Chamosite. Contains iron (FeO) with but little MgO. Occurs compact or oölitic with H. about 3; G. = 3–3·4; color greenish gray to black. From Chamoson, near St. Maurice, in the Valais.

Stilpnomelane. An iron silicate. In foliated plates; also fibrous, or as a velvety coating. G. = 2·77–2·96. Color black, greenish black. Occurs at Obergrund and elsewhere in Silesia; also in Moravia; near Weilburg, Nassau. *Chalcodite*, from the Sterling Iron mine, in Antwerp, Jefferson Co., N. Y., coating hematite and calcite, is the same mineral in velvety coating of mica-like scales with a bronze color.

Strigovite. $H_4Fe_2(Al,Fe)_2Si_2O$. In aggregations of minute crystals. Color dark green. Occurs as a fine coating over the minerals in cavities in the granite of Striegau in Silesia.

Rumpfite. $H_{28}Mg_7Al_{16}Si_{10}O_{65}$. Massive; granular, consisting of very fine scales. Color greenish white. Occurs with talc near St. Michael in Upper Styria.

APPENDIX TO THE MICA DIVISION.—VERMICULITES.

The Vermiculite Group includes a number of micaceous minerals, all hydrated silicates, in part closely related to the chlorites, but varying somewhat widely in composition. They are alteration-products chiefly of the micas, biotite, phlogopite, etc., and retain more or less perfectly the micaceous cleavage, and often show the negative optical character and small axial angle of the original species. Many of them are of a more or less indefinite chemical nature, and the composition varies with that of the original mineral and with the degree of alteration.

The laminæ in general are soft, pliable, and inelastic; the luster pearly or bronze-like, and the color varies from white to yellow and brown. Heated to 100°–110° or dried over sulphuric acid most of the vermiculites lose considerable water, up to 10 p. c., which is probably hygroscopic; at 300° another portion is often given off; and at a red heat a somewhat larger amount is expelled. Connected with the loss of water upon ignition is the common physical character of exfoliation; some of the kinds especially show this to a marked degree, slowly opening out, when heated gradually, into long worm-like threads. This character has given the name to the group, from the Latin *vermiculari, to breed worms*. The minerals included can hardly rank as distinct species and only their names can be given here: *Jefferisite, vermiculite, culsageeite, kerrite, lennilite, hallite, philadelphite, vaalite, maconite, dudleyite, pyrosclerite.*

III. Serpentine and Talc Division.

The leading species belonging here, Serpentine and Talc, are closely related to the Chlorite Group of the Mica Division preceding, as noted beyond. Some other magnesium silicates, in part amorphous, are included with them.

SERPENTINE.

Monoclinic. In distinct crystals, but only as pseudomorphs. Sometimes foliated, folia rarely separable; also delicately fibrous, the fibers often easily separable, and either flexible or brittle. Usually massive, but microscopically finely fibrous and felted, also fine granular to impalpable or cryptocrystalline; slaty. Crystalline in structure but often by compensation nearly isotropic; amorphous.

Cleavage *b* (010), sometimes distinct; also prismatic (50°) in chrysotile. Fracture usually conchoidal or splintery. Feel smooth, sometimes greasy. H. = 2·5–4, rarely 5·5. G. = 2·50–2·65; some fibrous varieties 2·2–2·3; retinalite, 2·36–2·55. Luster subresinous to greasy, pearly, earthy; resin-like, or wax-like; usually feeble. Color leek-green, blackish green; oil- and siskin-green; brownish red, brownish yellow; none bright; sometimes nearly white. On exposure, often becoming yellowish gray. Streak white, slightly shining. Translucent to opaque.

Pleochroism feeble. Optically −, perhaps also + in chrysotile. Double refraction weak. Ax. pl. ∥ *a* (100). Bx (a) ⊥ *b* (010) the cleavage surface; c ∥ elongation of fibers. Biaxial, angle variable, often large; 2V = 20° to 90°. Indices:

Antigorite $\alpha = 1{\cdot}560$ $\beta = 1{\cdot}570$ $\gamma = 1{\cdot}571$ $\gamma - \alpha = 0{\cdot}011$ Lévy-Lcx.

Var.—Many unsustained species have been made out of serpentine, differing in structure (massive, slaty, foliated, fibrous), or, as supposed, in chemical composition, and these now, in part, stand as varieties, along with some others based on variations in texture, etc.

A. In Crystals—Pseudomorphs. The most common have the form of chrysolite. Other kinds are pseudomorphs after pyroxene, amphibole, spinel, chondrodite, garnet, phlogopite, etc. *Bastite* or *Schiller Spar* is enstatite (hypersthene) altered more or less completely to serpentine. See p. 386.

B. Massive. 1. *Ordinary massive.* (*a*) *Precious* or *Noble Serpentine* is of a rich oil-green color, of pale or dark shades, and translucent even when in thick pieces. (*b*) *Common Serpentine* is of dark shades of color, and subtranslucent. The former has a hardness of 2·5–3; the latter often of 4 or beyond, owing to impurities.

Resinous. Retinalite. Massive, honey-yellow to light oil-green, waxy or resin-like luster.

Bowenite (Nephrite *Bowen*). Massive, of very fine granular texture, and much resembles nephrite, and was long so called. It is apple-green or greenish white in color; G. = 2·594–2·787, Bowen; and it has the unusual hardness 5·5–6. From Smithfield, R. I.; also a similar kind from New Zealand.

C. Lamellar. *Antigorite*, thin lamellar in structure, separating into translucent folia; H. = 2·5; G. = 2·622; color brownish green by reflected light; feel smooth, but not greasy. From Antigorio valley, Piedmont.

D. Thin Foliated. *Marmolite*, thin foliated; the laminæ brittle but separable. G. = 2·41; colors greenish white, bluish white to pale asparagus-green. From Hoboken, N. J.

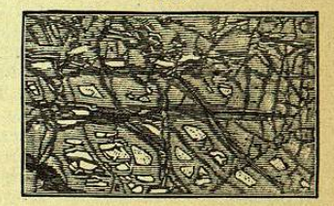
E. Fibrous. *Chrysotile.* Delicately fibrous, the fibers usually flexible and easily separating; luster silky, or silky metallic; color greenish white, green, olive-green, yellow and brownish; G. = 2·219. Often constitutes seams in serpentine. It includes most of the silky *amianthus* of serpentine rocks and much of what is popularly called *asbestus* (asbestos). Cf. p. 401.

Picrolite, columnar, but fibers or columns not easily flexible, and often not easily separable, or affording only a splintery fracture; color dark green to mountain-green, gray, brown. The original was from Taberg, Sweden. *Baltimorite* is picrolite from Bare Hills, Md.

F. Serpentine Rocks. Serpentine often constitutes rock-masses. It frequently occurs mixed with more or less of dolomite, magnesite, or calcite, making a rock of clouded green, sometimes veined with white or pale green, called *verd antique, ophiolite,* or *ophicalcite.* Serpentine rock is sometimes mottled with red, or has something of the aspect of a red porphyry; the reddish portions containing an unusual amount of oxide of iron. Any serpentine rock cut into slabs and polished is called *serpentine marble.*

Microscopic examination has established the fact that serpentine in rock-masses has been largely produced by the alteration of chrysolite, and many apparently homogeneous serpentines show more or less of this original mineral. In other cases it has resulted from the alteration of pyroxene or amphibole. Sections of the serpentine derived from chrysolite often show a peculiar structure, like the meshes of a net (Fig. 914); the lines marked by grains of magnetite also follow the original cracks and cleavage directions of the chrysolite (Fig. 915, *a*). The serpentine from amphibole and pyroxene commonly shows an analogous structure; the iron particles following the former cleavage lines Hence the nature of the original mineral can often be inferred. Cf. Fig. 915, *a, b, c* (Pirsson).

914.



Comp.—A magnesium silicate, $H_4Mg_3Si_2O_9$ or $3MgO.2SiO_2.2H_2O$ = Silica 44·1, magnesia 43·0, water 12·9 = 100. Iron protoxide often replaces a small part of the magnesium; nickel in small amount is sometimes present. The water is chiefly expelled at a red heat.

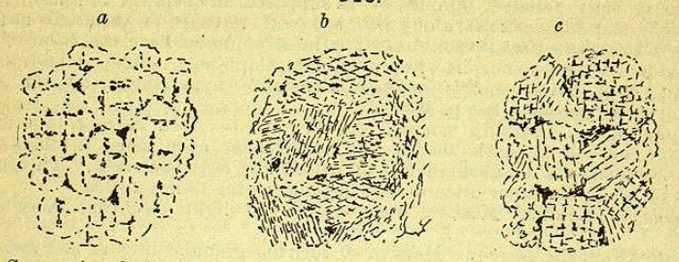
Pyr., etc.—In the closed tube yields water. B.B. fuses on the edges with difficulty.

F. = 6. Gives usually an iron reaction. Decomposed by hydrochloric and sulphuric acids. From chrysotile the silica is left in fine fibers.

Diff.—Characterized by softness, absence of cleavage and feeble waxy or oily luster; low specific gravity; by yielding much water B.B.

Readily recognized in thin sections by its greenish or yellowish-green color; low relief and aggregate polarization due to its fibrous structure. When the fibers are parallel, the

915.



a, Serpentine derived from chrysolite; *b*, from amphibole; *c*, from pyroxene.

interference-colors are not very low, but the confused aggregates may show the "ultra blue" or even be isotropic. The constant association with other magnesia bearing minerals like chrysolite, pyroxene, hornblende, etc., is also characteristic. The presence of lines of iron particles as noted above (Fig. 915) is characteristic.

Obs.—Serpentine is always a secondary mineral resulting, as noted above, from the alteration of silicates containing magnesia, particularly chrysolite, amphibole or pyroxene. It frequently forms large rock-masses, then being derived from the alteration of peridotites, dunites and other basic rocks of igneous origin; also of amphibolites, or pyroxene and chrysolite rocks of metamorphic origin. In the first case it is usually accompanied by spinel, garnet, chromite and sometimes nickel ores; in the second case by various carbonates such as dolomite, magnesite, breunnerite, etc.

Crystals of serpentine, pseudomorphous after monticellite, occur in the Fassathal, Tyrol; near Miask at Lake Aushkul, Barsovka, Ekaterinburg, and elsewhere; in Norway, at Snarum; etc. Fine precious serpentines come from Falun and Gulsjö in Sweden, the Isle of Man, the neighborhood of Portsoy in Aberdeenshire, the Lizard in Cornwall, Corsica, Siberia, Saxony, etc.

In N. America, in *Maine*, at Deer Isle, precious serpentine. In *Vermont*, at New Fane, Roxbury, etc. In *Mass.*, fine at Newburyport. In *R. Island*, at Newport; *bowenite* at Smithfield. In *Conn.*, near New Haven and Milford, at the verd-antique quarries. In *N. York*, at Port Henry, Essex Co.; at Antwerp, Jefferson Co., in crystals; in Gouverneur, St. Lawrence Co, in crystals; in Cornwall. Monroe, and Warwick, Orange Co., sometimes in large crystals at Warwick; and from Richmond to New Brighton, Richmond Co. In *N. Jersey*, at Hoboken, with brucite, magnesite, etc.; at Montville, Morris Co., chrysotile and retinalite, with common serpentine, produced by the alteration of pyroxene. In *Penn.*, massive, fibrous, and foliated, at Texas, Lancaster Co.; at West Chester, Chester Co., *williamsite;* at Mineral Hill, Newtown, Marple, and Middletown, Delaware Co. In *Maryland*, at Bare Hills; at Cooptown, Harford Co., with diallage. In *California*, at various points in the Coast Range.

In *Canada*, abundant among the metamorphic rocks of the Eastern Townships and Gaspé peninsula, Quebec; at Thetford, Coleraine, Broughton, Orford, S Ham, Bolton, Shipton, Melbourne, etc. The fibrous variety chrysotile (asbestus, bostonite) often forms seams several inches in thickness in the massive mineral, and is now extensively mined for technical purposes. Massive Laurentian serpentine also occurs in Grenville, Argenteuil Co., Quebec, and North Burgess, Lanark Co., Ontario. In *N. Brunswick*, at Crow's Nest in Portland.

The names *Serpentine*, *Ophite*, *Lapis colubrinus*, allude to the green serpent-like cloudings of the serpentine marble. *Retinalite* is from *ῥετινη, resin; Picrolite*, from *πικρός, bitter*, in allusion to the magnesia (or Bittererde) present; *Thermophyllite*, from *θέρμη, heat*, and *φύλλον, leaf*, on account of the exfoliation when heated; *Chrysotile*, from *χρυσος, golden*, and *τίλος, fibrous; Metaxite*, from *μέταξα, silk; Marmolite*, from *μαρμαίρω, to shine*, in allusion to its peculiar luster.

Deweylite. A magnesian silicate near serpentine but with more water. Formula perhaps $4MgO.3SiO_2.6H_2O$. Amorphous, resembling gum arabic, or a resin. H. = 2–3·5. G. = 2·0–2·2. Color whitish, yellowish, reddish, brownish. Occurs with serpentine in the Fleimsthal, Tyrol; also at Texas, Penn., and the Bare Hills, Md. *Gymnite* of Thomson, named from *γυμνός, naked*, in allusion to the locality at Bare Hills, Md., is the same species.

Genthite. Nickel-Gymnite. A gymnite with part of the magnesium replaced by nickel, $2NiO.2MgO.3SiO_2.6H_2O$. Amorphous, with a delicate stalactitic surface, incrusting. H. = 3–4; sometimes very soft. G. = 2·409. Luster resinous. Color pale apple-green, or yellowish. From Texas, Lancaster Co., Pa., in thin crusts on chromite.

Garnierite. Noumeite. An important ore of nickel, consisting essentially of a hydrated silicate of magnesium and nickel, perhaps $H_2(Ni,Mg)SiO_4 + aq$, but very variable in composition, particularly as regards the nickel and magnesium; not always homogeneous. Amorphous. Soft and friable. G. = 2·3–2·8. Luster dull. Color bright apple-green, pale green to nearly white. In part unctuous; sometimes adheres to the tongue. Occurs in serpentine rock near Noumea, capital of New Caledonia, associated with chromic iron and steatite, where it is extensively mined. A similar ore occurs at Riddle in Douglas County, southern Oregon; also at Webster, Jackson Co., N. C.

TALC.

Orthorhombic or monoclinic. Rarely in tabular crystals, hexagonal or rhombic with prismatic angle of 60°. Usually foliated massive; sometimes in globular and stellated groups; also granular massive, coarse or fine; fibrous (pseudomorphous); also compact or cryptocrystalline.

Cleavage: basal, perfect. Sectile. Flexible in thin laminæ, but not elastic. Percussion-figure a six-rayed star, oriented as with the micas. Feel greasy. H. = 1–1·5. G. = 2·7–2·8. Luster pearly on cleavage surface. Color apple-green to white, or silvery-white; also greenish gray and dark green; sometimes bright green perpendicular to cleavage surface, and brown and less translucent at right angles to this direction; brownish to blackish green and reddish when impure. Streak usually white; of dark green varieties lighter than the color. Subtransparent to translucent. Optically negative. Ax. pl. ∥ *a*. Bx ⊥ *c*. Axial angle small. $\gamma - \alpha = 0{\cdot}035–0{\cdot}050$.

Var.—*Foliated, Talc.* Consists of folia, usually easily separated, having a greasy feel, and presenting ordinarily light green, greenish white, and white colors. G. = 2·55–2·78.

Massive, Steatite or *Soapstone* (Speckstein *Germ.*). *a.* Coarse granular, grayish green, and brownish gray in color; H. = 1–2·5. *Pot-stone* is ordinary soapstone, more or less impure. *b.* Fine granular or cryptocrystalline, and soft enough to be used as chalk; as the *French chalk*, which is milk-white with a pearly luster. *c. Indurated talc.* An impure slaty talc, harder than ordinary talc.

Pseudomorphous. a. Fibrous, fine to coarse, altered from enstatite and tremolite. *b. Rensselaerite*, having the form of pyroxene from northern New York and Canada.

Comp.—An acid metasilicate of magnesium, $H_2Mg_3(SiO_3)_4$ or $H_2O.3MgO.4SiO_2$ = Silica 63·5, magnesia 31·7, water 4·8 = 100. The water goes off only at a red heat. Nickel is sometimes present in small amount.

Pyr., etc.—In the closed tube B.B., when intensely ignited, most varieties yield water. In the platinum forceps whitens, exfoliates, and fuses with difficulty on the thin edges to a white enamel. Moistened with cobalt solution, assumes on ignition a pale red color. Not decomposed by acids. Rensselaerite is decomposed by concentrated sulphuric acid.

Diff.—Characterized by extreme softness, soapy feel; common foliated structure; pearly luster; it is flexible but inelastic. Yields water only on intense ignition.

Obs.—Talc or steatite is a very common mineral, and in the latter form constitutes extensive beds in some regions. It is often associated with serpentine, talcose or chloritic schist, and dolomite, and frequently contains crystals of dolomite, breunnerite, also asbestus, actinolite, tourmaline, magnetite.

Steatite is the material of many pseudomorphs, among which the most common are those after pyroxene, hornblende, mica, scapolite, and spinel. The magnesian minerals are

those which commonly afford steatite by alteration; while those like scapolite and nephelite, which contain soda and no magnesia, most frequently yield pinite-like pseudomorphs. There are also steatitic pseudomorphs after quartz, dolomite, topaz, chiastolite, staurolite, cyanite, garnet, vesuvianite, chrysolite, gehlenite. Talc in the fibrous form is pseudomorph after enstatite and tremolite.

Apple-green talc occurs at Mt. Greiner in the Zillerthal, Tyrol; in the Valais and St. Gothard in Switzerland; in Cornwall, near Lizard Point, with serpentine; the Shetland islands.

In N. America, foliated talc occurs in *Maine*, at Dexter. In *Vermont*, at Bridgewater, handsome green talc, with dolomite; Newfane. In *Mass.*, at Middlefield, Windsor, Blanford, Andover, and Chester. In *R. Island*, at Smithfield, delicate green and white in a crystalline limestone. In *N. York*, at Edwards, St. Lawrence Co., a fine fibrous talc (*agalite*) associated with pink tremolite; on Staten Island. In *N. Jersey*, Sparta. In *Penn.*, at Texas, Nottingham, Unionville; in South Mountain, ten miles south of Carlisle; at Chestnut Hill, on the Schuylkill, talc and also soapstone, the latter quarried extensively. In *Maryland*, at Cooptown, of green, blue, and rose colors. In *N. Car.*, at Webster, Jackson Co. In *Canada*, in the townships Bolton, Sutton, and Potton, Quebec, with steatite in beds of Cambrian age; in the township of Elzevir, Hastings Co., Ontario, an impure grayish var. in Archæan rocks.

SEPIOLITE. Meerschaum *Germ.* L'Écume de mer *Fr.*

Compact, with a smooth feel, and fine earthy texture, or clay-like; also rarely fibrous. H. = 2–2·5. G. = 2. Impressible by the nail. In dry masses floats on water. Color grayish white, white, or with a faint yellowish or reddish tinge, bluish green. Opaque.

Comp.—$H_4Mg_2Si_3O_{10}$ or $2H_2O.2MgO.3SiO_2$ = Silica 60·8, magnesia 27·1, water 12·1 = 100. Some analyses show more water ($2H_2O$), which is probably to be regarded as hygroscopic. Copper and nickel may replace part of the magnesium.

Pyr., etc.—In the closed tube yields first hygroscopic moisture, and at a higher temperature gives much water and a burnt smell. B.B. some varieties blacken, then burn white, and fuse with difficulty on the thin edges. With cobalt solution a pink color on ignition. Decomposed by hydrochloric acid with gelatinization.

Obs.—Occurs in Asia Minor, in masses in stratified earthy or alluvial deposits at the plains of Eskihi sher; at Hrubschitz in Moravia; in Morocco, called in French *Pierre de Savon de Maroc;* at Vallecas in Spain, in extensive beds.

A fibrous mineral, having the composition of sepiolite, occurs in Utah.

The word *meerschaum* is German for *sea-froth*, and alludes to its lightness and color. *Sepiolite* Glocker is from *σήπια*, *cuttle-fish*, the bone of which is light and porous; and being also a production of the sea, "deinde *spumam marinam* significabat," says Glocker.

Connarite. A hydrous nickel silicate, perhaps $H_4Ni_2Si_3O_{10}$. In small fragile grains. G. = 2·459–2·619. Color yellowish, green. From Röttis, in Saxon Voigtland.

Spadaite. Perhaps $5MgO.6SiO_2.4H_2O$. Massive, amorphous. Color reddish. From Capo di Bove, near Rome.

SAPONITE. Piotine.

Massive. In nodules, or filling cavities. Soft, like butter or cheese, but brittle on drying. G. = 2·24–2·30. Luster greasy. Color white, yellowish, grayish green, bluish, reddish. Does not adhere to the tongue.

Comp.—A hydrous silicate of magnesium and aluminium; but the material is amorphous and probably always impure, and hence analyses give no uniform results. Contains SiO_2 40–45 p. c., Al_2O_3 5–10 p. c., MgO 19–26 p. c., H_2O 19–21 p. c.; also Fe_2O_3, FeO, etc.

Pyr., etc.—B.B. gives out water very readily and blackens; thin splinters fuse with difficulty on the edge. Decomposed by sulphuric acid.

Obs.—Occurs in cavities in basalt, diabase, etc.; also with serpentine. Thus at Lizard Point, Cornwall, in veins in serpentine; at various localities in Scotland, etc.

Saponite is from *sapo, soap;* and piotine from *πιότης, fat.*

Celadonite. A silicate of iron, magnesium and potassium. Earthy or in minute scales. Very soft. Color green. From cavities in amygdaloid at Mte. Baldo near Verona.

Glauconite. Essentially a hydrous silicate of iron and potassium. Amorphous, and resembling earthy chlorite; either in cavities in rocks, or loosely granular massive. Color dull green. Abundant in the "green sand," of the Chalk formation, sometimes constituting 75 to 90 p. c. of the whole.

Pholidolite. Corresponds approximately to $5H_2O.K_2O.12(Fe,Mg)O.Al_2O_3.13SiO_2$. In minute crystalline scales. G. = 2·408. Color grayish yellow. From Taberg in Wermland, Sweden, with garnet, diopside, etc.

IV. Kaolin Division.

KAOLINITE. Kaolin.

Monoclinic; in thin rhombic, rhomboidal or hexagonal scales or plates with angles of 60° and 120°. Usually constituting a clay-like mass, either compact, friable or mealy.

Cleavage: basal, perfect. Flexible, inelastic. H. = 2–2·5. G. = 2·6–2·63. Luster of plates, pearly; of mass, pearly to dull earthy. Color white, grayish white, yellowish, sometimes brownish, bluish or reddish. Scales transparent to translucent; usually unctuous and plastic.

Optically biaxial, negative. $Bx_o \perp b$. Bx_a and ax. pl. inclined behind some 20° to normal to *c* (001) Dick. Axial angle large, approx. 90°.

Var.—1. *Kaolinite.* In crystalline scales, pure white and with a satin luster in the mass. 2. *Ordinary.* Common kaolin, in part in crystalline scales but more or less impure including the compact *lithomarge.*

Comp.—$H_4Al_2Si_2O_9$, or $2H_2O.Al_2O_3.2SiO_2$ = Silica 46·5, alumina 39·5, water 14·0 = 100. The water goes off at a high temperature, above 330°.

Pyr., etc.—Yields water. B.B. infusible. Gives a blue color with cobalt solution. Insoluble in acids.

Diff.—Characterized by unctuous, soapy feel and the alumina reaction B.B. Resembles infusorial earth, but readily distinguished under the microscope.

Obs.—Ordinary kaolin is a result of the decomposition of aluminous minerals, especially the feldspar of granitic and gneissoid rocks and porphyries. In some regions where these rocks have decomposed on a large scale, the resulting clay remains in vast beds of *kaolin*, usually more or less mixed with free quartz, and sometimes with oxide of iron from some of the other minerals present. Pure kaolinite in scales often occurs in connection with iron ores of the Coal formation. It sometimes forms extensive beds in the Tertiary formation, as near Richmond, Va. Also met with accompanying diaspore and emery or corundum.

Occurs in the coal formation in Belgium; Schlan in Bohemia; in argillaceous schist at Lodève, Dept. of Hérault, France; as kaolin at Diendorf (Bodenmais) in Bavaria; at Schemnitz; with fluor at Zinnwald. Yrieix, near Limoges, is the best locality of kaolin in Europe (a discovery of 1765); it affords material for the famous Sèvres porcelain manufactory. Large quantities of clay (kaolin) are found in Cornwall and West Devon, England.

In the U. States, kaolin occurs at Newcastle and Wilmington, Del.; at various localities in the limonite region of Vermont (at Brandon, etc.), Massachusetts, Pennsylvania; Jacksonville, Ala.; Edgefield, S. C.; near Augusta, Ga.

The name *Kaolin* is a corruption of the Chinese *Kauling*, meaning *high-ridge*, the name of a hill near Jauchau Fu, where the material is obtained.

Pholerite Near kaolinite, but some analyses give 15 p. c. water. The original was from the coal mines of Fins, Dept. of Allier, France.

HALLOYSITE.

Massive. Clay-like or earthy.

Fracture conchoidal. Hardly plastic. H.= 1–2. G. = 2·0–2·20. Luster

somewhat pearly, or waxy, to dull. Color white, grayish, greenish, yellowish, bluish, reddish. Translucent to opaque, sometimes becoming translucent or even transparent in water, with an increase of one-fifth in weight.

Var.—*Ordinary*. Earthy or waxy in luster, and opaque massive. *Galapectite* is halloysite of Anglar. *Pseudosteatite* of Thomson & Binney is an impure variety, dark green in color, with H. = 2·25, G. = 2·469. *Indianaite* is a white porcelain clay from Lawrence Co., Indiana, where it occurs with allophane in beds four to ten feet thick.

Smectite is greenish, and in certain states of humidity appears transparent and almost gelatinous; it is from Condé, near Houdan, France.

Bole, in part, may belong here; that is, those colored, unctuous clays containing more or less iron oxide, which also have about 24 p. c. of water; the iron gives them a brownish, yellowish or reddish color; but they may be mixtures. Here belongs *Bergseife* (mountain-soap).

Comp.—A silicate of aluminium ($Al_2O_3.2SiO_2$) like kaolinite, but amorphous and containing more water; the amount is somewhat uncertain, but the formula is probably to be taken as $H_4Al_2Si_2O_9$ + aq, or $2H_2O.Al_2O_3.2SiO_2$ + aq = Silica 43·5, alumina 36·9, water 19·6 = 100.

Pyr., etc.—Yields water. B.B. infusible. A fine blue with cobalt solution. Decomposed by acids.

Obs.—Occurs often in veins or beds of ore, as a secondary product; also in granite and other rocks, being derived from the decomposition of some aluminous minerals.

Newtonite. $H_8Al_2Si_2O_{11}$ + aq. In soft white compact masses resembling kaolin. Found on Sneed's Creek in the northern part of Newton Co., Arkansas.

Cimolite. A hydrous silicate of aluminium, $2Al_2O_3.9SiO_2.6H_2O$. Amorphous clay-like, or chalky. Very soft. G. = 2·18–23·0. Color white, grayish white, reddish. From the island of Argentiera (Kimolos of the Greeks).

Montmorillonite. Probably $H_2Al_2Si_4O_{12}$ + *n* aq. Massive, clay-like. Very soft and tender. Luster feeble. Color white or grayish to rose-red, and bluish; also pistachio-green. Unctuous. *Montmorillonite*, from Montmorillon, France, is rose-red. *Confolensite* is paler rose-red; fr. Confolens, Dept. of Charente, at St. Jean-de-Côle, near Thiviers.

Stolpenite is a clay from the basalt of Stolpen. *Saponite* of Nicklès is a white, plastic, soap-like clay from the granite from which issues one of the hot springs of Plombières, France, called *Soap Spring;* it was named *smegmatite* by Naumann.

PYROPHYLLITE.

Monoclinic? Foliated, radiated lamellar or somewhat fibrous; also granular to compact or cryptocrystalline; the latter sometimes slaty.

Cleavage: basal, eminent. Laminæ flexible, not elastic. Feel greasy. H. = 1–2. G. = 2·8–2·9. Luster of folia pearly; of massive kinds dull and glistening. Color white, apple-green, grayish and brownish green, yellowish to ocher-yellow, grayish white. Subtransparent to opaque. Optically −. Bx ⊥ cleavage. Ax. angle large, to 108°.

Var.—(1) *Foliated*, and often radiated, closely resembling talc in color, feel, luster and structure. (2) *Compact massive*, white, grayish and greenish, somewhat resembling compact steatite, or French chalk. This compact variety includes part of what has gone under the name of agalmatolite, from China; it is used for slate-pencils, and is sometimes called *pencil-stone.*

Comp.—$H_2Al_2(SiO_3)_4$ or $H_2O.Al_2O_3.4SiO_2$ = Silica 66·7, alumina 28·3, water 5·0 = 100.

Pyr., etc.—Yields water, but only at a high temperature. B.B. whitens, and fuses with difficulty on the edges. The radiated varieties exfoliate in fan-like forms, swelling up to many times the original volume of the assay. Heated and moistened with cobalt solution gives a deep blue color (alumina). Partially decomposed by sulphuric acid, and completely on fusion with alkaline carbonates.

Diff.—Resembles some talc, but distinguished by the reaction for alumina with cobalt solution.

Obs.—Compact pyrophyllite is the material or base of some schistose rocks. The foliated variety is often the gangue of cyanite. Occurs in the Ural; at Westanå, Sweden; near Ottrez, Luxembourg; Ouro Preto, Brazil.

Also in white stellate aggregations in Cottonstone Mtn., Mecklenburg Co., N. C.; in Chesterfield Dist., S. C., with lazulite and cyanite; in Lincoln Co., Ga., on Graves Mtn. The compact kind, at Deep River, N. C., is extensively used for making slate-pencils and resembles the so-called agalmatolite or pagodite of China, often used for ornamental carvings.

ALLOPHANE.

Amorphous. In incrustations, usually thin, with a mammillary surface, and hyalite-like; sometimes stalactitic. Occasionally almost pulverulent.

Fracture imperfectly conchoidal and shining, to earthy. Very brittle. H. = 3. G. = 1·85–1·89. Luster vitreous to subresinous; bright and waxy internally. Color pale sky-blue, sometimes greenish to deep green, brown, yellow or colorless. Streak uncolored. Translucent.

Comp.—Hydrous aluminium silicate, Al_2SiO_5 + $5H_2O$ = Silica 23·8, alumina 40·5, water 35·7 = 100. Some analyses give 6 equivalents of water = Silica 22·2, alumina 37·8, water 40·0 = 100.

Impurities are often present. The coloring matter of the blue variety is due to traces of chrysocolla, and substances intermediate between allophane and chrysocolla (mixtures) are not uncommon. The green variety is colored by malachite, and the yellowish and brown by iron.

Pyr., etc.—Yields much water in the closed tube. B.B. crumbles but is infusible. Gives a blue color with cobalt solution. Gelatinizes with hydrochloric acid.

Obs.—Allophane is regarded as a result of the decomposition of some aluminous silicate (feldspar, etc.); and it often occurs incrusting fissures or cavities in mines, especially those of copper and limonite, and even in beds of coal.

Named from *αλλος, other*, and *φαίνεσθαι, to appear*, in allusion to its change of appearance under the blowpipe.

Collyrite. $2Al_2O_3.SiO_2.9H_2O$. A clay-like mineral, white, with a glimmering luster, greasy feel, and adhering to the tongue. G. = 2–2·15. From Ezquerra in the Pyrenees.

Schrötterite. $8Al_2O_3.3SiO_2.30H_2O$. Resembles allophane; sometimes like gum in appearance. H. = 3–3·5. G. = 1·95–2·05. Color pale green or yellowish. From Dollinger mountain, near Freienstein, in Styria; at the Falls of Little River, on the Sand Mtn., Cherokee Co., Alabama.

The following are clay-like minerals or mineral substances: Sinopite, smectite, catlinite.

Cenosite. $H_4Ca_2(Y,Er)_2CSi_4O_{17}$. Color yellowish brown. From Hitterö, Norway.

Thaumasite. $CaSiO_3.CaCO_3.CaSO_4.15H_2O$. Massive, compact, crystalline. Cleavage in traces. H. = 3·5. G. = 1·877. Color white. Occurs filling cavities and crevices at the Bjelke mine, near Åreskuta, Jemtland, Sweden; at first soft, but hardens on exposure to the air. Also in fibrous crystalline masses at Paterson, N. J.

Uranophane Uranotil. $CaO.2UO_3.2SiO_2 + 6H_2O$. In radiated aggregations; massive, fibrous. G. = 3·81–3·90. Color yellow. From the granite of Kupferberg, Silesia. *Uranotil* occurs at Wölsendorf, Bavaria; Mitchell Co., N. C.

CHRYSOCOLLA.

Cryptocrystalline; often opal-like or enamel-like in texture; earthy. Incrusting or filling seams. Sometimes botryoidal.

Fracture conchoidal. Rather sectile; translucent varieties brittle. H. = 2–4. G. = 2–2·238. Luster vitreous, shining, earthy. Color mountain-green, bluish green, passing into sky-blue and turquois-blue; brown to black when impure. Streak, when pure, white. Translucent to opaque.

Comp.—True chrysocolla appears to correspond to $CuSiO_3$ + $2H_2O$ = Silica

34·3, copper oxide 45·2, water 20·5 = 100, the water being double that of dioptase.

Composition varies much through impuities; free silica, also alumina, black oxide of copper, oxide of iron (or limonite) and oxide of manganese may be present; the color consequently varies from bluish green to brown and black.

Pyr., etc.—In the closed tube blackens and yields water. B.B. decrepitates, colors the flame emerald-green, but is infusible. With the fluxes gives the reactions for copper. With soda and charcoal a globule of metallic copper. Decomposed by acids without gelatinization.

Obs—Accompanies other copper ores, occurring especially in the upper part of veins. Found in copper mines in Cornwall; Hungary; Siberia; Saxony; South Australia; Chili, etc.

In the U. S., similarly at the Schuyler's mines, New Jersey; at Morgantown, Pa.; at the Clifton mines, Graham Co., Arizona; Emma mine, Utah.

Chrysocolla is from *χρυσος, gold,* and *κόλλα, glue,* and was the name of a material used in soldering gold. The name is often applied now to borax, which is so employed.

CHLOROPAL.

Compact massive, with an opal-like appearance; earthy.

H. = 2·5–4·5. G. = 1·727–1·870, earthy varieties, the second a conchoidal specimen; 2·105, Ceylon, Thomson. Color greenish yellow and pistachio-green. Opaque to subtranslucent. Fragile. Fracture conchoidal and splintery to earthy. Feebly adhering to the tongue, and meager to the touch.

Var.—*Chloropal* has the above-mentioned characters, and was named from the Hungarian mineral occurring at Unghwar.

Nontronite is pale straw-yellow or canary-yellow, and greenish, with an unctuous feel; flattens and grows lumpy under the pestle, and is polished by friction; from Nontron, Dept. of Dordogne, France. *Pinguite* is siskin- and oil-green, extremely soft, like new-made soap, with a slightly resinous luster, not adhering to the tongue; from Wolkenstein in Saxony. *Graminite* has a grass-green color (whence the name), and occurs at Menzenberg, in the Siebengebirge, in thin fibrous seams, or as delicate lamellæ.

Comp.—A hydrated silicate of ferric iron, perhaps with the general formula $H_6Fe_2(SiO_4)_3 + 2H_2O$ or $Fe_2O_3.3SiO_2.5H_2O$ = Silica 41·9, iron sesquioxide 37·2, water 20·9 = 100. Alumina is present in some varieties.

The water and silica both vary much. The Hungarian chloropal occurs mixed with opal, and graduates into it, and this accounts for the high silica of some of its analyses.

Obs.—Localities mentioned above. *Chloropal* occurs also at Meenser Steinberg near Göttingen; *pinguite* at Sternberg, Moravia. On Lehigh Mt., Pa., south of Allentown, occurs in connection with iron deposits.

HŒFERITE. An iron silicate near chloropal. Color green. From Křitz, Bohemia.

Hisingerite. A hydrated ferric silicate, of uncertain composition. Amorphous, compact. Fracture conchoidal. H. = 3. G. = 2·5–3·0. Luster greasy. Color black to brownish black. Streak yellowish brown. From Riddarhyttan, Tunaberg, Sweden; Långban, etc., Norway.

The following are hydrous manganese silicates.

Bementite. Approximately $2MnSiO_3.H_2O$. In soft radiated masses resembling pyrophyllite. G. = 2·981. Color pale grayish yellow. From the zinc mines of Franklin Furnace, N. J.

Caryopilite. Approximately $4MnO.3SiO_2.3H_2O$. In stalactitic and reniform shapes. G. = 2·83–2·91. Color brown. From the Harstig mine near Pajsberg, Sweden.

Neotocite. A hydrated silicate of manganese and iron, of doubtful composition, usually derived from the alteration of rhodonite. Amorphous Color black to dark brown and liver-brown.

TITANO-SILICATES, TITANATES.

This section includes the common calcium titano-silicate, Titanite; also a number of silicates which contain titanium, but whose relations are not altogether clear; further the titanate, Perovskite, and niobo-titanate, Dysanalyte, which is intermediate between Perovskite and the species Pyrochlore, Microlite, Koppite of the following chapter.

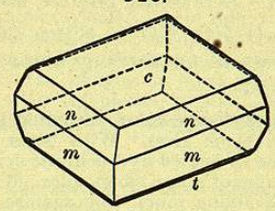
In general the part played by titanium in the many silicates in which it enters is more or less uncertain. It is probably in most cases, as shown in the preceding pages, to be taken as replacing the silicon; in others, however, it seems to play the part of a basic element; in schorlomite (p. 419) it may enter in both relations.

TITANITE. Sphene.

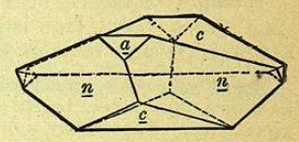
Monoclinic. Axes $\breve{a} : \dot{b} : \dot{c} = 0·7547 : 1 : 0·8543$; $\beta = 60° 17'$.

mm''',	110 ∧ $1\bar{1}0$ =	66° 29′.
cx,	001 ∧ $10\bar{2}$ =	21° 0′.
ss',	021 ∧ $0\bar{2}1$ =	112° 3′.
nn',	111 ∧ $1\bar{1}1$ =	43° 49′.
ll',	$\bar{1}12$ ∧ $\bar{1}\bar{1}2$ =	46° 7½′.
cn,	001 ∧ 111 =	38° 16′.
cm,	001 ∧ 110 =	65° 30′.
cl,	001 ∧ $\bar{1}12$ =	40° 34′.

916.

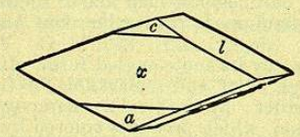


918.

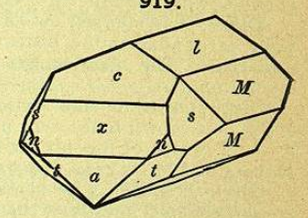


Twins: tw. pl. *a* rather common, both contact-twins and cruciform penetration-twins. Crystals very varied in habit; often wedge-shaped and flattened ∥ *c*; also prismatic. Sometimes massive, compact; rarely lamellar.

917.

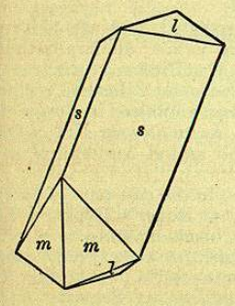


919.

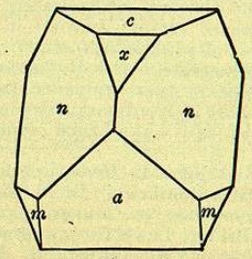


Cleavage: *m* rather distinct; *a*, *l* ($\bar{1}12$) imperfect; in greenovite, *n* (111) easy, *t* ($\bar{1}11$) less so (Dx.). Parting often easy ∥ *η* (221) due to twinning

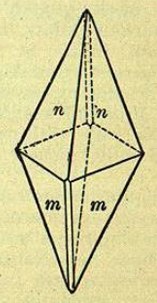
920.



921.



922.



923.

lamellæ. H. = 5–5·5. G. = 3·4–3·56; 3·541 Chester, Pirsson. Luster adamantine to resinous. Color brown, gray, yellow, green, rose-red and black. Streak white, slightly reddish in greenovite. Transparent to opaque.