

Oxygen Salts.

5. BORATES.

The aluminates, ferrates, etc., allied chemically to the borates, have been already introduced among the oxides. They include the species of the Spinel Group, pp. 337-341, also Chrysoberyl, p. 342, etc.

SUSSEXITE.

In fibrous seams or veins. $H. = 3$. $G. = 3.42$. Luster silky to pearly. Color white with a tinge of pink or yellow. Translucent.

Comp.— $HRBO_3$, where $R = Mn, Zn$ and $Mg =$ Boron trioxide 34.1, manganese protoxide, 41.5, magnesia 15.6, water 8.8 = 100. Here $Mn (+ Zn) : Mg = 3 : 2$.

Pyr., etc.—In the closed tube darkens in color and yields neutral water. If turmeric paper is moistened with this water, and then with dilute hydrochloric acid, it assumes a red color (boric acid). In the forceps fuses in the flame of a candle ($F = 2$), and B.B. in O.F. yields a black crystalline mass, coloring the flame intensely yellowish green. With the fluxes reacts for manganese. Soluble in hydrochloric acid.

Obs.—Found on Mine Hill, Franklin Furnace, Sussex Co., N. J., with franklinite, zincite, willemite, etc. An intimate mixture of zincite and calcite, not uncommon at Mine Hill, is often mistaken for sussexite, but the ready fusibility of the genuine mineral is distinctive.

Ludwigite. Perhaps $3MgO.B_2O_3 + FeO.Fe_2O_3$. In finely fibrous masses. $G. = 3.91-4.02$. Color blackish green to nearly black. From Morawitz, Hungary.

Pinakiolite. $3MgO.B_2O_3 + MnO.Mn_2O_3$. In small rectangular crystals. $H. = 6$. $G. = 3.881$. Luster metallic. Color black. From Långban, Sweden.

Nordenskiöldine. A calcium-tin borate, $CaSn(BO_3)_2$. In tabular rhombohedral crystals. $H. = 5.5-6$. $G. = 4.20$. Color sulphur-yellow. From the Langensund fiord, Norway.

Jeremejevite. Eichwaldite. Aluminium borate, $AlBO_3$. In prismatic hexagonal crystals. $H. = 6.5$. $G. = 3.28$. Colorless to pale yellow. From Mt. Sektuj, Adun-Chalon range in Eastern Siberia.

Hambergite. $Be_2(OH)BO_3$. In grayish-white prismatic crystals. $H. = 7.5$. $G. = 2.347$. From Langesund fiord, southern Norway.

Szaibelyite. $2Mg_5B_4O_{11}.3H_2O$. In small nodules; white outside, yellow within. From Rezbánya, Hungary.

BORACITE.

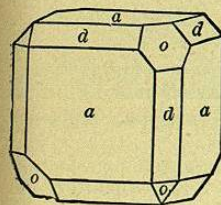
Isometric and tetrahedral in external form under ordinary conditions, but in molecular structure orthorhombic and pseudo-isometric: the structure becomes isotropic, as required by the form, only when heated to 265° . (See Art. 411.)

Habit cubic and tetrahedral or octahedral; also dodecahedral. Crystals usually isolated, embedded; less often in groups. Faces o bright and smooth, o' dull or uneven.

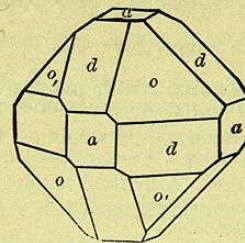
Cleavage: o, o' , in traces. Fracture conchoidal, uneven. Brittle. $H. = 7$

in crystals. $G. = 2.9-3$. Luster vitreous, inclining to adamantine. Color white, inclining to gray, yellow and green. Streak white. Subtransparent to translucent. Commonly shows double refraction, which, however, disappears upon heating to 265° , when a section becomes isotropic. Refractive index, $n_\gamma = 1.667$; $\gamma - \alpha = 0.0107$.

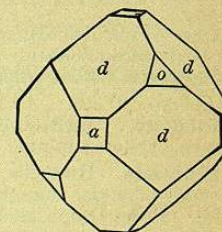
949.



950.



951.



Strongly pyroelectric, the opposite polarity corresponding to the position of the + and - tetrahedral faces (see pp. 234, 235). The faces of the dull tetrahedron o , (111) form the analogous pole, those of the polished form o' (111) the antilogous pole, Rose.

Comp.— $Mg_2Cl_2B_6O_{30}$ or $6MgO.MgCl_2.8B_2O_3 =$ Boron trioxide 62.5, magnesia 31.4, chlorine 7.9 = 101.8, deduct ($O = Cl$) 1.9 = 100.

Var.—1. *Ordinary*. In crystals of varied habit. 2. *Massive*, with sometimes a sub-columnar structure; *stassfurtite* of Rose. It resembles a fine-grained white marble or granular limestone. *Parasite* of Volger is the plumose interior of some crystals of boracite. 3. *Eisenstassfurtite* contains some Fe.

Pyr., etc.—The massive variety gives water in the closed tube. B.B. both varieties fuse at 2 with intumescence to a white crystalline pearl, coloring the flame green; heated after moistening with cobalt solution assumes a deep pink color. Mixed with oxide of copper and heated on charcoal colors the flame deep azure-blue (copper chloride). Soluble in hydrochloric acid.

Alters very slowly on exposure, owing to the magnesium chloride present, which takes up water. It is the frequent presence of this deliquescent chloride in the massive mineral, thus originating, that led to the view that there was a hydrous boracite (*stassfurtite*). *Parasite* of Volger is a result of the same kind of alteration in the interior of crystals of boracite; this alteration giving it its somewhat plumose character, and introducing water.

Obs.—Observed in beds of anhydrite, gypsum or salt. In crystals at Kalkberg and Schildstein in Lüneburg, Hannover; at Segeberg, near Kiel, in Holstein; at Luneville, La Meurthe, France; massive, or as part of the rock, also in crystals, at Stassfurt, Prussia.

Ascharite. A hydrous magnesium borate. In white lumps with boracite. From Ascherleben, Germany.

Rhodizite. A borate of aluminium and potassium, with caesium and rubidium. Isometric-tetrahedral; in white, translucent dodecahedrons. $H. = 8$. $G. = 3.41$. Found on red tourmaline from the vicinity of Ekaterinburg in the Ural.

Warwickite. Perhaps $6MgO.FeO.2TiO_2.3B_2O_3$. In elongated prismatic crystals. $G. = 3.36$. Color dark brown to dull black. From Edenville, N. Y.

Howlite. A silico-borate of calcium, $H_2Ca_2B_5SiO_{14}$. In small white rounded nodules; also earthy. From Nova Scotia.

Lagonite. $Fe_2O_3.3B_2O_3.3H_2O$. An incrustation at the Tuscan lagoons.

Larderellite. $(NH_4)_2O.4B_2O_3.4H_2O$. From the Tuscan lagoons.

COLEMANITE.

Monoclinic. Axes $a : b : c = 0.7748 : 1 : 0.5410$; $\beta = 61^\circ 5'$.

Crystals usually short prismatic ($mm''' = 72^\circ 4'$). Massive cleavable to granular and compact.

Cleavable: *b* highly perfect; *c* distinct. Fracture uneven to subconchoidal. *H.* = 4-4.5. *G.* = 2.42. Luster vitreous to adamantine, brilliant. Colorless to milky white, yellowish white, gray. Transparent to translucent.

Comp.— $\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$, perhaps $\text{HCa}(\text{BO}_2)_2 + 2\text{H}_2\text{O}$ = Boron trioxide 50.9, lime 27.2, water 21.9 = 100.

Pyr.—B.B. decrepitates, exfoliates, sinters, and fuses imperfectly, coloring the flame yellowish green. Soluble in hot hydrochloric acid with separation of boric acid on cooling.

Obs.—First discovered in Death Valley, Inyo Co., California; later in Calico district, San Bernardino county.

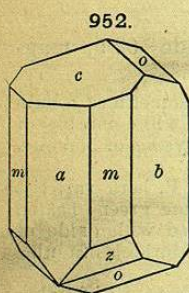
PRICHITE. Near colemanite. Massive, friable and chalky. Color snow-white. From Curry Co., Oregon. *Pandermitite* is similar; in compact nodules from Asia Minor.

Pinnoite. $\text{MgB}_2\text{O}_4 \cdot 3\text{H}_2\text{O}$. Tetragonal-pyramidal. Usually in nodules, radiated fibrous. Color sulphur- or straw-yellow. From Stassfurt.

Heintzite. Hintzeite. Kaliborite. A hydrous borate of magnesium and potassium. In small crystals, sometimes aggregated together. *H.* = 4-5. *G.* = 2.13. Colorless to white. From Leopoldshall, Stassfurt.

BORAX.

Monoclinic. Axes $a : b : c = 1.0995 : 1 : 0.5632$; $\beta = 73^\circ 25'$.



ca., $001 \wedge 100 = 73^\circ 25'$. *cz.*, $001 \wedge \bar{2}21 = 64^\circ 8'$.
mm''', $110 \wedge \bar{1}\bar{1}0 = 93^\circ 0'$. *oo'*, $\bar{1}11 \wedge \bar{1}\bar{1}1 = 57^\circ 27'$.
co., $001 \wedge \bar{1}11 = 40^\circ 31'$. *zz'*, $\bar{2}21 \wedge \bar{2}\bar{2}1 = 83^\circ 28'$.

Crystals prismatic, sometimes large; resembling pyroxene in habit and angles.

Cleavage: *a* perfect; *m* less so; *b* in traces. Fracture conchoidal. Rather brittle. *H.* = 2-2.5. *G.* = 1.69-1.72. Luster vitreous to resinous; sometimes earthy. Color white; sometimes grayish, bluish or greenish. Streak white. Translucent to opaque. Taste sweetish-alkaline, feeble. Optically —. $\text{Ax. pl.} \perp b$. $\text{Bx}_a \perp b$. $\text{Bx}_{o,r} \wedge c = -56^\circ 50'$. $\beta = 1.470$. $2E_r = 59^\circ 30'$.

Comp.— $\text{Na}_2\text{B}_4\text{O}_{10} \cdot 10\text{H}_2\text{O}$ or $\text{Na}_2\text{O} \cdot 2\text{B}_2\text{O}_3 \cdot 10\text{H}_2\text{O}$ = Boron trioxide 36.6, soda 16.2, water 47.2 = 100.

Pyr., etc.—B.B. puffs up and afterward fuses to a transparent globule, called the glass of borax. Fused with fluorite and potassium bisulphate, it colors the flame around the assay a clear green. Soluble in water, yielding a faintly alkaline solution. Boiling water dissolves double its weight of this salt.

Obs.—Obtained from the salt lakes of Tibet; the crude mineral is called *tinca*. In California, abundant in Lake Co., at Borax Lake and Hachinbama, two small alkaline lakes in the immediate vicinity of Clear Lake; present in solution in the lake waters, and obtained also in large quantities in fine crystals embedded in the lake mud and the surrounding marshy soil; also found in fine large clear crystals at Borax Lake, San Bernardino Co.; at Death Valley, Inyo Co. Also Rhodes Marsh, etc., Esmeralda Co., Nevada.

Named borax from the Arabic *burag*, which included also the *niter* (sodium carbonate) of ancient writers, the *natron* of the Egyptians. Borax was called chrysocola by Agricola because used in soldering gold.

ULEXITE. Boronatrocalcite. Natronborocalcite.

Usually in rounded masses, loose in texture, consisting of fine fibers, which are acicular or capillary crystals. *H.* = 1. *G.* = 1.65. Luster silky within. Color white. Tasteless.

Comp.—A hydrous borate of sodium and calcium, probably $\text{NaCaB}_3\text{O}_7 \cdot 8\text{H}_2\text{O}$ = Boron trioxide 43.0, lime 13.8, soda 7.7, water 35.5 = 100.

Pyr., etc.—Yields water. B.B. fuses at 1 with intumescence to a clear blebby glass, coloring the flame deep yellow. Moistened with sulphuric acid the color of the flame is momentarily changed to deep green. Not soluble in cold water, and but little so in hot; the solution alkaline in its reactions.

Obs.—From the dry plains of Iquique, Chili. In Nevada, in large quantities in the salt marshes of the Columbus Mining District, Esmeralda Co.

Named after the German chemist, G. L. Ulex.

Bechilite. $\text{CaB}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$. In crusts, as a deposit from springs in Tuscany.

Hydroboracite. $\text{CaMgB}_6\text{O}_{11} \cdot 6\text{H}_2\text{O}$. Resembles fibrous and foliated gypsum; color white. From the Caucasus.

Sulfoborite. $3\text{MgSO}_4 \cdot 2\text{Mg}_3\text{B}_2\text{O}_7 + 12\text{H}_2\text{O}$. In colorless prismatic orthorhombic crystals. *H.* = 4. *G.* = 2.38-2.45. From Westeregeln, Germany.

Uranates.

URANINITE. Cleveite. Bröggerite. Nivenite. Uranpecherz *Germ.*

Isometric. In octahedrons, also with dodecahedral faces (*d*); less often in cubes with *o* and *d*. Crystals rare. Usually massive and botryoidal; also in grains; structure sometimes columnar, or curved lamellar.

Fracture conchoidal to uneven. Brittle. *H.* = 5.5. *G.* = 9.0 to 9.7 of crystals; of massive altered forms from 6.4 upwards. Luster submetallic, to greasy or pitch-like, and dull. Color grayish, greenish, brownish, velvet-black. Streak brownish black, grayish, olive-green, a little shining; Opaque.

Comp.—A uranate of uranyl, lead, usually thorium (or zirconium), often the metals of the lanthanum and yttrium groups; also containing the gases nitrogen, helium and argon, in varying amounts up to 2.6 p. c. Calcium and water (essential?) are present in small quantities; iron also, but only as an impurity. The relation between the bases varies widely and no definite formula can be given.

Var.—The minerals provisionally included under the name uraninite are as follows:

1. *Crystallized.* *Uranniobite* from Norway. In crystals, usually octahedral, with *G.* varying for the most part from 9.0 to 9.7; occurs as an original constituent of coarse granites. The variety from Branchville, which is as free from alteration as any yet examined, contains chiefly UO_2 with a relatively small amount of UO_3 . Thoria is prominent, while the earths of the lanthanum and yttrium groups are only sparingly represented.

Bröggerite, as analyzed by Hillebrand, gives the oxygen ratio of UO_3 to other bases of about 1 : 1; it occurs in octahedral crystals, also with *d* and *a*. *G.* = 9.03.

Cleveite and *nivenite* contain UO_3 in larger amount than the other varieties mentioned, and are characterized by containing about 10 p. c. of the yttrium earths. Cleveite is a variety from the Arendal region occurring in cubic crystals modified by the dodecahedron and octahedron. *G.* = 7.49. It is particularly rich in the gas helium. Nivenite occurs massive, with indistinct crystallization. Color velvet-black. *H.* = 5.5. *G.* = 8.01. It is more soluble than other kinds of uraninite, being completely decomposed by the action for one hour of very dilute sulphuric acid at 100° .

2. *Massive*, probably amorphous. Pitchblende. Uranpecherz *Germ.* Contains no thoria; the rare earths also absent. Water is prominent and the specific gravity is much lower, in some cases not above 6.5; these last differences are doubtless largely due to alteration. Here belong the kinds of pitchblende which occur in metalliferous veins, with sulphides of silver, lead, cobalt, nickel, iron, zinc, copper, as that from Johannegeorgenstadt, Pöbbram, etc.; probably also that from Black Hawk, Colorado (Hillebrand).

Pyr., etc.—B.B. infusible, or only slightly rounded on the edges, sometimes coloring the outer flame green (copper). With borax and salt of phosphorus gives a yellow bead in O.F., becoming green in R.F. (uranium). With soda on charcoal gives a coating of lead oxide, and frequently the odor of arsenic. Many specimens give reactions for sulphur and arsenic in the open tube. Soluble in nitric and sulphuric acids; the solubility differs widely in different varieties, being greater in those kinds containing the rare earths. Not attractable by the magnet.

Obs.—As noted above, uraninite occurs either as a primary constituent of granitic rocks or as a secondary mineral with ores of silver, lead, copper, etc. Under the latter condition it is found at Johanngeorgenstadt, Marienberg, and Schneeberg in Saxony, at Joachimsthal and Příbram in Bohemia, and Rezbánya in Hungary. Occurs in Norway in pegmatite veins at several points near Moss, viz.: Ånnerød (*bröggerite*), Elvestad, etc.; also near Arendal at the Garta feldspar quarry (*cleveite*), associated with orthite, fergusonite, thorite, etc.

In the U. States, at the Middletown feldspar quarry, Conn., in large octahedrons, rare; at Hale's quarry in Glastonbury, a few miles N.E. of Middletown. At Branchville, Conn., in a pegmatite vein, as small octahedral crystals, embedded in albite. In N. Carolina, at the Flat Rock mine and other mica mines in Mitchell Co., rather abundant, but usually altered, in part or entirely, to gummite and uranophane; the crystals are sometimes an inch or more across and cubic in habit. In S. Carolina, at Marietta. In Texas, at the gadolinite locality in Llano Co. (*nivenite*). In large quantities at Black Hawk, near Central City, Colorado. Rather abundant in the Bald Mountain district, Black Hills, S. Dakota. Also with monazite, etc., at the Villeneuve mica veins, Ottawa Co., Quebec, Canada.

Gummite. An alteration-product of uraninite of doubtful composition. In rounded or flattened pieces, looking much like gum. $G. = 3.9-4.20$. Luster greasy. Color reddish yellow to orange-red, reddish brown. From Johanngeorgenstadt, also Mitchell Co., N. C.

YTTROGUMMITE. Occurs with cleveite as a decomposition-product.

THOROGUMMITE. Occurs with fergusonite, cyrtolite, and other species at the gadolinite locality in Llano Co., Texas.

Uranosphærite. $(\text{BiO})_2\text{U}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$. In half-globular aggregated forms. Color orange-yellow, brick-red. From near Schneeberg, Saxony.

Oxygen Salts.

6. SULPHATES, CHROMATES, TELLURATES.

A. Anhydrous Sulphates, etc.

The important **BARITE GROUP** is the only one among the anhydrous sulphates and chromates.

Mascagnite. Ammonium sulphate, $(\text{NH}_4)_2\text{SO}_4$. Usually in crusts and stalactitic forms. Occurs about volcanoes, as at Etna, Vesuvius, etc.

Taylorite. $5\text{K}_2\text{SO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$. In small compact lumps or concretions. From the guano of the Chincha Islands.

Thenardite. Anhydrous sodium sulphate, Na_2SO_4 . In orthorhombic crystals, pyramidal, short prismatic or tabular; also as twins (Fig. 346, p. 118). White to brownish. Soluble in water. Often observed in connection with salt lakes, as on the shores of Lake Balkhash, Central Asia; similarly elsewhere; also in S. America in Tarapaca. In the U. S. forms extensive deposits on the Rio Verde, Arizona. In California, at Borax Lake, San Bernardino Co.

Aphthitalite. Arcanite, $(\text{K}, \text{Na})_2\text{SO}_4$. Rhombohedral; also massive, in crusts. Color white. From Vesuvius, upon lava; at Douglashall near Westeregeln in blödite; Rocalmuto, Sicily.

GLAUBERITE.

Monoclinic. Axes $a : b : c = 1.2200 : 1 : 1.0275$; $\beta = 67^\circ 49'$.

ca , $001 \wedge 100 = 67^\circ 49'$. cs , $001 \wedge 111 = 43^\circ 2'$.
 mm'' , $111 \wedge \bar{1}\bar{1}1 = 96^\circ 58'$. cm , $001 \wedge 110 = 75^\circ 30\frac{1}{2}'$.

In crystals tabular $\parallel c$; also prismatic.

Cleavage: c perfect. Fracture conchoidal. Brittle. $H. = 2.5-3$. $G. = 2.7-2.85$. Luster vitreous. Color pale yellow or gray; sometimes brick-red. Streak white. Taste slightly saline. On the optical properties (see p. 225).

Comp.— $\text{Na}_2\text{SO}_4 \cdot \text{CaSO}_4 =$ Sulphur trioxide 57.6, lime 20.1, soda 22.3 = 100; or, Sodium sulphate 51.1, calcium sulphate 48.9 = 100.

Pyr., etc.—B.B. decrepitates, turns white, and fuses at 1.5 to a white enamel, coloring the flame intensely yellow. On charcoal fuses in O.F. to a clear bead; in R.F. a portion is absorbed by the charcoal, leaving an infusible hepatic residue. Soluble in hydrochloric acid. In water it loses its transparency, is partially dissolved, leaving a residue of calcium sulphate, and in a large excess this is completely dissolved.

Obs.—In crystals in rock salt at Villa Rubia, in New Castile, Spain; also at Aussee, Upper Austria; Berchtesgaden, Bavaria; Westeregeln; Stassfurt. In crystals in the Rio Verde Valley, Arizona, with thenardite, mirabilite, etc.; Borax lake, San Bernardino Co., California.

Langbeinite. $\text{K}_2\text{Mg}_2(\text{SO}_4)_3$. Isometric-tetartohedral. In highly modified colorless crystals. $G. = 2.83$. From Westeregeln, Germany.

