pyroxenic rock called *canaanite*. In *N. York*, at *Warwick*, fine *cryst.*; in *Westchester Co.*, white, at the *Sing Sing quarries*; in *Orange Co.*, in *Monroe*, at *Two Ponds*, *cryst.*, often large, in *limestone*; near *Greenwood furnace*, and also near *Edenville*; 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*; at *Moriah*, *coccolite*, in *limestone*. 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*. In *Tennessee*, at the *Ducktown mines*.

In *Canada*, at *Calumet I.*, grayish-green *cryst.* in *limestone*; in *Bathurst*, colorless or white *cryst.*; at *Grenville*, dark green *cryst.*, and *granular*; *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.

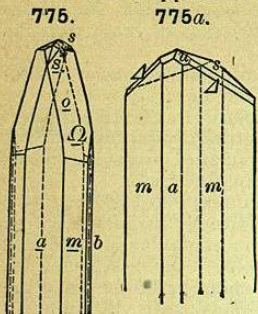
Pyroxene undergoes alteration in different ways. A change of molecular constitution without essential change of composition, i.e., by *paramorphism* (using the word rather broadly), may result in the formation of some variety of *amphibole*. Thus, the white pyroxene crystals of *Canaan*, *Conn.*, are often changed on the exterior to *tremolite*; similarly with other varieties at many localities. See *uralite*, p. 401. Also changed to *steatite*, *serpentine*, etc.

ACMITE. ÆGIRITE.

Monoclinic. Axes: $a : b : c = 1.0996 : 1 : 0.6012$; $\beta = 73^\circ 11'$.

Twins: tw. pl. *a*, very common; crystals often polysynthetic, with enclosed twinning lamellæ. Crystals long prismatic, vertically striated or channeled; acute terminations very characteristic.

The above applies to ordinary *acmite*. For *ægirite*, crystals prismatic, bluntly terminated; twins not common; also in groups or tufts of slender acicular to capillary crystals, and in fibrous forms.



Acmite. Ægirite.

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. Optically —. Ax. pl. $\parallel b$. $Bx_a \wedge c = a \wedge c = +2\frac{1}{2}^\circ$ acmite, to 6° ægirite. $\beta_y = 1.808$; $\gamma - \alpha = 0.052$.

Var.—Includes *acmite* in sharp-pointed crystals (Fig. 775) often twins. $Bx_a \wedge c = 5\frac{1}{2}^\circ-6^\circ$. Also *ægirite* (Fig. 775a) in crystals bluntly terminated, twins rare, $Bx_a \wedge c = 2\frac{1}{2}^\circ-3\frac{1}{2}^\circ$.

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

With some authors (vom Rath, etc.) $s = (011)$ and $a \wedge c = -2^\circ$ to -6° , as in Fig. 776a. Fig. 776 shows the optical orientation according to Brögger.

Comp.—Essentially $NaFe^{III}(SiO_3)_2$ or $Na_2O \cdot Fe_2O_3 \cdot 4SiO_2 =$ Silica 52.0, iron sesquioxide 34.6, soda 13.4 = 100. Ferrous iron is also present.

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.

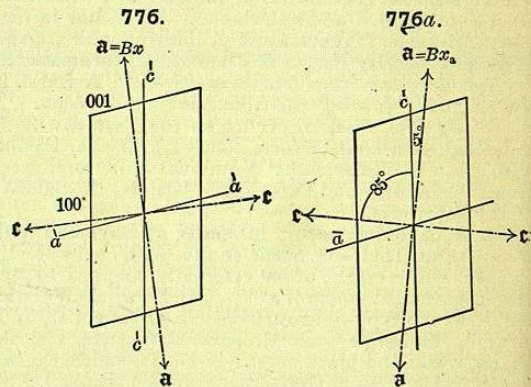
Diff.—*Ægirite* is characterized in thin sections by its grass-green color; strong pleochroism in tones of green and yellow; the small extinction-angle in sections $\parallel b$ (010). Distinguished from common green hornblende, with which it might be confounded, by the fact that in such sections the direction of extinction lying near the cleavage is negative (*a*), while the same direction in hornblende is positive (*c*).

Obs.—The original *acmite* occurs at Rundemyr, east of the little lake called Rokeberg-skjern, in the parish of Eker, near Kongsberg, Norway, in a pegmatite vein; it is in slender crystals, sometimes a foot long, embedded in feldspar and quartz.

Ægirite occurs especially in igneous rocks rich in soda and containing iron; thus in *ægirite*-granite, nephelite-syenite, and some varieties of phonolite; often in such cases iron-ore grains are wanting in the rock, their place being taken by *ægirite* crystals. In the sub-variety of phonolite called *tinguaite*, the rock has often a deep greenish color due to the abundance of minute crystals of *ægirite*. Large crystals are found in the pegmatite facies of nephelite-syenites as in West Greenland, Southern Norway, the peninsula Kola in Russian Lapland, Ditro in Transylvania.

Prominent American occurrences are the following: Magnet Cove, Arkansas (large crystals); Montreal; Salem, Mass.; Libertyville, N. J. (dike); Trans Pecos district in Texas (Osann); Black Hills; Cripple Creek, Colorado; Bearpaw Mts. and Judith Mts. (Pirsson), and the Crazy Mts. (Wolff) in Montana.

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

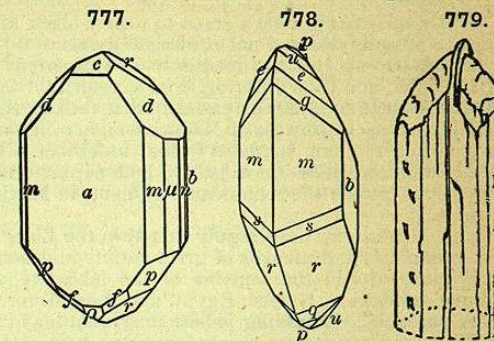


SPODUMENE. Triphane.

Monoclinic. Axes: $a : b : c = 1.1238 : 1 : 0.6355$; $\beta = 69^\circ 40'$.

Twins: tw. pl. *a*. Crystals prismatic ($mm''' = 93^\circ 0'$), often flattened $\parallel a$; the vertical planes striated and furrowed; crystals sometimes very large. Also massive, cleavable.

Cleavage: *m* perfect. A lamellar structure $\parallel a$ 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. $\parallel b$. $Bx_a \wedge c = +26^\circ$ Dx., $= 24^\circ$ to $25\frac{1}{2}^\circ$ Greim. Dispersion $\rho > v$, horizontal. $2H_{a,y} = 64^\circ 58\frac{1}{2}'$; $\beta_y = 1.669$; $\gamma - \alpha = 0.016$.



Norwich, Mass. Hiddenite. Hiddenite.

Hiddenite has a yellow-green to emerald-green color; the latter variety is used as a gem. In small ($\frac{1}{2}$ in. to 2 inches long) slender prismatic crystals, faces often etched.

Comp.— $LiAl(SiO_3)_2$ or $Li_2O \cdot Al_2O_3 \cdot 4SiO_2 =$ 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.

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.

Diff.—Characterized by its perfect orthodiagonal parting (in some varieties) as well as by prismatic cleavage; has a higher specific gravity and more pearly luster than feldspar or scapolite. Gives a red flame B.B. Less fusible than amblygonite.

Obs.—Occurs on the island of Utö, Sweden; at Killiney Bay, Ireland; in small transparent crystals of a pale yellow in Brazil, province of Minas Gerais.

In the U. S., in granite at Goshen, Mass.; also at Chesterfield, Chester, Huntington (formerly Norwich), and Sterling, Mass.; at Windham, Maine, with garnet and staurolite; at Peru, with beryl, triphylite, petalite. In *Conn.* at Branchville, the crystals often of immense size; near Stony Point, Alexander Co., N. C. (*hiddenite*); in South Dakota at the Etta tin mine in Pennington Co.

The name *spodumene* is from *σποδιός*, *ash-colored*. *Hiddenite* is named for W. E. Hidden of New York.

The *spodumene* at Goshen and Chesterfield is extensively altered; pseudomorphs occur of *cymatolite* (an intimate mixture of albite and muscovite with wavy fibrous structure and silky luster), *killinite* (pinite), *muscovite*, albite, quartz, and of "vein granite." Similar alteration-products occur at Branchville.

JADEITE.

Monoclinic. Axes, see p. 383. Cleavage and optical characters like pyroxene. Usually 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. $Bx_a \wedge c = 30^\circ$ to 40° ; $2H_{a,y} = 82^\circ 48'$. Streak uncolored. Translucent to subtranslucent.

Comp.—Essentially a metasilicate of sodium and aluminium corresponding to spodumene, $NaAl(SiO_3)_2$ or $Na_2O \cdot Al_2O_3 \cdot 4SiO_2 =$ Silica 59.4, alumina 25.2, soda 15.4 = 100.

Chloromelanite is a dark green to nearly black kind of jadeite (hence the name), containing iron sesquioxide and not conforming exactly to the above formula.

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

Obs.—Occurs chiefly in eastern Asia, thus in the Mogoung distr. in Upper Burma, in a valley 25 miles southwest of Meinkhoom, in rolled masses in a reddish clay; in Yungchang, province of Yunnan, southern China; in Tibet. 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.

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.

A pyroxene, resembling jadeite in structure and consisting of the molecules of jadeite, diopside, and acmite in nearly equal proportions, occurs at the manganese mines of St. Marcel, Italy (Penfield).

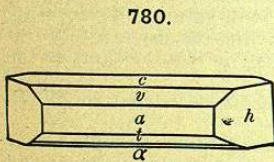
JADE is a general term used to include various mineral substances of tough compact texture and nearly white to dark green color used by early man for utensils and ornaments, and still highly valued in the East, especially in China. It includes properly two species only; *nephrite*, a variety of amphibole (p. 401), either tremolite or actinolite, with $G. = 2.95-3.0$, and *jadeite*, of the pyroxene group and in composition 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.

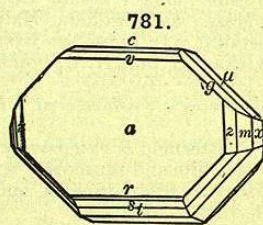
The name jade is also sometimes loosely used to embrace other minerals of more or less similar characters, and which have been or might be similarly used—thus sillimanite, pectolite, serpentine; also vesuvianite, garnet. Bowenite is a jade like variety of serpentine. The "jade tenace" of de Saussure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

WOLLASTONITE. Tabular Spar. Tafelspath *Germ.*

Monoclinic. Axes $a : b : c = 1.0531 : 1 : 0.9676$; $\beta = 84^\circ 30'$.



Diana, N. Y.



Santorin.

mm'' ,	$110 \wedge 1\bar{1}0 = 92^\circ 42'$.
hh''' ,	$540 \wedge 5\bar{4}0 = 79^\circ 58'$.
gg' ,	$011 \wedge 0\bar{1}\bar{1} = 87^\circ 51'$.
cv ,	$001 \wedge 101 = 40^\circ 3'$.
cr ,	$001 \wedge \bar{3}01 = 74^\circ 59'$.
ct ,	$001 \wedge \bar{1}01 = 45^\circ 5'$.

Twins: tw. pl. a . Crystals commonly tabular $\parallel a$ or c ; also short prismatic.

Usually cleavable massive to fibrous, fibers parallel or reticulated; also compact.

Cleavage: a perfect; also c ; $t(\bar{1}01)$ less so. Fracture uneven. Brittle. $H. = 4.5-5$. $G. = 2.8-2.9$. Luster vitreous, on cleavage surfaces pearly. Color white, inclining to gray, yellow, red, or brown. Streak white. Sub-transparent to translucent. Optically —. $Bx_a \wedge c = + 37^\circ 40'$. Dispersion

$\rho > v$ weak; inclined strong. Ax. pl. $\parallel b$. $2E_r = 70^\circ 40'$; $\beta = 1.633$; $\gamma - \alpha = 0.014$.

Comp.—Calcium metasilicate, $CaSiO_3$ or $CaO \cdot SiO_2 =$ Silica 51.7, lime 48.3, = 100.

Pyr., etc.—In the matrass no change. B.B. fuses easily on the edges; with some soda, a blebby glass; with more, swells up and is infusible. With hydrochloric acid decomposed with separation of silica; most varieties effervesce slightly from the presence of calcite. Often phosphoresces.

Obs.—Wollastonite is found especially in granular limestone, and in regions of granite, as a contact formation; also in ejected masses in connection with basalt and lavas. It is often associated with a lime garnet, diopside, etc.

Occurs in the copper mines of Cziklowa in the Banat; at Orawitza; at Dognaczka and Nagyág; at Pargas in Finland; at Harzburg in the Harz; at Auerbach, in granular limestone; at Vesuvius, rarely in fine crystals; on Elba; on Santorin.

In the U. S., in *N. York*, at Willsborough; Diana, Lewis Co.; Bonaparte Lake, Lewis Co. In *Penn.*, Bucks Co., 3 m. w. of Attleboro'. In *Canada*, at Grenville; at St. Jérôme and Morin, Quebec, with apatite.

Named after the English chemist, W. H. Wollaston (1766-1828).

PECTOLITE.

Monoclinic. Axes: $a : b : c = 1.1140 : 1 : 0.9864$; $\beta = 84^\circ 40'$.

Commonly in close aggregations of acicular crystals; elongated $\parallel b$, but rarely terminated. Fibrous massive, radiated to stellate.

Cleavage: a perfect; c also perfect. Fracture uneven. Brittle. $H. = 5$. $G. = 2.68-2.78$. Luster of the surface of fracture silky or subvitreous. Color whitish or grayish. Subtranslucent to opaque. Optically +. Ax. pl. and $Bx_a \perp b$; Bx_o nearly $\perp a$; $2H_o = 143^\circ-145^\circ$.

Comp., Var.— $HNaCa_2(SiO_3)_3$ or $H_2O \cdot Na_2O \cdot 4CaO \cdot 6SiO_2 =$ Silica 54.2, lime 33.8, soda 9.3, water 2.7 = 100.

Pectolite is sometimes classed with the hydrous species allied to the zeolites.

Pyr., etc.—In the closed tube yields water. B.B. fuses at 2 to a white enamel. Decomposed in part by hydrochloric acid with separation of silica as a jelly. Often gives out light when broken in the dark.

Obs.—Occurs mostly in basic eruptive rocks, in cavities or seams; occasionally in metamorphic rocks. Found in Scotland near Edinburgh; at Kilsyth, Corstorphine Hill (*walkerite*); I. Skye. Also at Mt. Baldo and Mt. Monzoni in the Tyrol; at Niederkirchen, Bavaria (*osmelite*).

Occurs also at Bergen Hill and Paterson, N. J.; Lehigh Co., Penn.; compact at Isle Royale, L. Superior; at Magnet Cove, Ark., in elæolite-syenite (*manganpectolite* with 4 p. c. MnO); compact, massive in Alaska, where used, like jade, for implements.

Rosenbuschite. Near pectolite, but contains zirconium. From Norway.

Wöhlerite. A zirconium-silicate and niobate of Ca, Na, etc. In prismatic, tabular crystals, yellow to brown. Occurs in elæolite-syenite, on several islands of the Langesund fiord, near Brevik, in Norway.

Låvenite. A complex zirconium-silicate of Mn, Ca, etc., containing also F, Ti, Ta, etc. In yellow to brown prismatic crystals. Found on the island Låven in the Langesund fiord, southern Norway; also elsewhere in elæolite-syenite.

γ . *Triclinic Section.*

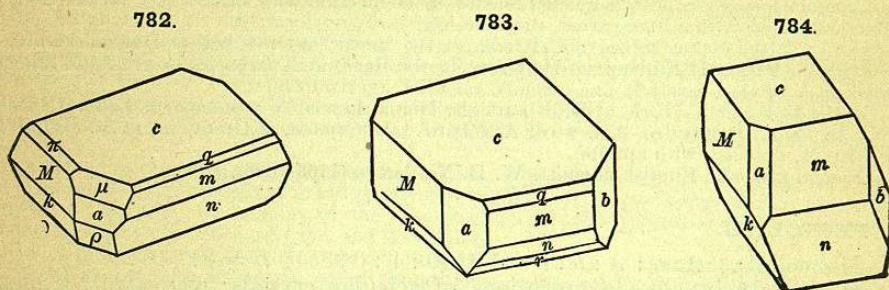
RHODONITE.

Triclinic. Axes $a : b : c = 1.07285 : 1 : 0.6213$; $\alpha = 103^\circ 18'$; $\beta = 108^\circ 44'$; $\gamma = 81^\circ 39'$.

Crystals usually large and rough with rounded edges. Commonly tabular $\parallel c$; sometimes resembling pyroxene in habit. Commonly massive, cleavable to compact; also in embedded grains.

Cleavage: *m*, *M* perfect; *c* less perfect. Fracture conchoidal to uneven; very tough when compact. *H.* = 5.5-6.5. *G.* = 3.4-3.68. Luster vitreous; on cleavage-surfaces somewhat pearly. Color light brownish red, flesh-red, rose-pink; sometimes greenish or yellowish, when impure; often black outside from exposure. Streak white. Transparent to translucent.

Comp., Var.—Manganese metasilicate, MnSiO_3 or $\text{MnO} \cdot \text{SiO}_2$ = Silica 45.9, manganese protoxide 54.1 = 100. Iron, calcium (in *bustamite*), and occasionally zinc (in *fowlerite*) replace part of the manganese.



Franklin Furnace, N. J.

$$\begin{aligned} ab, 100 \wedge 010 &= 94^\circ 26'. \\ ac, 100 \wedge 001 &= 72^\circ 36\frac{1}{2}'. \\ bc, 010 \wedge 001 &= 78^\circ 42\frac{1}{2}'. \\ am, 100 \wedge 110 &= 48^\circ 33'. \end{aligned}$$

$$\begin{aligned} mM, 110 \wedge 1\bar{1}0 &= 92^\circ 28\frac{1}{2}'. \\ cn, 001 \wedge \bar{2}21 &= 73^\circ 52'. \\ ck, 001 \wedge \bar{2}21 &= 62^\circ 28'. \\ kn, \bar{2}21 \wedge \bar{2}21 &= 86^\circ 5'. \end{aligned}$$

Pyr., etc.—B.B. blackens and fuses with slight intumescence at 2.5; with the fluxes gives reactions for manganese; fowlerite gives with soda on charcoal a reaction for zinc. Slightly acted upon by acids. The calciferous varieties often effervesce from mechanical admixture of calcium carbonate. In powder, partly dissolves in hydrochloric acid, and the insoluble part becomes of a white color. Darkens on exposure to the air, and sometimes becomes nearly black.

Diff.—Characterized by its pink color; distinct cleavages; fusibility and manganese reactions B.B.

Obs.—Occurs at Långban, Wermland, Sweden, in iron-ore beds, in broad cleavage-plates, and also granular massive; at the Pajsberg iron mines near Filipstad (*pajsbergite*) sometimes in small brilliant crystals; in the district of Ekaterinburg in the Ural massive like marble, whence it is obtained for ornamental purposes; with tetrahedrite at Kapnik and Rezbánya, Hungary; St. Marcel, Piedmont; Mexico (*bustamite*, containing CaO).

Occurs in Cummington, Mass.; on Osgood's farm, Blue Hill Bay, Maine; *fowlerite* (containing ZnO) at Mine Hill, Franklin Furnace, and Sterling Hill, near Ogdensburgh, N. J., usually embedded in calcite and sometimes in fine crystals.

Named from *rhodon*, a rose, in allusion to the color.

Rhodonite is often altered chiefly by oxidation of the MnO (as in *marceine*, *dysnite*); also by hydration (*stratopseite*, *neotocite*, etc.); further by introduction of CO_2 (*allagite*, *photocite*, etc.).

Babingtonite. $(\text{Ca}, \text{Fe}, \text{Mn})\text{SiO}_3$ with $\text{Fe}_2(\text{SiO}_3)_3$. In small black triclinic crystals, near rhodonite in angle (axes on p. 383). *H.* = 5.5-6. *G.* = 3.35-3.37. From Arendal, Norway; at Herbornseelbach, Nassau; at Baveno, Italy.

Hiortdahlite. Essentially $(\text{Na}, \text{Ca})(\text{Si}, \text{Zr})\text{O}_3$, with also fluorine. In pale yellow tabular crystals (triclinic). Occurs sparingly on an island in the Langesund fiord, southern Norway.

3. Amphibole Group.

Orthorhombic, Monoclinic, Triclinic.

Composition for the most part that of a metasilicate, RSiO_3 , with R = Ca, Mg, Fe chiefly, also Mn, Na, (K), H. Further often containing aluminium and ferric iron, in part with alkalis as $\text{NaAl}(\text{SiO}_3)_2$ or $\text{NaFe}(\text{SiO}_3)_2$; perhaps also containing RR_2SiO_6 .

α. Orthorhombic Section.

Anthophyllite $(\text{Mg}, \text{Fe})\text{SiO}_3$ $\alpha : \bar{b}$
GEDRITE $(\text{Mg}, \text{Fe})\text{SiO}_3$ with $(\text{Mg}, \text{Fe})\text{Al}_2\text{SiO}_6$ 0.5138 : 1

β. Monoclinic Section.

Amphibole $\alpha : \bar{b} : c$ β
0.5511 : 1 : 0.2938 73° 58'

I. NONALUMINOUS VARIETIES.

1. TREMOLITE $\text{CaMg}_3(\text{SiO}_3)_6$
2. ACTINOLITE $\text{Ca}(\text{Mg}, \text{Fe})_3(\text{SiO}_3)_6$
Nephrite, Asbestos, Smaragdite, etc.
Cummingtonite $(\text{Fe}, \text{Mg})\text{SiO}_3$
Dannemorite $(\text{Fe}, \text{Mn}, \text{Mg})\text{SiO}_3$
Grünerite FeSiO_3
3. RICHTERITE $(\text{K}, \text{Na}, \text{Mg}, \text{Ca}, \text{Mn})_4(\text{SiO}_3)_8$

II. ALUMINOUS VARIETIES.

4. HORNBLLENDE
Edenite } Chiefly $\text{Ca}(\text{Mg}, \text{Fe})_3(\text{SiO}_3)_6$ with
Pargasite and } $\text{Na}_2\text{Al}_2(\text{SiO}_3)_4$ and $(\text{Mg}, \text{Fe})_2(\text{Al}, \text{Fe})_2\text{Si}_2\text{O}_{12}$
Common Hornblende }

Glaucothane $\text{NaAl}(\text{SiO}_3)_2 \cdot (\text{Fe}, \text{Mg})\text{SiO}_3$ $\alpha : \bar{b} : c$ β
Riebeckite $2\text{NaFe}(\text{SiO}_3)_2 \cdot \text{FeSiO}_3$ 0.5475 : 1 : 0.2925 = 76° 10'
Crocidolite $\text{NaFe}(\text{SiO}_3)_2 \cdot \text{FeSiO}_3$
Arfvedsonite $\text{Na}_2(\text{Ca}, \text{Mg})_2(\text{Fe}, \text{Mn})_4(\text{Al}, \text{Fe})_2\text{Si}_{21}\text{O}_{48}$
0.5509 : 1 : 0.2378 = 73° 2'

γ. Triclinic Section.

Ænigmatite.

The only species included under the triclinic section is the rare and imperfectly known ænigmatite (cossyrite).

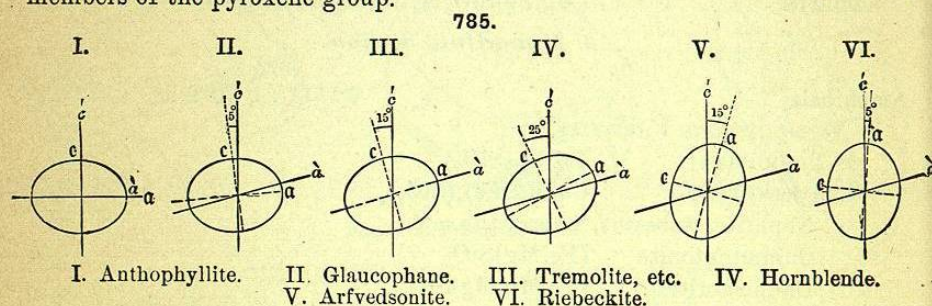
The AMPHIBOLE GROUP embraces a number of species which, while falling in different systems, are yet closely related in form—as shown in the common prismatic cleavage of 54° to 56°—also in optical characters and chemical composition. As already noted (see p. 383), the species of this group form chemically a series parallel to that of the closely allied Pyroxene Group, and between them there is a close relationship in crystalline form and other characters. The Amphibole Group, however, is less fully developed, including fewer species, and those known show less variety in form.

The chief *distinctions* between pyroxene and amphibole proper are the following: Prismatic angle with pyroxene 87° and 93° ; with amphibole 56° and 124° ; the prismatic cleavage being much more distinct in the latter.

With pyroxene, crystals usually short prismatic and often complex, structure of massive kinds mostly lamellar or granular; with amphibole, crystals chiefly long prismatic and simple, columnar and fibrous massive kinds the rule.

The specific gravity of most of the pyroxene varieties is higher than of the like varieties of amphibole. In composition of corresponding kinds, magnesium is present in larger amount in amphibole (Ca : Mg = 1 : 1 in diopside, = 1 : 3 in tremolite); alkalis more frequently play a prominent part in amphibole.

The optical relations of the prominent members of the group, as regards the position of the ether-axes, is exhibited by the following figures (Cross); compare Fig. 751, p. 384, for a similar representation for the corresponding members of the pyroxene group.



α . Orthorhombic Section.

ANTHOPHYLLITE.

Orthorhombic. Axial ratio $a : b = 0.5137 : 1$. Crystals rare, habit prismatic ($mm''' = 54^\circ 23'$). Commonly lamellar, or fibrous massive; fibers often very slender; in aggregations of prisms.

Cleavage: prismatic, perfect; b less so; a sometimes distinct. $H. = 5.5-6$. $G. = 3.1-3.2$. Luster vitreous, somewhat pearly on the cleavage-face. Color brownish gray, yellowish brown, clove-brown, brownish green, emerald-green, sometimes metalloid. Streak uncolored or grayish. Transparent to sub-translucent. Sometimes pleochroic. Usually optically +; also + for red, - for yellow, green. Ax. pl. always $\parallel b$. Bx_a usually $\perp c$; also $\perp c$ for red, $\perp a$ for yellow, green. Axial angle large. $\beta = 1.642$; $\gamma - \alpha = 0.024$.

Comp., Var.—(Mg,Fe)SiO₃, corresponding to enstatite-bronzite-hypersthene in the pyroxene group. Aluminium is sometimes present in considerable amount. There is the same relation in optical character between anthophyllite (+) and gedrite (-) as between enstatite and hypersthene (cf. Figs. 753, 754, p. 385).

Var.—ANTHOPHYLLITE, Mg : Fe = 4 : 1, 3 : 1, etc. For 3 : 1, the percentage composition is: Silica 55.6, iron protoxide 16.6, magnesia 27.8 = 100. Anthophyllite sometimes occurs in forms resembling asbestos.

Aluminous, GEDRITE. Iron is present in larger amount, and also aluminium; it hence corresponds nearly to a hypersthene, some varieties of which are highly aluminous.

Hydrous anthophyllites have been repeatedly described, but in most cases they have been shown to be hydrated monoclinic amphiboles.

Pyr., etc.—B.B. fuses with difficulty to a black magnetic enamel; with the fluxes gives reactions for iron; unacted upon by acids.

Obs.—Anthophyllite occurs in mica schist near Kongsberg in Norway; at Hermannschlag, Moravia. In the U. S., at the Jenks corundum mine, Franklin, Macon Co., N. C.

The original *gedrite* is from the valley of Héas, near Gèdres, France. Named from *anthophyllum*, clove, in allusion to the clove-brown color.

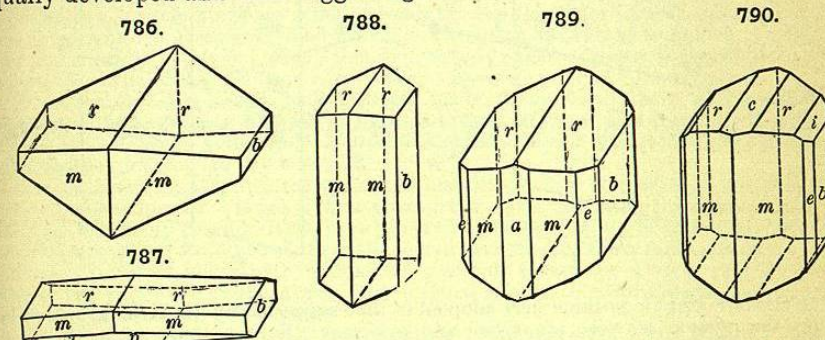
β . Monoclinic Section.

AMPHIBOLE. Hornblende.

Monoclinic. Axes $a : b : c = 0.5511 : 1 : 0.2938$; $\beta = 73^\circ 58'$.

mm'' , $110 \wedge \bar{1}\bar{1}0 = 55^\circ 49'$.	rr' , $011 \wedge 0\bar{1}1 = 31^\circ 32'$.
ca , $001 \wedge 100 = 73^\circ 58'$.	ii , $031 \wedge 0\bar{3}1 = 80^\circ 32'$.
cp , $001 \wedge \bar{1}01 = 31^\circ 0'$.	pr , $\bar{1}01 \wedge 011 = 34^\circ 25'$.

Twins: (1) tw. pl. a , common as contact-twins; rarely polysynthetic. (2) c , as tw. lamellæ, occasionally producing a parting analogous to that more common with pyroxene (Fig. 430, p. 131). Crystals commonly prismatic; usually terminated by the low clinodome, r (011), sometimes by r and p ($\bar{1}01$) equally developed and then suggesting rhombohedral forms (as of tourmaline).



Also columnar or fibrous, coarse or fine, fibers often like flax; rarely lamellar; also granular massive, coarse or fine, and usually strongly coherent, but sometimes friable.

Cleavage: m highly perfect; a , b sometimes distinct. Fracture subconchoidal, uneven. Brittle. $H. = 5-6$. $G. = 2.9-3.4$, varying with the composition. Luster vitreous to pearly on cleavage-faces; fibrous varieties often silky. Color between black and white, through various shades of green, inclining to blackish green; also dark brown; rarely yellow, pink, rose-red. Streak uncolored, or paler than color. Sometimes nearly transparent; usually sub-translucent to opaque.

Pleochroism strongly marked in all the deeply colored varieties, as described beyond. Absorption usually $c > b > a$. Optically -, rarely +. Ax. pl. $\parallel b$. Extinction-angle on b , or $c \wedge c = +15^\circ$ to 18° in most cases, but varying from about 1° up to 37° ; hence also $Bx_a \wedge c = -75^\circ$ to -72° , etc. See Fig. 791. Dispersion $\rho < v$. Axial angles variable; see beyond.

Comp., Var.—In part a normal metasilicate of calcium and magnesium, $RSiO_3$, usually with iron, also manganese, and thus in general analogous to the pyroxenes. The alkali metals, sodium and potassium, also present, and more commonly so than with pyroxene. In part also aluminous, corresponding to the aluminous pyroxenes. Titanium sometimes is present and also rarely fluorine in small amount.

The aluminium is in part present as $NaAl(SiO_3)_2$, but many amphiboles containing aluminium or ferric iron are more basic than a normal metasilicate; they may sometimes be explained as containing $R(Al,Fe)_2SiO_6$, but the exact nature of the compound is often