CHAMPASITE. Contains iron (FeO) with but little MgO. Occurs compact or conchoidal with H. about 3; G, 2-3-4; color greenish gray to black. From Clamtown, near St. Michael, in Upper St. Mary's.

Silicopinacite. An iron silicate. In foliated plates; also fibrous, or as a velvety coating. H, 1-2; G, 2-2-3-5. Color black, greenish black. Occurs at Overburg and elsewhere in Sierra; also in Nova Scotia; Wilburn, Massena. Chlorite, from the Stelzig Iron mine, in Antwerg, Jefferson Co., N. Y., occurring lamellate and nodular, is the same mineral in the coating of minus-sizes with a bronzé color.

Strigivite. Fe₂₃O₄Al₂O₃SiO₄. In aggregations of minute crystals. Color dark green. Occurs as a fine coating over the minerals in cavities of the striegite in Stoligum.

Rumpfite. H₂Mg₆Al₄Si₈O₂₀. Massive; granular, consisting of very fine scales. Color greenish white. Occurs in talc near St. Michael in Upper St. Mary's.

APPENDIX TO THE MICA DIVISION.—VERMICULITES.

The Vermiculites Group includes a number of micaceous minerals, all hydrated silicates, in part closely related to the chlorites, but occurring 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 minerals in general are soft, phyllic, and foliated; the latter nearly or bronze-like, and the color varies from white to yellow and brown. Hardened to 100°-110° or direct over albite, all of the vermiculites lose considerable water, up to 10 per cent., which is probably by anhydrous. At 80° another portion is often given off, and 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 these minerals lose water at different temperatures. This character has given the name to the group, from the Latin versicolori, to breed white.

The minerals included can hardly rank as distinct species and only their names can be given here: Aluminite, sericite, celadonite, hettite, talcite, phlogopite, muscovite, illite, etc.

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 before. Some other magnesium silicates, in part amorphous, are included with them.

SERPENTINE.

MONOCLINITE. 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; silky. Crystalline in structure but often by compression nearly isotropic; angular. Cleavage 010, sometimes distinct; also prismatic (56°) in chlorisite. Fracture usually conchoidal or splintery. Feel smooth, sometimes greasy. H, 2-3-3; G, 2-3-3; some fibrous varieties 2-3-3; reticulated, 2-3-3. Luster submetalline to greasy, nearly earthy; resin-like; usually feeble. Color leek-green, blackish green; oil- and skin-green; brownsish 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 chrysoellite. Double refraction weak. A. 1.000; B. 1.000; X. 1.000; y = 1.00; y = a. 0.011. Lévy et Lévy.

Varieties. — Many unclassified species have been made out of serpentine, differing in structure (massive, gysy, foliated, fibrous), or, as supposed, in chemical composition; and these may show some analogy to the talc or chlorite varieties, along with some others based on variations in texture and appearance. A. In CRYSTALS—SERPENTINE. The most common have the form of chlorite. B. In Pseudomorphs after Pyroxene, Amphibole, Plagioclase, Chalcedony, Gneiss, and Granite, etc. C. In Amphibole, Serpentine, and Amphidote, or Serpentine, with or without impurities. D. In Coarse, coarsely crystalline, and fibrous varieties. E. In Serpentine, with a mixed character, and mixed with other minerals.

Pleochroism feeble. Optically — perhaps also + in chrysoellite. Double refraction weak. A. 1.000; B. 1.000; X. 1.000; y = 1.00; y = y. 0.011. Lévy et Lévy.

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Descriptive Mineralogy.

Silicate.

Deweyite. A manganous silicate near serpentine but with more water. Formula perhaps \(3\text{Mg}_2\text{SiO}_4\cdot2\text{H}_2\text{O}\). Amorphous, resembling gunsmoke, or a resin. \(H = 3-3.5\). \(G = 2.9-3.2\). Color bluish, yellowish, reddish, brownish. Occurs with serpentine in the Fenestral Tyrol; also at Texas, Pana, and the Bare Hills Md. Granulate of Thomson, named from \(\text{tuhrs}\), nether, in allusion to the locality near Bare Hills, Md., is the same species.


Garnierite. Neninite. An important ore of nickel, consisting essentially of a hydrated silicate of magnesium and nickel, perhaps \(\text{Ni}_2\text{Mg}_3\text{SiO}_4\cdot2\text{H}_2\text{O}\). Amorphous, with a delicate mica-like surface, incrustation \(H = 1\). Niccolite very soft. \(G = 2.40-2.42\). Luster vitreous. Color pale green, or yellowish. From Texas, Lancaster Co., Pa., in thin crusts on chromite.

Talc.

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

Clearance: basal, perfect. Seizite. Flexible in thin laminae, but not elastic. Permeation figures a six-rayed star, oriented as with the mica. Fracture on an angle of 90°, \(H = 1-1.5\). \(G = 2.7-3.2\). Luster pearly on cleavage surface. Color apple-green to white, or silver-white; also greenish grey and dark green; sometimes in bands; crystals in tabular, prismatic, or mica-like, fibrous, or scaly form; and brown and less frequent in massive form; \(H = 1\). Flat crystals at right angles to this direction; blackish to brownish green and reddish when impure. Sustained only white; of dark green varieties lighter than the color. Slightly transparent to translucent. Optically negative. Ax. pl. 4. Bx. pl. 4. A. axial angle small.

Var. — Foliated. Talc. Consists of folia, usually easily separated, having a greenish feel, and presenting ordinarily light green, greenish white, and white colors. \(G = 2.6-2.7\). Mesite, Serpentine or Serpentine. Stick-sawed form. 

Comp. — An acicular metallicate of magnesium, \(\text{Mg}_2\text{SiO}_4\), or \(\text{Mg}_3\text{SiO}_4\) and \(\text{SiO}_2\) as in serpentine. 

Geology. — The mineral forms a common constituent of the earth's crust, occurring in various forms and compositions. It is commonly found in contact with other metamorphic rocks, and is often associated with serpentine, talc, and chlorite.
those which commonly afford stenite by alteration; while those like scapolite and nepheline, which contain soda and no magnesia, most frequently yield philitic-like pseudomorphs. The silica is also stenitic pseudomorph after quartz, dolomite, topaz, clinochlore, scapolite, fayalite, garnet, vesuvianite, crysotile, gehlenite. Tale in the thomson form is pseudomorph after cassiterite and tremolite.

Apple-green talc occurs at Mt. Green in the Zillerthal, Tyrol; in the Valais and St. Gotthard in Switzerland; in Cornwall, near Lizard Point, with serpentine, the St. Ives Island.

In N. America, foliated talc occurs in Mount, at Dexter, in Vermont, at Bridgewater, handsome green talc, with dolomite; Newhalem, in Miss., at Middlefield, Windsor, Blanford, Antwerp, and Clifton, in N. J., at Jersey, Sparta, in Pines, at Texas, at Nottingham, Unionville, in South Mountain, ten miles south of Carrollville, at Osbourn-Yarry, tall and also serpentine, the latter quarried extensively. In Maryland, at Coopscour, of green, blue, and rose colors. In N. Conn., at Webster, Jackson Co. In Canada, in the townships Bolton, Snotin, and Ponton, Quebec, with serpentine in beds of Cambrian age; in the township of Erskine, Hastings Co., Ontario, an impure grayish var. in Argus, rocks.

SEPIOLITE. Merriam Gerna. L’Eocene de mer Pr.

Compact, with a smooth feel, and fine earthy texture, or clay-like; also rare fine fibrous. H. = 2–2.5. G. = 2–2.8. Impressive 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.—H₂Mg₂Si₄O₁₀·2H₂O = Silica 60%: magnesium 27.1, water 12.1–100. Some analyses show more water (2H₂O), which is probably to be regarded as hygroscopic. Copper and nickel may replace part of the magnesium.

Pyro. 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 edge. With cobalt solution a pink color on ignition. Decomposed by hydrochloric acid with gelatinization. Obs.—Occurs in Austria Minor, in masses in stratiﬁed earthy or alluvial deposits at the place of rocks in Moravia, in Morocco, called in French Pierre de Sore de Moro; at Vallieres in Spain, in extensive beds. A ﬁbreous mineral, having the composition of seppellite, occurs in Utah. The word merriamite is German for sepiolite, and alludes to its lightness and color. Sepiolite Glasper is from ärten, cupa, the bone of which is light and porous, and being also a production of the sea, “dritte argumentum marneum signiﬁcavit,” says Glocker. Conantite is a hydrous limonite, perhaps H₂Mg₂Si₄O₁₀. In small fragile grains. G. = 2.53–2.61. Color yellowish-green. From Kalkin, in Saxony, Vogtland.

Spaatite. Perhaps Mg₃Si₃O₈, 4H₂O: Massive, amorphous. Color reddish from Cupro di Bove, near Rome.

SAPONITE. Potassic.


Pyro. 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.

SILICATES.

Saponite is from sapo, soap; and plissage from visage, face.


Glaucolite. Essentially a hydrous silicate of iron and potassium. Amorphous and resembling earthy chlorite; either in cavities in rocks, or loosely granular mass. Color does not stick, adherent to the “green sand,” of the Osaka formation, sometimes consisting of 75 to 90% c. of the whole.

Phlogopite. Corresponds approximately to Mg₃[Al₂O₄·Fe₂O₃], MgAl₂O₄·2SiO₂. In minerals; crystalline scales. G. = 3.2–3.3. Color greenish yellow. From Tuyberg in Denmark, Sweden, with garnet, diopside, etc.

IV. Kaolinite Division.

KAOLINITE. Kaolin.

Monoclinic; thin rhombic, rhombohedral or hexagonal scales or plates with angles of 60° and 120°. Usually consisting of a clay-like mass, either compact, friable or mussy. Cleavage: basal, perfect. Flexible, inelastic. H. = 2–2.5. G. = 2.6–2.7. Luster of plates, pearly; of mass, pearly to dull earthy. Color white, grayish white, yellowish, somtimes brownish, bluish or reddish. Scales transparent to translucent; usually amorphous and plastic. Optically biaxial, negative. Bx., Bx., 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. Ordinarily. Common kaolin, in part in crystalline scales but more or less impure including the compact kaolinite.

Comp.—H₃[Al₂O₃·Si₂O₅], 2H₂O = Silica 46.5: alumina 39.5, water 14.0 = 100. The water goes off at a high temperature, above 330°C.


Diff.—Characterized by an astringent, sour feel and the alumina reaction B.B. Resembles kaolin texturally, but readily distinguished under the microscope.

Obs.—Ordinary kaolin is a result of the decomposition of aluminum minerals, especially the feldspar of granite and gneissoid rocks and porphyry. In some regions where these rocks have decomposed on a large scale, the resulting clay remains in vast beds of kaolinite, usually more or less mixed with free quartz, and sometimes with calcite or iron from some of the other minerals present. Pure kaolinite in scales often occurs in contact with less decomposed parts of the rock. It sometimes forms extensive beds in the Tertiary formations, near Richmond, Va. Also met with accompanying diaspore and enairy or cordierite.

Occurs in the coal formation in Belgium; Schlan in Bohemia; in argillaceous schist at Lodève, Dept. of Hérault, France; in kaolinite at Dernedorf (Bodenwalde) in Bavaria; at Schernitz, with ﬂour at Ziencow. Whyls, near Linnes, is the best locality of kaolinite in Europe (a discovery of 1769); it affords material for the famous Sèvres porcelain manufacture. Large quantities of clay (kaolin) are found in Cornwall and West Devon, England.

In the U. S. State, kaolinite occurs at Newcastle and Wilmington, Del.; at various localities in the Mississippi region of Vermont (at Brandon, etc.), Massachusetts, Pennsylva-

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

HALICYSTITE.

Massive. Clay-like or earthy.

Fracture conchoidal. Hardly plastic. H. = 1–2. G. = 2.9–2.9. 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 lustre, and opaque massive. Giganteite is a balsam-like of Anguila. *Pseudodiorite* of Tummon & Binney is an impure variety, dark green in color; with H = 3-3. G = 3-4. *Indiaste* is a white porcelain clay from Lawrence Co., Indiana, where it occurs with alabaster in beds four to ten feet thick.

Silicate is greenish, and in certain states of humidity appears transparent and almost palatable; it is from Ojuela, near Hermosillo, Mexico.

*Calcite*, in part, may belong here; that is, those colored, uneneous clays containing more or less iron oxide, which also here about 38 c.c. of water, the fire gives them a brownish, yellowish or reddish color; but they may be mixtures. Here belongs Breyer's montains-socket.

Comp.—A silicate of aluminum (Al₂O₃SiO₃) like kaolinite, but amorphous and containing more water; the amount is somewhat uncertain, but the formula is probably to be taken as H₃Al₅Si₅O₁₈·aq, or 2H₃O·Al₃O₃SiO₂,·aq = Silica 35-3, alumina 36-3, water 18% = 100.

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

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

Newtonite. H₃Al₅Si₅O₁₈·aq. In soft white compact masses resembling kaolin. Found near Smokey Creek in the northern part of Newton Co., Arkansas.


Staurolite is a clay from the behalf of Sudwik. Sepolite of Nickels is a white, plastic, soap-like clay from the granite from which issues one of the hot springs of Pitorias, France, called Soop Spring; it was named staurolite by Naumann.

**PYROPHYLITE**

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


Var.—(1) Foliated, and often radiated, closely resembling tite in color, feel, lustre and structure. (2) Compact masses, white, grayish and greenish, somewhat resembling compact chalcopyrite, or French chalk. This compact variety includes part of what has been under the name of agnamine, from China; it is used for paste-stones, and is sometimes called pyroxphantes.

Comp.—H₃Al₅Si₃O₁₈, or H₂O·Al₂O₃SiO₂,·aq = Silica 67%, alumina 23%, water 3% = 100.

Pyr., etc.—Yields water, but only at a high temperature. B.B. whitens, and fuses with difficulty on the cobalt. This variety is known as the aluminite of wolfeite.

**SILICATE**

Diff.—Resembles some slate, but distinguished by the reaction with aluminum for coal.

Obs.—Compacted pyrophyllite is the material of some slate-like rocks. The foliated variety occurs in the agnamine of slate. The compact variety occurs in slate-like slate.

Oxidized in North Carolina, Mendenhall Co., N.C.; at Chatsworth, S.C., with forsterite and calcite; in Lincoln Co., Ga., at Rogers Mtn. The compact kind, at Deep River, N. C., is extensively used for making slate-pencils and inks; also used as the so-called agniomine or plate of China, often used for ornamental carvings.

**ALLOGY**

Amorphous. In inclusions, usually thin, with a mammillar surface, and hydrous-like; sometimes stelarvite. Occasionally almost pulverulent. Fracture imperfectly conchoidal and shining to earthy, very brittle.

Var. = 2. G = 1.85-1.89. Luster vitreous to sublustrous; bright and waxy internally. Color pale sky-blue, sometimes greenish to deep gray, brown, yellow or colorless. Streak uncolored. Translucent.

Comp.—Hydrous silicate of aluminum, Al₂O₃·5H₂O = Silica 25%, alumina 45%, water 30% = 100. Some analyses give 6 equivalents of water = Silica 25%, alumina 37%, water 40% = 100.

Importance often present. The coloring matter of the blue variety is due to traces of chrysocolla, and substances intermediate between allogyte 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 fusible. Gives a blue color with cobalt solution. Distinctly with hydrous acid.

Obs.—Oxychlorite is regarded as a result of the decomposition of some aluminous silicate (feldspar, etc.); and it often occurs inclusions in felspars in minerals, especially those of copper and limonite, and in a few beds of coal. Named from a Greek, after, and *phoros*, to appear, in allusion to its change of appearance under the bleaching.

Collyrite. 2Al₂O₃SiO₂,·aq. A clay-like mineral, white, with a glistening luster, glossy feel, and adhering to the tongue. G = 2.7-2.8. From Esquerr in the Pyrenees. Subhassite. 8Al₂O₃·3H₂O = 4SiO₂·3H₂O. A clay-like silicate, sometimes like glass to appearance. G = 2.9-3.0. G = 1.95-2.05. Color red or green or yellow. From Dillingen mountain, near Freienau, in Siria; at the Falls of Little River, on the Sand Mt., Cherohala Co., Alabama. The following are clay-like minerals or mineral substances: Stopeite, smectite, calcitite.


**CHROMOLEA**

Cerophylleite; crystalline; often opal-like or enamel-like in texture; earthy. Incrustating or filling seams. Sometimes botryoidal.

Fracture conchoidal. Rather sectile; transparent varieties brittle. G = 3-3.5. Light purple, bluish, yellow, or black. Earthy, on mountain-green, bluish green, passing into sky-blue and turquoise-blue; brown to black when impure. Streak, when pure, white. Translucent to opaque.

Comp.—True chrysocolla appears to correspond to Cu₂SiO₃·5H₂O = Silica
34.3, copper oxide 45.2, water 20.5 = 100, the water being double that of diopside.

Composition varies much through impurities; 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. decuples, colors the flame emerald-green, but is inflammable. With the fluxes gives the reactions for copper. With acids and charcoal a globule of metallic copper. Decomposed by acids without gelatinization.

Che.—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 mine, New Jersey; at Morgantown, Pa.; at the Clifton mines, Graham Co., Arizona; Emma mine, Utah.

Chloroprase is from gen. pras, gold, and chloros, green, and was the name of a material used in soldering gold. The name is often applied now to brass, which is so employed.

CHLOROPHANE


Var.—Chloroprase has the above-mentioned characters, and was named from the Hungarian mineral occurring at Ungvar.

Rostrhale is pale straw-yellow or canary-yellow, and greenish, with an unctuous feel; fissures and grooves humpy under the puzzle, and is polished by friction: from Nonsort, Dept. of Aisne, France. Prasigale is sickly- and oil-green, extremely soft, like new-made soap, with a slightly resinous luster, not adhering to the tongue; from Wolfsenstein in Saxony. Orasimii has a grass-green color (the name of the museum), and occurs at Meersberg in the Siebenurbige, in this florine seams, or as delicate lamelle.

Comp.—A hydrated silicate of ferric iron, perhaps with the general formula 

F2O(OH)2 + 2H2O or Fe2O3 + 3H2O, = Silica 41.9, Iron sesquioxide 57.9, water 20.9 = 100. Alumina is present in some varieties.

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

Ob.—Localities mentioned above. Chloroprase occurs also at Meersberg Steinberg near Graz; monticules at Steinberg, Moravia. On Lehedi Kt., Pa., south of Allentowns, occurs in connection with iron deposits.


The following are hydrous manganese silicates.


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

TITANO-SILICATES, TITANIATES.

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

In general the play to be titanium in the many silicates in which it enters is more or less uncertain. It is probaly 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 schorlite (6. 410) it may enter in both relations.

TITANITE. Apatite. Axial α : β : γ = 0.76 : 0.94 : 1. 0.84; β = 60° 12'.

Twins: tw. pl. a rather common, both contacting twins and octomorph penetration-twins. Crystals varied in habit: often wedge-shaped and flattened; also prismatic. Sometimes massive, compact; rarely lamellar.

Cleavage: four rather distinct; {111} imperfect; in greenowite, a (111) easy, l (111) less so (Dx.). Parting often easy {111} due to twinning.

Lamelle. H. = 5-5.5. G. = 3.4-3.56; 3.54. Chester, Pirson. Luster adamantine to resinous. Color brown, gray, yellow, green, rose-red and black. Streak white, slightly reddish in greenowite. Transparent to opaque.