Phosphoresces with heat or friction; gelatinizes in h. acid. B.B. difficultly fusible to a semitransparent glass. C.c.: 51·7 silica and 48·3 lime, but with 0 to 2 magnesia and 0 to 2 iron protoxide. Glen Gairn, Crathie, &c., in Aberdeenshire, Urquhart in Inverness, Skye, Banat, Finland, Sweden, Vesuvius (fig. 501), North America, Ceylon, Capo di Bove.

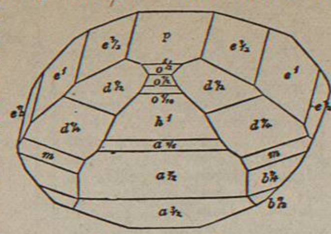


Fig. 501 (sp. 566).

567. **Augite** (*Pyroxene*), $\dot{\mathrm{R}}\ddot{\mathrm{Si}}=(\dot{\mathrm{Ca}}, \dot{\mathrm{Mg}}, \dot{\mathrm{Fe}})\ddot{\mathrm{Si}}$.

Oblique prismatic, C 74°11′. ∞P 87° 6′; P (*s* : *s*) 120° 48′; − P (*u*) 131° 30′; 2P (*o*) 95° 48′; 0P; 3P; ∞P°∞. In fig. 130 ∞P (*M*), ∞P°∞ (*r*), ∞Pᶜ∞ (*l*), P(*s*); also various twins and hemitropes of same form (figs. 191, 502, 503). Almost always prismatic, imbedded, or attached; also granular, columnar, and scaly. Cl. prismatic along ∞P (with angles of 87° 6′ and 92° 54′), generally rather imperfect; orthodiagonal and clinodiagonal imperfect. H. = 5 to 6; G. = 3 to 3·5. Pellucid in all degrees; vitreous; in some pearly on ∞P°∞. Colourless, and white, but usually grey, green, or black. B.B. generally fusible; imperfectly soluble in acids. C.c. generally as follows:—

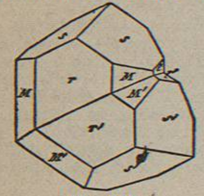


Fig. 502.

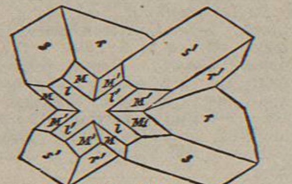


Fig. 503.

	Silica.	Lime.	Magnesia.	Iron.
(*a*) Magnesia augite	56·22	25·54	18·24	...
(*b*) Magnesia-iron augite	52·72	23·81	8·50	14·97
(*c*) Iron augite	49·06	22·29	...	28·65

Analysis gives 47 to 56 silica, 20 to 25 lime, 5 to 15 magnesia, 1 to 20 iron protoxide, with 0 to 3 manganese protoxide and 0 to 8 alumina. The alumina, chiefly found in very dark green or black augites, may in some replace either silica or part of the silicate.

The more important varieties are—

Diopside.—Greyish or greenish white, to pearl-grey or leek-green; streak white. Crystallized or broad columnar, or concentric lamellar. Transparent to translucent on the edges. Not affected by acids. B.B. fuses to a whitish semitransparent glass. C.c.: generally lime 26 and magnesia 18·5, with 55·5 silica. Mussa Alp (*Mussite*) and Ala (*Alalite*) in Piedmont, Schwarzenstein in Tyrol, Scandinavia, Finland, Urals, and North America.

Malacolite, Sahlite.—White, green, rarely yellow, brown, or red; streak white. Translucent, or only on the edges; vitreous, inclining to pearly. Seldom crystallized, mostly columnar or lamellar. B.B. melts to a dark-coloured glass. Malacolite common in primary limestones in Scotland, as at Shinness, Ledbeg (fig. 505), and Glen Tilt. Fassa Valley (*Fassaite*), Piedmont, Arendal, Philipstadt in Sweden; Lake Baikal (*Baikalite*); near Lake Lherz in the Pyrenees (*Lherzolite*); Sala (or Sahla) in Sweden (*Sahlite*); Shinness (figs. 504, 506), Glenelg, Tiree, in Scotland; Tyrol; North America. *Coccolite* is a granular sahlite or augite.

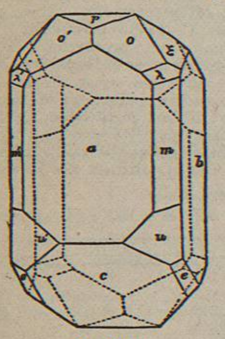


Fig. 504.

Fig. 505.

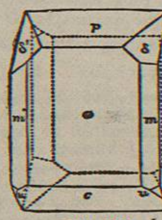


Fig. 506.

Augite.—Leek-green, greenish black, or velvet-black, rarely brown; streak greenish grey. Vitreous to resinous; translucent or opaque. Only slightly affected by acids. B.B. fuses to a black, often magnetic glass. An essential component of many rocks, as basalt, dolerite, clinkstone, and augite porphyry; Germany, Auvergne, Vesuvius; St Kilda, Rum, Tiree, Dalnain, and Urquhart in Scotland. Augite crystals in basalt often contain very many microscopic crystals and glasses; also pores with fluid carbonic acid.

Hudsonite.—Cleavable lamellar, and jet-black, with green streak and bronzy tarnish, from the Hudson river; the most highly ferruginous variety.

Amianthus.—Some asbestiform minerals are augite, but the greater number hornblende.

Breislackite.—Fine yellowish or brown woolly crystals. Vesuvius, and Capo di Bove near Rome.

568. **Diallage**, $(\dot{\mathrm{Ca}}, \dot{\mathrm{Mg}}, \dot{\mathrm{Fe}})\ddot{\mathrm{Si}}$.

Like augite, and only a variety with very perfect cleavage in the clinodiagonal, which forms with a second cleavage an angle of 87°. Lustre metallic pearly; colour grey or pinchbeck-brown. H. = 4; G. = 3·23. B.B. melts easily to a greyish or greenish enamel. C.c.: 50 to 53 silica, 1 to 5 alumina, 15 to 23 magnesia, 11 to 20 lime, and 5 to 20 manganese protoxide. Constituent of the augite rock of the Cuchullins in Skye and of the gabbro of Unst and Ayrshire. Baste in the Harz, Silesia, the Alps, Apennines, and Urals. *Vanadine-Bronzite*, containing soda and vanadic acid, is similar. At Craig Buroch (Banffshire) diallage passes in paulite.

569. **Jeffersonite.**

Oblique prismatic. Cl. prismatic ∞P 87° 30′, and orthodiagonal. H. = 4·5; G. = 3·3 to 3·5. Dark olive-green, brown to black. Lustre greasy. A manganese and zinc augite, with 10·2 protoxide of manganese, and 10·15 oxide of zinc. Sparta in New Jersey.

570. **Acmite**, $2\ddot{\bar{\mathrm{Fe}}}\ddot{\mathrm{Si}}_3+3\dot{\mathrm{R}}\ddot{\mathrm{Si}}$.

Oblique prismatic. Crystals long often acute-pointed prisms. ∞P 87° 15′, ∞P̄∞ (*r*), P(*s*), 6P (*o*), − 6Pᶜ3(*z*) (figs. 507, 508). Cl. like augite. H. = 6 to 6·5; G. = 3·4 to 3·6. Nearly opaque; vitreous. Brownish or greenish black; streak greenish grey. Imperfectly soluble in acids, B.B. fuses easily to a black magnetic glass. C.c.: 52 silica, 30 iron peroxide, 5 iron protoxide, and 13 soda, but with 1 to 3 manganese peroxide, and also 3 to 4 titanic acid. Eger and Porsgrund in Norway.

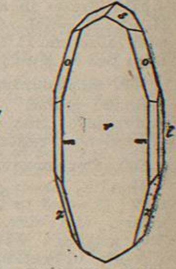


Fig. 507. (Sp. 570.) Fig. 508.

571. **Ægerine**, $\dot{\mathrm{R}}_2\ddot{\mathrm{Si}}_5+\ddot{\bar{\mathrm{R}}}\ddot{\mathrm{Si}}+2\dot{\bar{\mathrm{Na}}}\ddot{\mathrm{Si}}$.

Oblique prismatic; striated or reed-like prisms of 86° 30′ to 87° 45′. Cl. orthodiagonal perfect, less distinct clinodiagonal, and prismatic. H. = 5·5 to 6; G. = 3·4 to 3·5 or 3·6. Vitreous; translucent on edges, or opaque. Greenish black. B.B. fuses easily, colouring the flame yellow. Scarcely affected by acids. C.c.: 49 silica, 31·7 iron peroxide, 6·6 iron (and manganese) protoxide, and 12·7 soda, with a little magnesia and potash. Has the same relation to augite as arfvedsonite to hornblende. Near Brevig and Barkevig in Norway.

572. **Spodumene**, $4\ddot{\bar{\mathrm{Al}}}\ddot{\mathrm{Si}}_3+3(\dot{\bar{\mathrm{Li}}}, \dot{\bar{\mathrm{Na}}}, \dot{\bar{\mathrm{K}}})\ddot{\mathrm{Si}}$.

Oblique prismatic, C 69° 40′. ∞P 87° (fig. 509). Cl. prismatic ∞P and orthodiagonal, perfect; chiefly massive or foliated. H. = 6·5 to 7; G. = 3·1 to 3·2. Translucent; vitreous or pearly. Pale greenish grey or white to apple-green; streak white. B.B. intumesces slightly, tinging the flame momentarily purplish red, and fuses easily to a colourless glass. Not affected by acids. C.c.: 65 silica, 28·7 alumina, and 6·3 lithia. Killiney near Dublin, Utö in Sweden, Tyrol. *Killinite* (sp. 651), from Killiney, seems to be decomposed spodumene.

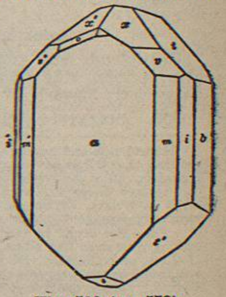


Fig. 509 (sp. 572).

573. **Petalite** (*Castor*), $4\ddot{\bar{\mathrm{Al}}}\ddot{\mathrm{Si}}_6+3(\dot{\bar{\mathrm{Li}}}, \dot{\bar{\mathrm{Na}}})\ddot{\mathrm{Si}}_2$.

Oblique prismatic. Castor has C 67° 34′ and ∞P 86° 20′, in irregular rectangular prisms, petalite being massive and coarse granular. Cl. basal, distinct; in a second direction (meeting at 141½°) less so. H. = 6·5; G. = 2·4 to 2·5. Greenish, greyish, or reddish white to pale red. Translucent; vitreous or pearly. B.B. melts easily into a porous obscure glass, colouring the flame red. Not affected by acids. C.c.: 78·3 silica, 17·4 alumina, 3·2 lithia, and 1·1 soda. Utö, Bolton in Massachusetts, York in Canada. *Castor* in Elba. *Milarite*, valley of Milar, Switzerland.

574. **Rhodonite** (*Manganese-Spar*), $\dot{\mathrm{Mn}}\ddot{\mathrm{Si}}$.

Anorthic. ∞P̆∞ (*a*); ∞P̄∞ (*b*); 0P (*c*); ∞P′ (*u*); P̆′∞ (*k*); P̄∞ (*s*); ′P̄′∞ (*o*); *m*′P̄′∞ (*t*): *a* : *b* 111° 9′; *c* : *a* 93° 28′; *n* : *a* 106° 19′; but chiefly massive or granular. Cl. ∞P∞ and 0P, meeting at 87° 38′, perfect; brittle. H. = 5 to 5·5; G. = 3·5 to 3·7. Translucent; vitreous or partly pearly. Dark rose-red, bluish red, or reddish brown. Not affected by acids. B.B. fusible. C.c.: 45·8 silica and 54·2 manganese protoxide, with 3 to 5 lime and 0 to 6 iron protoxide. St Marcel, Långban, Ekaterinburg, the Harz, and New Jersey. *Bustamite*, pale greenish or reddish grey, with 14 lime, Mexico; *Fowlerite*, New Jersey, with 7 to 11 iron protoxide; and *Paisbergite*, Sweden, are varieties. *Hydropite*. *Photicite*, *Allagite*, and *Horn-Manganese* are mere mixtures.

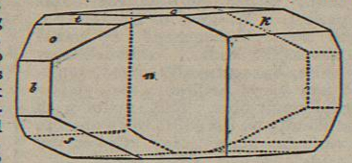


Fig. 510.

575. **Babingtonite**, $9(\dot{\mathrm{Ca}}, \dot{\mathrm{Fe}}, \dot{\mathrm{Mn}})\ddot{\mathrm{Si}}+\ddot{\bar{\mathrm{Fe}}}\ddot{\mathrm{Si}}_3$.

Anorthic. Crystals very low eight-sided prisms, small, attached. *g* : *h* 90° 24′; *c* : *a* 87° 27′; *a* : *b* 112° 12′; *b* : *d* 81° 8′; *c* : *d* 150° 10′ (fig. 511). Cl. basal (*c*), very perfect; also along *b*. H. = 5·5 to 6; G. = 3·3 to 3·4. Thin laminæ translucent. Splendent vitreous; black. Not affected by acids. B.B. fuses easily with effervescence to a black magnetic bead. C.c.: 50·7 silica, 11 iron peroxide, 10·3 iron protoxide, 7·7 manganese protoxide, and 20·3 lime, in the Arendal specimens; one from Nassau gave about 17 of peroxide, with protoxides only 11. Tongue (Sutherland), Portsoy (Banffshire), Arendal, Nassau, and Gouverneur (New York)

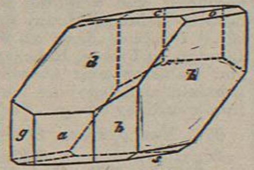


Fig. 511

576. **Szaboite**, $11\ddot{\bar{\mathrm{Fe}}}\ddot{\mathrm{Si}}_3+2\dot{\mathrm{Ca}}\ddot{\mathrm{Si}}$

Anorthic. ∞P′ (*l*); ∞′P (*m*) 88° 40′; ∞P∞ (*b*); ∞P∞ (*a*); P′ (*p*); ′P (*o*); 2′P̆,∞ (*y*); 2P̆′∞ (*x*) (fig. 512). H. = 6·5; G. = 3·5. Brownish red to reddish yellow. Pleochroic. C.c.: silica 52·4, peroxide of iron 44·7, lime 3·1. Slightly sol. in s. acid, more so in h. acid. Calvario on Etna, Mont Dore.

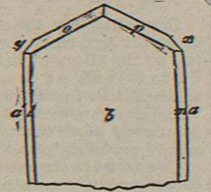


Fig. 512 (sp. 576).

577. **Anthophyllite**, $3\dot{\mathrm{Mg}}\ddot{\mathrm{Si}}+\dot{\mathrm{Fe}}\ddot{\mathrm{Si}}$.

Right prismatic. ∞P 124° 30′. Cl. macrodiagonal, perfect. Clove-brown to purplish brown and leek-green. Translucent; radiating and foliated. Pearly on cl. plane. H. = 5·5; G. = 3·2. C.c.: silica 55·9, protoxide of iron 16·7, magnesia 27·8. B.B. very difficultly fusible. Hillswick, Shetland; Kongsberg and Modum, Norway; Greenland, and the United States.

578. **Hornblende.**

Oblique prismatic (figs. 513 to 517; see also fig. 192). Distinct cleavage in several directions. H. = 4 to 6, but generally 5 (will scratch with knife); G. = 2·5 to 4·0, but mostly high. Mostly coloured. Lustre vitreous, in some silky or metallic pearly. Sol., but not very readily, in acids; more or less easily fusible. C.c.: anhydrous silicates and aluminates of lime, magnesia, iron protoxide; more sparingly of soda, yttria, and manganese protoxide. The chief species form by their decomposition highly fertile soils.

Amphibole.—Oblique prismatic, C 75° 10′. ∞P 124° 30′, P 148° 30′. The crystals short and thick, or long and thin prismatic; formed especially by ∞P (*m*), ∞Pᶜ∞ (*x*), and bounded on the ends chiefly by 0P (*p*) and P (*r*). Twins common, with the chief axis the twin axis. Very often radiated, fibrous, or columnar, or granular. Cl. prismatic along ∞P 124½°, very perfect; orthodiagonal and clinodiagonal very imperfect. H. = 5 to 6; G. = 2·9 to 3·4. Pellucid in all degrees; vitreous, but sometimes pearly or silky. Colourless or white, but usually some shade of grey, yellow, green, brown, or black. B.B. fuses, generally intumescing and boiling, to a grey, green, or black glass. Those containing most iron are most fusible, and are also partially sol. in h. acid, which scarcely affects the others. C.c. very variable; the silica is partly replaced by alumina, specially in the green or black varieties; RO is chiefly MgO, CaO, and FeO. Lime is the most constant element, in most from 10 to 12; magnesia and iron protoxide replace each other, the one increasing as the other diminishes.

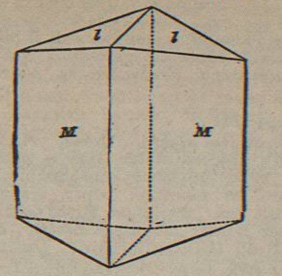


Fig. 513.

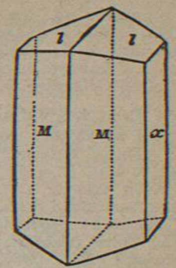


Fig. 514.

With $4\ddot{\mathrm{Si}}$ and $\dot{\mathrm{R}}=2\dot{\mathrm{Mg}}+1\dot{\mathrm{Ca}}+1\dot{\mathrm{Fe}}$, the average composition is 53·6 silica, 17·8 magnesia, 12·5 lime, and 16·1 iron protoxide; but analyses give 40 to 60 silica, 0 to 17 alumina, 0 to 30 magnesia, 10 to 15 lime, 0 to 36 iron protoxide (or peroxide), and 0 to 4 manganese protoxide, 0 to 8 soda, 0 to 3 potash, and 0 to 1·5 fluorine with a little water.

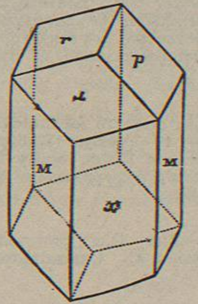


Fig. 515.

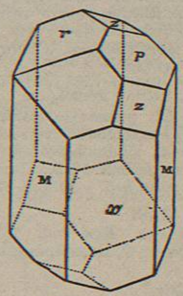


Fig. 516.

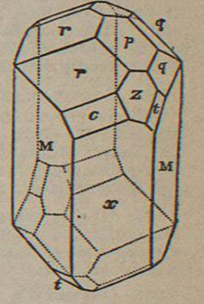


Fig. 517.

The more important varieties are—

Amianthus, *Asbestos*, and *Byssolite*, $2\dot{\mathrm{Mg}}\ddot{\mathrm{Si}}+\mathrm{CaSi}$. Fine fibrous. White, grey, or green. The fibres often easily separable, elastic, and flexible. Unst, Shinness, Portsoy, Savoy, Tyrol, Corsica.

Tremolite, *Grammatite*, $3\dot{\mathrm{Mg}}\ddot{\mathrm{Si}}+\dot{\mathrm{Ca}}\ddot{\mathrm{Si}}$, with 58·35 silica, 28·39 magnesia, and 13·26 lime. White, grey, green; in long prismatic crystals, often striated longitudinally. Pearly or silky; semi-transparent or translucent. B.B. fuses readily to a white or nearly colourless glass. Loch Shin (Sutherland), Glen Tilt, Glenelg, Tiree, Cornwall, Cumberland, Sweden, the Alps, Pyrenees, Silesia, Siberia, North America.

Nephrite, or *Jade*, is a tough, compact, fine-grained tremolite, with H. = 6 to 6·5; G. = 2·9 to 3·1. Fracture close splintery. Very tenacious. Translucent; dull to resinous. Leek-green to blackish green. Feels slightly greasy. Formerly made into ring-stones, amulets, idols, and war axes. New Zealand, China, Mexico, Peru, Balta (Shetland).

Actinolite, *Actinote*, or *Strahlstein* $(\mathrm{Ca}, \dot{\mathrm{Mg}}, \mathrm{Fe})\,\mathrm{Si}$. Colour green, inclining to black, grey, or brown. Translucent throughout, or only on the edges. Long prismatic crystals, or radiated-columnar masses. B.B. melts to a greenish or blackish enamel. Fethaland and Colafirth and Hillswick (Shetland), Oronsay. Ord Ban (Inverness), Sweden, Tyrol, North America.

Hornblende.—$6\dot{\mathrm{R}}\ddot{\mathrm{Si}}+\ddot{\bar{\mathrm{R}}}_2\ddot{\mathrm{Si}}_3$. Green or black, seldomer brown or grey. G. = 3·1 to 3·3. B.B. fuses rather easily to a yellow, greenish, or black enamel. Three varieties are distinguished. (*a*) The noble or *Pargasite*, pale celadon- or olive-green, and strong pearly or vitreous lustre; at Pargas in Finland, Tyrie in Scotland. (*b*) Common hornblende, dark leek- or blackish-green, opaque; streak greenish grey. A constituent of many rocks, as in Norway, the Alps, and Scottish Highlands (Ballater, Ben Arihaar, Glenbucket, Colafirth). (*c*) Basaltic, foliated, with bright even cleavage, opaque, velvet-black; streak grey or brown. Generally contains alumina (9 to 15) and much (5 to 11) iron peroxide. In basalt and volcanic rocks: Etna, Vesuvius, Rhineland, Bohemia.

579. ARFVEDSONITE, $\dot{R}\ddot{Si}+\ddot{Fe}\ddot{Si}_3$.

Oblique prismatic. ∞P; $\infty P^{c}\infty$; P; $2P^{c}\infty$ 120° 24′; 0P. Cl. ∞P 124° 22′, perfect; also 0P. Massive. Black; opaque. Vitreous. H. = 6; G. = 3·44. C.c.: silica 43, alumina 4·5, peroxide of iron 3·8, protoxide 34, lime 5·7, soda 8·5. Streak dark blue-grey. Fusible in fine splinters in the flame of a candle. B.B. intumesces and melts easily to a black magnetic globule. Not sol. in acids. Kangerdluarsuk in Greenland, Frederiksvärn, Arendal, El Paso in Colorado.

580. PILOLITE, $4\dot{Mg}\ddot{Si}_2+\dddot{Al}\ddot{Si}_2+15\dot{H}$.

Felted or matted fibres more or less dense. Cream yellow to buff. Dull; extremely tough; absorbs water like a sponge. H. = 1 to 2·5; G. = ·68 to 1·34. Structure varies considerably, and has given rise to trivial names, as mountain paper, mountain leather, mountain flesh, rock cork, &c. *Mountain Paper* occurs in thin sheets at Boyne Castle near Banff; *Mountain Leather*, Burn of the Cairn (Cabrach), Tod Head (Kincardineshire), Leadhills, Strontian; *Rock Cork*, Portsoy and Boyne Castle, Saxony, and Sweden. C.c.: silica 51·6, alumina 8·6, ferrous oxide 2·88, magnesia 10·2, water 23·3.

581. KROKIDOLITE, $3\dot{Fe}\ddot{Si}+(\dot{Na},Mg)\ddot{Si}_2+2\dot{H}$.

Delicate, easily separable, but tough fibres; elastic. H. = 4; G. = 3·2 to 3·3. Translucent; silky. Indigo-blue; streak lavender. B.B. fuses easily to a black magnetic glass. C.c.: silica 50·3, iron protoxide 35, magnesia 2·2, soda 6·7, water 5·8. Stavern in Norway, Greenland. A fibrous yellow mineral from Orange river, South Africa, has been referred here; its fibres are not separable, and its hardness is 7. *Abriachanite*, a very similar mineral, of blue colour, occurs near Inverness.

582. GLAUCOPHANE, $9\dot{R}\ddot{Si}+2\dddot{Al}\ddot{Si}_3$.

Oblique prismatic. Cl. prismatic, perfect; fracture conchoidal. H. = 5·5; G. = 3·1. Translucent; vitreous to pearly. Indigo-blue, grey, bluish black. B.B. becomes brown, fusing easily to olive-green glass. C.c.: silica 56·5, alumina 12·2, protoxide of iron 10·9, magnesia 8, soda 9·3. Island of Syra.

583. HERMANNITE, $\dot{Mn}\ddot{Si}$.

Granular and arborescent. Rose-red. G. = 3·4. C.c.: protoxide of manganese 46·7, silica 48·9, lime 2, magnesia 2·4. Cummington in Massachusetts.

584. GRUNERITE, $\dot{Fe}\ddot{Si}$.

Asbestiform. G. = 3·7. Brown; silky lustre. C.c.: protoxide of iron 51·55, silica 45·45. Mt. des Maures (Var).

585. IOLITE (*Cordierite, Dichroite*), $\dddot{A}_2\ddot{Si}_3+2(\dot{Mg},\dot{Fe})\ddot{Si}$.

Right prismatic. ∞P (*P*) 119° 10′, middle edge of P 95° 36′. Form ∞P (*T*), $\infty\breve{P}\infty$ (*l*), 0P (*m*); and this with $\infty\bar{P}\infty$ (*k*), $\infty\breve{P}3$ (*d*), $\breve{P}\infty$ (*n*), and $\frac{1}{2}P$ (*s*), (fig. 518); short, prismatic. Cl. $\infty\bar{P}\infty$ distinct, traces along $\bar{P}\infty$; fracture conchoidal or uneven. H. = 7 to 7·5; G. = 2·5 to 2·7. Transparent or translucent; vitreous, inclining to resinous. Colourless, but chiefly dark blue, or violet, green, brown, yellow, and grey. Often with distinct trichroism; on 0P blue, on $\infty\bar{P}\infty$ grey, and on $\infty\breve{P}\infty$ yellowish. B.B. fuses difficultly to a clear glass; slightly affected by acids. C.c.: 48 to 51 silica, 29 to 33 alumina, 8 to 13 magnesia, 1 to 12 iron protoxide. Cabo de Gata in Spain, Bodenmais (*Peliom*), Orijerfvi in Finland (*Steinheilite*), Norway, Sweden, Greenland, North America, and Siberia. Small rolled masses of an intense blue colour and transparent, found in Ceylon, are the *Sapphire d'Eau* or *Luchssapphir* of the jewellers.

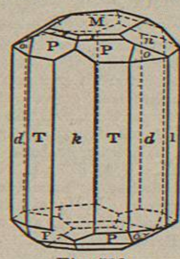


Fig. 518.

The following have been considered cordierite altered, or with 2 to 6 atoms water:—(*a*) *Bonsdorfite, Hydrous Iolite*, greenish brown or dark olive-green; near Åbo. (*b*) *Esmarkite, Chlorophyllite*, large prisms or foliated, green or brownish; near Cabrach (Aberdeen), Brevig in Norway, Unity in Maine, and Haddam in Connecticut. (*c*) *Fahlunite, Triclasite*, compact, greenish brown or black, foliated; H. = 2·5 to 3; G. = 2·5 to 2·8; Falun. (*d*) *Huronite*, granular; pearly, yellowish-green; H = 3·3; G. = 2·86; infusible and insoluble; Lake Huron. (*e*) *Weissite*, kidney-shaped and ash-grey or brown; Falun and Lower Canada. (*f*) *Pyrargillite*, indistinct imbedded crystals, black passing into brown or red, dull resinous lustre; H. = 3·5; G. = 2·5; Helsingfors. (*g*) *Pinite*, crystallized, or massive and laminar, with imperfect cleavage; H. = 2 to 3; G. = 2·7 to 2·9, semitranslucent or opaque, dull or resinous, and dirty grey, green, or brown; B.B. fuses to a glass, sometimes clear, at other times dark-coloured; Auvergne, Schneeberg, Penig in Saxony, the Harz, Cornwall, Cabrach and Torry (Aberdeenshire), the United States, and Greenland (*Gieseckite*, sp. 650). *Oosite* from Geroldsau in Baden, snow-white, opaque, fragile, is similar. (*h*) *Gigantolite*; H. = 3·5; G. = 2·8 to 2·9; opaque, dull resinous, and greenish grey or brown; B.B. intumesces slightly, and fuses easily to a greenish slag; Tammela in Finland. (*i*) *Praseolite*, lamellar and green; Brevig in Norway.

586. EMERALD (*Beryl*), $\dddot{Al}\ddot{Si}_3+3\dot{Gl}\ddot{Si}$.

Hexagonal; P 59° 53′. Crystals of ∞P, 0P, and ∞P, $\infty P2$, 0P, P (*a, p, c, s*, fig. 519) are prismatic, generally with vertical striæ. Cl. basal, rather perfect; ∞P imperfect. H. = 7·5 to 8; G. = 2·6 to 2·8. Transparent or translucent; vitreous. Colourless or white, but generally green, sometimes very brilliant; also yellow and smalt-blue. B.B. melts with difficulty on the edges to an obscure vesicular glass. Not affected by acids. C.c.: 67·5 silica, 18·7 alumina, and 13·8 glucina, with 0·3 to 3 iron peroxide, and 0·3 to 3·5 chrome oxide in the rich green emerald. *Emerald*, bright green; G. = 2·710 to 2·759; occurs in Muso Valley near Bogota, also in Salzburg and the Urals. *Beryl*, or *Aquamarine*, colourless, or less brilliant; G. = 2·677 to 2·725; near Mursinsk and Nertchinsk in Siberia, Salzburg, and Brazil; in the United States, where at Grafton, between the Connecticut and Merrimack, crystals 4 to 6 feet long, and weighing 2000 to 3000 lb, occur; Mourne Mountains in Ireland; Mount Battock and Cairngorm in Scotland (fig. 98). *Common Beryl* at Falun in Sweden, Fossum in Norway, Limoges in France, Rabenstein in Bavaria, Nigg Bay and Pitfodels and Rubislaw near Aberdeen (*Davidsonite*), Struay Bridge (Ross). Emerald and beryl are much valued as precious stones. Known from quartz by face *p*. Forms shown in figs. 92, 95, 96, 97, 98, 276.

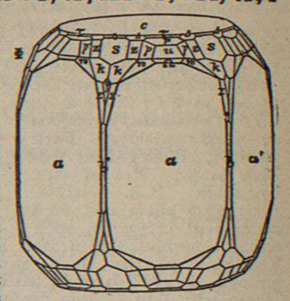


Fig. 519.

587. LEUCOPHANE, $6\dot{Ca}\ddot{Si}+3\dot{Gl}\ddot{Si}+2NaF$.

Right prismatic. ∞P 91°. Cl. basal perfect. H. = 3·5 to 4; G. = 2·97. Pellucid. Wine-yellow to olive-green. Vitreous. B.B. fuses to pale violet-blue bead. C.c.:—silica 47, lime 23·4, glucina 10·7, soda 11·3, fluorine 6·6. Lamö in Norway.

588. MELINOPHANE, $7(\dot{R}_3\ddot{Si}_2)+6NaF$.

Pyramidal. P 122° 23′. Mostly lamellar. H. = 5; G. = 3. Honey-yellow to citron-yellow. Brevig and Frederiksvärn.

FELSPAR GROUP.

Crystallization oblique prismatic or anorthic; very similar both in aspect and in angles. Cl. very distinct, especially the basal P; less so the clino- or brachydiagonal M. G. = 2·4 to 3·2, but mostly 2·5 to 2·8; H. = 6 or a little more. Slightly or not at all soluble in acids. B.B. fusible, but often with difficulty. Translucent; pure varieties transparent. Colourless, white, or shades of red; less commonly of green or yellow. C.c.: anhydrous silicates of alumina, and of an alkali or alkaline earth.

The felspars are very important constituents of the earth's crust, occurring in nearly all the igneous rocks, and in many of the stratified crystalline schists. In true strata they are found chiefly as fragments or decomposed, and in the latter state form a large part of wet soils and clays. By the older mineralogists and in popular language many species are conjoined under the common name of *felspar* which are now considered as distinct, each of them having not only its peculiar physical and chemical characters, but also geognostic position and associated groups of minerals. Thus orthoclase, and the other more siliceous felspars with potash, abound in granite and the plutonic rocks; the less siliceous, with soda and lime, characterize the volcanic rocks,—*e.g.*, labradorite the basaltic group, glassy felspar the trachytic. Orthoclase is associated with quartz, hornblende, and mica; glassy felspar either with hornblende and a black mica or with augite; labradorite with augite, very rarely with quartz or hornblende.

The felspars are best known from similar minerals by their hardness (they scarce scratch with a good knife), difficult fusibility, and unequal cleavages. The following marks may aid the student in distinguishing the more common species. In orthoclase the basal cleavage plane forms a right angle with the clinodiagonal cleavage planes *M* on both hands; in the triclinic or plagioclase felspars the angles are unequal. Orthoclase, albite, andesine, and oligoclase are insoluble in acids; labradorite and anorthite are more or less soluble. In granite, when decomposing, orthoclase often becomes reddish or dark-red; oligoclase dull green, and at length white.

Walterhausen considers that the felspars are mixtures of three true species, forming a series with the oxygen of the silica, alumina, and RO in the proportions $x:3:1$,—x ranging from 24 to 4. Tchermak and most mineralogists now take a similar view, regarding orthoclase, albite, and anorthite alone as true species, of which the others are mixtures. Those consisting essentially of potash and soda only are mechanical mixtures of orthoclase and albite, the distinct lamellæ being visible by the microscope; those again that contain essentially lime and soda together are, sometimes at least, chemical, being isomorphous compounds of albite and anorthite in various proportions, and with corresponding transitions in crystallographic and physical properties. Notwithstanding this, these intermediates must be regarded as independent mineral species, inasmuch as they are severally typical of certain rocks, and have characteristic forms differing from each other in angular inclination.

589. ORTHOCLASE, $\dddot{Al}\ddot{Si}_3+\dot{K}\ddot{Si}_3$.

Oblique prismatic, C = 63° 57′. ∞P (*T* and *l*) 118° 47′; $P^{o}\infty$ (*x*) 65° 46′; $2P^{c}\infty$ (*n*) 90° 71′; $2P^{o}\infty$ (*y*) 35° 45′. The commonest and simplest forms are ∞P, 0P, $P^{o}\infty$, and $\infty P^{c}\infty$ (*M*), ∞P, 0P (*P*), $2P^{o}\infty$ (figs. 520 to 527). When ∞P predominates the crystals are short rhombic prisms; when $\infty P^{c}\infty$ predominates they are tabular; when ∞P and $\infty P^{c}\infty$ predominate they are short hexagonal prismatic, when 0P and $\infty P^{c}\infty$ they are rectangular prismatic, often much lengthened. Twins are very frequent, and occur according primarily to four laws. *First*, through revolution of one half or of a whole crystal, then forming interpenetrating twins round a vertical axis (fig. 195). In the case of this hemitropic revolution one of the external faces becomes a face of union. According as the right or the left half (or whole crystal) is conceived to be that which has been revolved the crystals are termed right and left, as in figs. 188, 189. *Second*, by revolution of one half around an axis normal to *M*; in such twins the composition is not evidenced externally except by sutures. *Third*, through revolution round an axis normal to *P*, forming orthorhombic prisms which show a herring-bone lineation, through the meeting of striæ commonly present upon the face *M* parallel to the intersection of its edge with the face *T* (fig. 528). *Fourth*, by revolution round an axis normal to $2P^{c}\infty$ (*n*); this also forms a prism the section of which is nearly square (fig. 529). Compound twins on this last type are formed of 3 to 4 and 8 crystals (fig. 530).

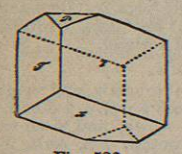


Fig. 520.

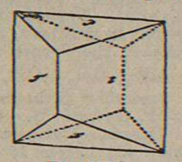


Fig. 521.

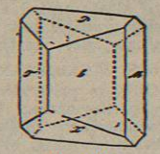
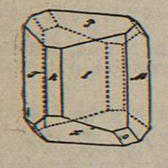


Fig. 522.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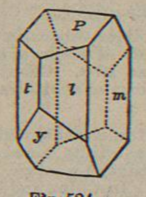

Fig. 524.

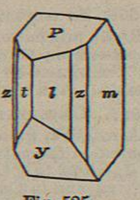

Fig. 525.

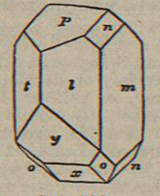

Fig. 526.

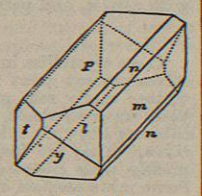

Fig. 527.

Fig. 528.

Fig. 529.

Fig. 530.

Occurs also massive, and coarse or fine granular. Cl. basal (*P*), very perfect; clinodiagonal (*M*), perfect ($P:M=90°$); fracture conchoidal or splintery. H. = 6; G. = 2·53 to 2·58. Transparent to translucent on the edges; vitreous but pearly on cl.; and also opalescent, with bluish or changing colours. Occasionally colourless but generally red, yellow, grey, or green. B.B. fuses with difficulty to an opaque vesicular glass. Not affected by acids. C.c.: 64·6 silica, 18·5 alumina, and 16·9 potash, but generally 10 to 14 potash, 1 to 4 soda, 0 to 1·3 lime, 0 to 2 iron peroxide. Varieties are—

(1) *Adularia* and *Ice-spar*, transparent or translucent, splendent, and almost colourless. Some with bluish opalescence are named *Moonstone*; St Gotthard, Mont Blanc, Dauphiné, Arendal, Greenland, and Ceylon.

(2) *Common Felspar*, generally white or red, especially flesh-red, is a common constituent of many rocks. Crystals at Baveno on Lago Maggiore, Lomnitz in Silesia, Mourne Mountains and Wicklow in Ireland, Aberdeenshire (at Rubislaw 6 or 8 inches long) in Scotland, and at Carlsbad and Elnbogen in Bohemia. *Amazon Stone*, verdigris-green, from Sutherland, Lake Ilmen, and Colorado, and *Murchisonite*, golden or greyish yellow, from Arran and Dawlish, are varieties.

(3) The *Glassy Felspar* or *Sanidine* (C 64° 1′, ∞P 119° 16′) contains 3 to 12 potash and 3 to 10 soda. Crystals imbedded; vitreous, translucent, and often much cracked; Arran, Eigg, and other parts of Scotland, Drachenfels, Auvergne, and other countries.

Orthoclase occurs in granite, gneiss, and porphyry in many countries. It is commonly associated with quartz; sometimes, as in the *Graphic Granite* of Sutherland, Harris, and Portsoy, in letter-like combinations of the latter. It is very liable to decomposition, when it is converted especially into kaolin, used for manufacturing porcelain and stoneware. The adularia or moonstone and the green amazon stone are cut as ornamental stones. *Leelite*, from Biddean nam Bian in Argyllshire and Grythyttan in Sweden, is a somewhat siliceous horny-lustred flesh-coloured compact variety. *Petuntze* and *Hornstone* are similar but more impure. *Microcline* is a variety with angle distorted by interstitial penetration, by oligoclase (Sutherland), and by albite (Frederiksvärn, &c.).

590. ALBITE, $\dddot{Al}\ddot{Si}_3+\dot{Na}\ddot{Si}_3$.

Anorthic. 0P (*P*) : $\infty\breve{P}\infty$ (*M*) 86° 24′; $\infty P'$ (*l*) : $\infty'P$ (*T*) 122° 15′; but angles variable. Crystals, generally like those of orthoclase, are tabular or prismatic (fig. 197). Hemitropes common, especially united by a face of $\infty\breve{P}\infty$ (figs. 531, 532) the re-entering angle between the faces of 0P (*P* and *P′*) 172° 48′ being very characteristic. Fig. 198 is another common hemitrope. Also massive, and in radiating plates. Cl. basal and brachydiagonal, almost equally perfect; fracture conchoidal or uneven. H. = 6 to 6·5; G. = 2·6 to 2·67. Rarely transparent; vitreous, pearly on the cl. Colourless, but generally white, grey, green, red, or yellow; streak white. B.B. difficultly fusible, tinging the flame yellow, to a white semiopaque glass. Not affected by acids. C.c.: 68·6 silica, 19·6 alumina with 0·1 to 1 iron peroxide, and 11·8 soda, with 0·3 to 4 lime, 0 to 2·5 potash. Hence albite and orthoclase both contain soda and potash, only in different proportions. Albite is most easily recognized by its frequent re-entering angles, its readier fusibility, and the obliquity (93° 36′) of its cl. planes, often marked with striæ. *Pericline* is a variety of which fig. 533 is a typical form.

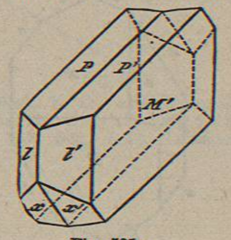

Fig. 531.

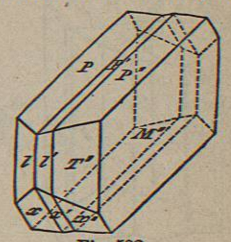

Fig. 532.

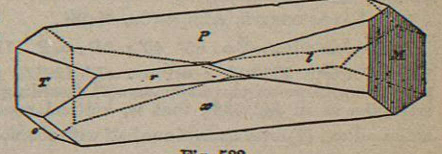

Fig. 533.

Albite is a constituent of many "greenstones," as at Corstorphine (Edinburgh), and of granite, syenite, gneiss, porphyry, and trachyte. Crystallized at Murdoch's Cairn, Aberdeenshire, being the colourless felspar of the red granites of Scotland. Dauphiné, St Gotthard, Tyrol, Salzburg, and Arendal.

Adinole is a compact variety similar in appearance to *Leelite*.

591. ANORTHITE, $\dddot{Al}\ddot{Si}+\dot{Ca}\ddot{Si}$.

Anorthic. 0P (*P*) : $\infty\breve{P}\infty$ (*M*) 85° 50′; $\infty P'$ (*l*) : $\infty'P$ (*T*) 120° 30′. Hemitropes common on both *M* and *P*. Angle between *P* and *P′* 180° 24′. Cl. basal and brachydiagonal, perfect. H. = 6;

G. = 2·7 to 2·78. Transparent or translucent; vitreous. Colourless or white. B.B. fuses to a clear glass; soluble without gelatinizing in con. h. acid. C.c.: 43 silica. 36·9 alumina. 20·1 lime. sometimes with magnesia and soda. Fetlar in Shetland; Lendalfoot in Ayrshire, in gabbro; Monte Somma, Iceland, Java. *Lepolite* and *Amphodelite* are varieties. In *Latrobite* the greater part of the lime is replaced by potash. Glen Gairn and Labrador. At both rose-red.

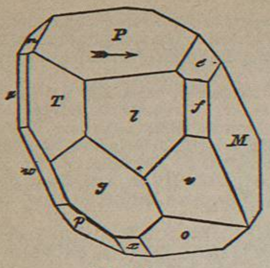

Fig. 534.

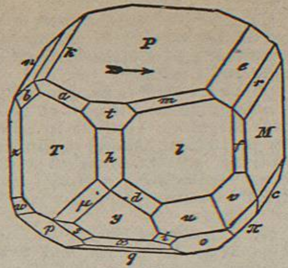

Fig. 535.

592. **Oligoclase**, $2\dddot{\bar{A}}l\ddot{S}i_3 + (\dot{\bar{N}}a, \dot{C}a)_2\ddot{S}i_3$.

Anorthic. 0P : ∞P̆∞ 86° 10′; ∞P′ : ∞′P 120° 42′. Hemitropes face *m*, with *p* : *p′* 173° 4′; *l* : *l* 120° 20′; *y* : *y* 179° 9′; *x* : *x* 175° 59′. Cl. basal, perfect; brachydiagonal, less so. H. = 6; G. = 2·62 to 2·84. Vitreous, resinous on the cl. White, with a tinge of green, grey, or red. B.B. melts easier than orthoclase or albite to a clear glass; not affected by acids. C.c.: 63 silica, 23·4 alumina, 8·4 soda, and 4·2 lime; thus nearly = 3 albite and 1 anorthite. Distinguished from orthoclase by the marked striæ on the faces; less readily from albite, but more fusible and G. higher. The common associate of orthoclase in the Scotch grey granites, especially in vein granite, as at Rispond and Ben Loyal (figs. 536, 537) in Sutherland, and at Rubislaw; Scandinavia, Urals, Harz, and North America. The *Sunstone*, from Foinaven in Sutherland, Norway, Lake Baikal, and Ceylon, with a play of colour due to imbedded crystals of rubinglimmer (göthite), belongs to this species.

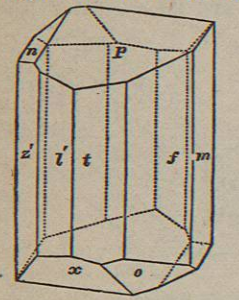

Fig. 536.

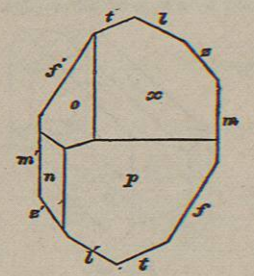

Fig. 537.

593. **Labradorite**, $\dddot{\bar{A}}l\ddot{S}i_3 + (\dot{C}a, \dot{\bar{N}}a)\ddot{S}i$.

Anorthic. 0P : ∞P̆∞ 86° 40′; 0P : ∞′P 111°; 0P : ∞P′ 113° 34′; ∞P′ : ∞′P 121° 37′; ∞P̆∞ : ∞P′ 120° 53′; ∞P̆∞ : ∞′P 117° 30′. Hemitropes of three types:—(1) according to the first law of orthoclase as in fig. 538; that is, vertical revolution and face of union ∞P̆∞; (2) revolution of one half with reunion on the face ∞P̄∞, as in fig. 539; (3) with twin face P, as in fig. 540. Hemitropes of the last form also occur in which the lower half consists of a hemitrope formed according to the second method. Crystals imbedded in rocks consist generally of repeated twins affording an angle of 173° 20′. Cl. basal, perfect; brachydiagonal, less so; both usually striated on account of the above twinning. H. = 6; G. = 2·68 to 2·74. Translucent; vitreous, on the cl. resinous. Grey, passing into white, green, yellow, or red. The faces of ∞P̆∞ often exhibit very beautiful changing colours—blue, green, yellow, red, or brown—sometimes bands intersecting at certain angles. B.B. fuses more readily than orthoclase to a compact colourless glass. Sol. in h. acid. C.c.: 52·9 silica, 30·3 alumina, 12·3 lime, and 4·5 soda. It is thus = 1 albite and 3 anorthite. Common constituent of dolerite, gabbro, and hypersthene rocks. In Scotland, Labrador, Finland, Harz, Tyrol; also at Etna and Vesuvius.

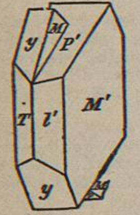

Fig. 538.

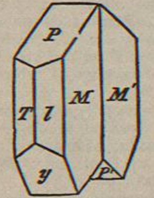

Fig. 539.

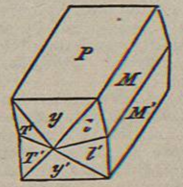

Fig. 540.

594. **Andesine**, $\dddot{\bar{A}}l\ddot{S}i_3 + (\dot{\bar{N}}a\dot{C}a)\ddot{S}i$.

Anorthic. Crystals similar to albite and anorthite. Twin face *M*. Crystals generally formed of repeated plates. G. = 2·67 to 2·7. Physical properties like albite; more easily fusible to a porous white glass; h. acid sometimes dissolves out alternate laminæ of crystals. C.c.: 59·7 silica, 25·6 alumina, 7·7 soda, and 7 lime, and thus nearly 1 of albite and 1 anorthite. Typical of the primary limestones and a granitic belt therein in Scotland, as at Shinness, Urquhart, Dalnain, &c. In the Andes, the Vosges, and Iceland.

595. **Hyalophane**, $\dddot{\bar{A}}l\ddot{S}i_3$, $\dot{\bar{K}}\ddot{S}i_3 + \dddot{\bar{A}}l\ddot{S}i$, $\dot{B}a\ddot{S}i$.

Oblique prismatic; resembles orthoclase; crystals and angles nearly the same. Cl. 0P, perfect. H. = 6 to 6·5; G. = 2·8 to 2·9. Transparent. Lustre vitreous. Colourless, white, and flesh-red. C.c.: silica 52·7, alumina 21, baryta 15·1, potash 7·8, soda 2·1. B.B. difficultly fusible to a blebby glass, not acted upon by acids. Binnen in Valais, Jacobsberg in Sweden.

596. **Barsovite**, $\dddot{\bar{A}}l\ddot{S}i + \dot{C}a\ddot{S}i$.

Right prismatic, or oblique prismatic. H. = 5·5 to 6; G. = 2·5. Snow-white; translucent. Fracture granular. Pearly. C.c.: silica 42·2, alumina 36·4, lime 19·8. Gelatinizes in h. acid, difficultly fusible. A dimorphic form of anorthite. Barsovskoi in the Urals.

597. **Saussurite.**

A massive, granular, translucent, white or pale green felspathic mineral of the nature of anorthite mixed with labradorite. H. = 6 to 7; G. = 3·26 to 3·4. Probably a mixture. Occurs in loose blocks near Geneva, and in Corsica. In China and in India is carved under the name of Oriental jade (nephrite). Seems to be confounded also with zoizite, and perhaps with yu (prehnite). *Jadeite* is similar.

ZEOLITE GROUP.

These crystallize in all the systems except the anorthic, and themselves present great variety of development. Mostly hyaline and white; rarely red, grey, or yellow. Cl. generally distinct. All yield water in closed tube; all fusible B.B. most easily, and often intumescing; all sol. in acids, and mostly gelatinize or deposit silica. They are hydrated silicates of alkalies, or alkaline earths, mostly with silicates of alumina, but rarely contain magnesia. Some mineralogists regard the water as basic, in union with silica, and Kenngott gives the formula in that form, thus:—

Analcime, $(\dot{\bar{N}}a\dddot{\bar{A}}l)\,2\ddot{S}i + 2(\dot{\bar{H}}, \ddot{S}i)$,

Natrolite, $(\dot{\bar{N}}a\dddot{\bar{A}}l)\,2\ddot{S}i + 2(\dot{\bar{H}}, \ddot{S}i)$,

Stilbite, $\dot{C}a$, $\dddot{\bar{A}}l + 6(\dot{\bar{H}}, \ddot{S}i)$,

and the others similar. They are generally found in amygdaloidal cavities or fissures of trap or plutonic rocks, apparently as deposits from water percolating into them, and are thus probably products of decomposing nepheline or felspars, or hydrated felspars themselves. They never form constituents of rocks. Natrolite, scolezite, thomsonite, and the connected varieties are marked by their needle-like radiating forms; stilbite and heulandite by their broad, foliated, pearly cleavage.

598. **Pectolite**, $4\dot{C}a\ddot{S}i + \dot{\bar{N}}a\ddot{S}i_2 + \dot{\bar{H}}$.

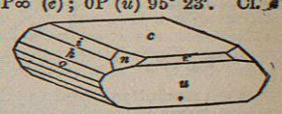

Fig. 541

Oblique prismatic, C 84° 37′. ∞P̄∞ (*c*); 0P (*u*) 95° 23′. Cl. *c* and *u*. Twin-face *c*; chiefly spheroidal and radiating fibrous. H. = 5; G. = 2·74 to 2·88. Translucent; crystals pearly; fibres silky. Pale green to yellowish white. Sol. in h. acid, leaving silica. C.c.: 54·2 silica, 33·7 lime, 9·4 soda, and 2·7 water. Ratho, Corstorphine, Castle Rock, and Arthur's Seat, Edinburgh; Kilsyth, Stirling; Knockdolian and Lendalfoot, Ayrshire; Skye; Montebaldo; Monzoni Valley in Tyrol.

599. **Walkerite**, $4\dot{C}a\ddot{S}i + \dot{M}g\ddot{S}i + \dot{\bar{N}}a\ddot{S}i_2 + 2\dot{\bar{H}}$.

Like pectolite, but columnar. H. = 4·5; G. = 2·7. Flesh-coloured. Lustre pearly to greasy. C.c.: silica 53·7, lime 28·6, magnesia 5·1, soda 7·9, water 4·6. Corstorphine Hill, Burntisland.

600. **Xonotlite**, $4\dot{C}a\ddot{S}i + \dot{\bar{H}}$.

Massive. H. = 6; G. = 2·6 to 2·7. Pink, white, and grey. Tough fracture conchoidal and splintery. C.c.: silica 49·8, lime 43·5, protoxide of manganese 2·3, protoxide of iron 2·9, water 3·7. Kilfinichen and Torosay (Mull), Xonotla (Mexico).

601. **Tobermorite**, $3(\dot{C}a_4, \dot{\bar{H}})\ddot{S}i_5 + 2\tfrac{1}{2}\dot{\bar{H}}$.

Massive, fine granular; translucent; fracture hackly. H. = 5; G. = 2·4. Pale pink. C.c.: silica 49·8 lime 37·2, water 12·9. Tobermory (Mull), Dunvegan (Skye).

602. **Okenite**, $\dot{C}a\dot{\bar{H}}\ddot{S}i_2 + \dot{\bar{H}}$.

Right prismatic. ∞P 122° 19′. Usually fine fibrous; radiating. H. = 5; G. = 2·28 to 2·36. Pellucid; slightly pearly. Yellowish to bluish white. In powder easily sol. in h. acid, leaving gelatinous flakes after ignition. C.c.: 56·6 silica, 28·4 lime, and 17 water; an apophyllite without the fluorine. Disco Island, Faroes, and Iceland.

603. **Apophyllite**, $8(\dot{C}a\ddot{S}i + 2\dot{\bar{H}}) + KF$.

Pyramidal. P 120° 56′. P, ∞P∞ (*m*), 0P (*o*), ∞P2 (*r*). Rarely lamellar. Cl. *o*, perfect. Brittle. H. = 4·5 to 5; G. = 2·3 to 3·4. Transparent; vitreous. On *o* pearly (*Ichthyophthalmite*). Colourless, rarely pink, green, red, brown, and yellow. B.B. exfoliates, intumesces, and melts to white enamel. Sol. in h. acid, leaving silica. C.c: silica 50·3, lime 24·7, water 15·9, potassium 4·3, fluorine 2·1. Dunvegan and Storr, Skye (fig. 544); Chapel, Fife; Corstorphine (fig. 542) and Ratho, near Edinburgh; Kilsyth, Bowling, Kilpatrick; Port Rush, Ireland. In the form P (fig. 79), grass-green at Oxhaveer, Iceland (*Oxhaverite*); Utö, Sweden; Andreasberg and Faroes (pink); Faroes, and Poonah in India (green). Internal structure tesselated, being built up of wedge and lenticular forms with varying refractive indices, hence exhibiting a beautiful structure with polarized light.

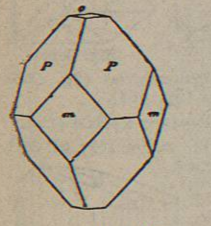

Fig. 542.

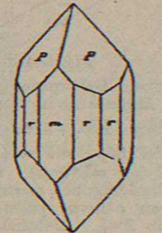

Fig. 543.

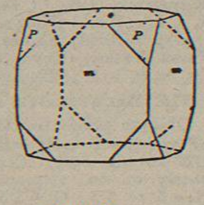

Fig. 544.

604. **Gyrolite**, $(\tfrac{2}{3}\dot{C}a + \tfrac{1}{3}\dot{\bar{H}})\ddot{S}i + \dot{\bar{H}}$.

Lamellar, radiate, spherical, and investing. H. = 3 to 4. Pearly. Bluish white to cream-coloured. Transparent, rapidly becoming opaque. C.c.: silica 53·3, lime 32·9, water 13·8. Quiraing, Lyndale, and Storr, Skye; Loch Screden and Carsaig, Mull; Canna; Karartut, Niakornak, and Disco; Faroes: Nova Scotia.

605. **Analcime**, $\dddot{\bar{A}}l\ddot{S}i_3 + \dot{\bar{N}}a\ddot{S}i + 2\dot{\bar{H}}$.

Cubic. ∞O∞; 2O2. Fracture uneven. H. = 5·5; G. = 2·1 to 2·28. Colourless, white, flesh-red, scarlet. Vitreous; transparent. B.B. melts without frothing to a clear vesicular glass. Decomposable with gelatinization in h. acid. C.c.: 54·5 silica, 23·3 alumina, 14·1 soda, 8·2 water. Walls, Orkney; Talisker, Skye; Sanda, and Hebrides generally. Transparent at Eigg, and Elie, Fife scarlet at Bowdens, Kincardine; opaque white at Glen Farg, Salisbury Crags, and Dumbarton; Giant's Causeway, Seisser Alp in Tyrol, Cyclopean Islands (fig. 545), Faroes, Iceland, and Nova Scotia. *Eudnophite* is a variety. Pectolite (sp. 598) occurs pseudomorphous after analcime, in large crystals of *a*, *n*, at Ratho, Edinburghshire.

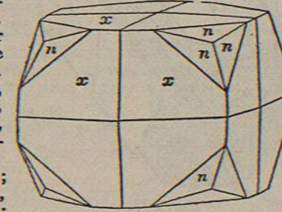

Fig. 545.

606. **Pollux**, $3(\dddot{\bar{A}}l\ddot{S}i_3 + (\dot{C}s\tfrac{2}{3}, \dot{\bar{N}}a\tfrac{1}{3})\ddot{S}i) + 2\dot{\bar{H}}$.

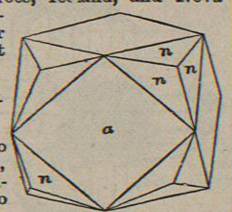

Fig. 546 (sp. 606).

Cubic. ∞O∞; 2O2 (fig. 546). Also massive. Gum-like externally. Brittle, with traces of cleavage. Fracture conchoidal. H. = 5·5 to 6·5; G. = 2·86 to 2·9. Colourless. Vitreous. Sol. in h. acid. C.c.: silica 44, alumina 16, oxide of cæsium 34, soda 2·5, water 2·4. Elba. The only mineral which contains cæsium in quantity

607. **Faujasite**, $2\dddot{\bar{A}}l\ddot{S}i_3 + (\dot{C}a\dot{\bar{N}}a)_2\ddot{S}i_3 + 18\dot{\bar{H}}$.

Cubic; in octahedrons with the icositetrahedron $\tfrac{3}{2}$O$\tfrac{3}{2}$. Fracture uneven; brittle. H. = 7; G. = 1·92. Transparent; vitreous to adamantine. White to brown. Sol. in h. acid. C.c.: 46·8 silica, 16 alumina, 4·4 lime, 4·8 soda, 28 water. Kaiserstuhl in Baden, Annerod near Giessen, Eisenach, Marburg.

608. **Chabasite** (*Lime-Chabasite*), $\dddot{\bar{A}}l\ddot{S}i_3 + \dot{C}a\ddot{S}i + 6\dot{\bar{H}}$.

Rhombohedral; R 94° 46.′ $\tfrac{1\frac{2}{5}}{}$R$\tfrac{4}{5}$; $-\tfrac{1}{2}$R (*r*); −2R (*e*); ∞P2 (*a*). Twins very common (generally intersesting), on faces ∞P and P̆∞. Primary rhombohedron is sometimes twinned with a crystal with faces *r*, *e*, *s*. Cl. *r* perfect. H. = 4 to 4·5; G. = 2 to 2·2. Transparent or translucent; vitreous. Colourless, and brownish, yellowish, brick-, and flesh-red. Sol. in h. acid, leaving silica. C.c.: silica 47·8, alumina 20·8, lime 10·7, water 21·3. Lyndale (figs. 547, 548, 549), Talisker (figs. 176, 550, sometimes flesh colour), and Storr, Skye (figs. 547, 548); Port Glasgow and Kilmalcolm (pink and brown); Giant's Causeway and Magee Island (red), Faroes, Iceland, Aussig, Andreasberg (fig. 551). *Haydenite* in twinned rhombohedra with *p* : *p* 95° to 97° and *p* : *d* 170° reentering (fig. 552), from Fassa and Maryland, is similar. *Phacolite* is chabasite in twins of $\tfrac{2}{3}$P2, ∞P2, R, $-\tfrac{1}{2}$R at the Giant's Causeway (fig. 154). At Richmond in Victoria they occur as in fig. 553, −2R (*n*), $-\tfrac{2}{3}$R (*r*), $\tfrac{2}{3}$P2 (*t*), 0P (*c*); polar edge, $\tfrac{2}{3}$P2 145°. In this, half of the lime is replaced by soda.

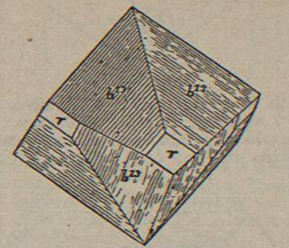

Fig. 547.

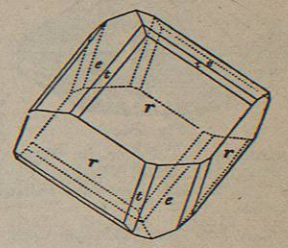

Fig. 548.

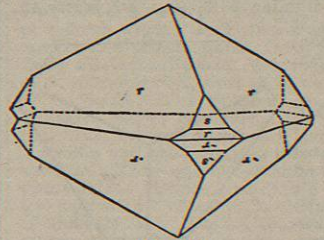

Fig. 549.

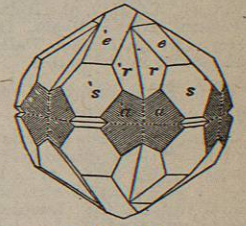

Fig. 550.

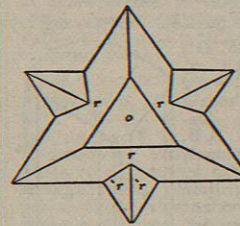

Fig. 551.

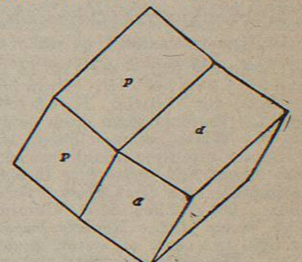

Fig. 552.

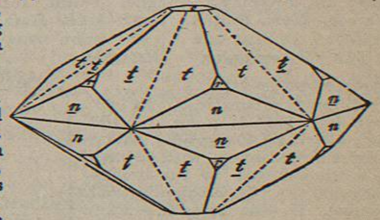

Fig. 553.

609. **Gmelinite** (*Soda-Chabasite*), $\dddot{\bar{A}}l\ddot{S}i_3 + \dot{\bar{N}}a\ddot{S}i + 6\dot{\bar{H}}$.

Hexagonal. R 112° 26′; P 79° 54′. Combination P, 0P, ∞P