

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. 418-423, also Chrysoberyl, p. 423, 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. Index, 1.59.

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 $3\text{MgO} \cdot \text{B}_2\text{O}_3 \cdot \text{FeO} \cdot \text{Fe}_2\text{O}_3$. Orthorhombic. In finely fibrous masses. G. = 3.91–4.02. Color blackish green to nearly black. Index, 1.86. Strongly pleochroic. From Morawitz, Hungary. *Colbranite* from Korea is ludwigite.

VONSENITE. $3(\text{Fe}, \text{Mg})\text{O} \cdot \text{B}_2\text{O}_3 \cdot \text{FeO} \cdot \text{Fe}_2\text{O}_3$. Similar to ludwigite with more ferrous iron. Riverside, Cal.

Magnesioludwigite. $3\text{MgO} \cdot \text{B}_2\text{O}_3 \cdot \text{MgO} \cdot \text{Fe}_2\text{O}_3$. From Mountain Lake mine, south of Brighton, Utah.

Pinakiolite. $3\text{MgO} \cdot \text{B}_2\text{O}_3 \cdot \text{MnO} \cdot \text{Mn}_2\text{O}_3$. In small rectangular crystals. H. = 6. G. = 3.881. Luster metallic. Color black. From Långban, Sweden.

Nordenskiöldine. A calcium-tin borate, $\text{CaSn}(\text{BO}_3)_2$. In tabular rhombohedral crystals. H. = 5.5–6. G. = 4.20. Color sulphur-yellow. From the Langesund fiord, Norway.

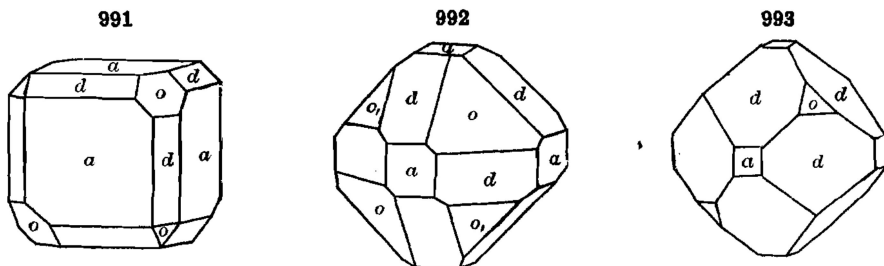
Jeremejevite. *Eichwaldite.* Aluminium borate, AlBO_3 . In prismatic hexagonal crystals. H. = 6.5. G. = 3.28. Colorless to pale yellow. Index, 1.64. From Mt. Sektuj, Adun-Chalon range in Eastern Siberia.

Hambergitte. $\text{Be}_2(\text{OH})\text{BO}_3$. In grayish white orthorhombic prismatic crystals. H. = 7.5. G. = 2.347. Optically +. $\beta = 1.588$. From Langesund fiord, southern Norway; various localities in Madagascar.

Szabelyite. $2\text{Mg}_3\text{B}_4\text{O}_{11} \cdot 3\text{H}_2\text{O}$. 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. 429.)



Habit cubic and tetrahedral or octahedral; also dodecahedral. Crystals usually isolated, embedded; less often in groups. Faces o (111) bright and smooth, o , $(\bar{1}\bar{1}\bar{1})$ 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, $n = 1.667$; $\gamma - \alpha = 0.0107$.

Strongly pyroelectric, the opposite polarity corresponding to the position of the + and - tetrahedral faces (see pp. 306, 307). The faces of the dull tetrahedron o , (111) form the analogous pole, those of the polished form o (111) the antilogous pole.

Comp. — $Mg_7Cl_2B_{16}O_{30}$ or $6MgO.MgCl_2.8B_2O_3 =$ Boron trioxide 62.5, magnesia 31.4, chlorine 7.9 = 101.8, deduct (O = Cl) 1.8 = 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 in Germany at Kalkberg and Schildstein in Lüneburg, Hannover; at Segeberg, near Kiel, in Holstein; massive, or as part of the rock, also in crystals, at Stassfurt, Prussia; at Luneville, La Meurthe, France.

Ascharite. A hydrous magnesium borate. In white lumps with boracite. $G. = 2.7$. Index, 1.54. From Aschersleben and Neustassfurt, Germany. *Paternoite*. A similar mineral from Sicily.

Rhodizite. A borate of aluminium and potassium, with caesium and rubidium. Isometric-tetrahedral; in white, translucent dodecahedrons. $H. = 8$. $G. = 3.41$. $n = 1.69$. Found on red tourmaline from near Ekaterinburg, Ural Mts.; from Madagascar.

Warwickite. $(Mg, Fe)_3TiB_2O_8$. In elongated prismatic crystals. $G. = 3.36$. Color dark brown to dull black. From Edenville, N. Y.

Howlite. A silico-borate of calcium, $H_6Ca_2B_6SiO_{14}$. In small white rounded nodules; also earthy. From Nova Scotia; Lang, Los Angeles Co., and in San Bernardino Co., Cal.

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

Larderellite. $(NH_4)_2B_{10}O_{16}.5H_2O$. From the Tuscan lagoons, Italy.

COLEMANITE.

Monoclinic. Axes $a : b : c = 0.7748 : 1 : 0.5410$; $\beta = 69^\circ 51'$.

Crystals usually short prismatic ($mm''' 110 \wedge \bar{1}\bar{1}0 = 72^\circ 4'$). Massive cleavable to granular and compact.

Cleavable: b (010) highly perfect; c (001) distinct. Fracture uneven to subconchoidal. $H. = 4.45$. $G. = 2.42$. Luster vitreous to adamantine, brilliant. Colorless to milky white, yellowish white, gray. Transparent to translucent. Optically +. $\alpha = 1.586$. $\beta = 1.592$. $\gamma = 1.614$.

Comp. — $Ca_2B_6O_{11}.5H_2O$, perhaps $HCa(BO_2)_3.2H_2O =$ 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., Cal.; later in Calico district, San Bernardino Co. *Neocolemanite* from Lang, Los Angeles Co., Cal., is identical with colemanite.

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

Inyoite. $2\text{CaO}\cdot 3\text{B}_2\text{O}_3\cdot 13\text{H}_2\text{O}$. Monoclinic. In large tabular crystals. Cleavage, c (001). $H. = 2$. $G. = 1.87$. Indices, 1.49–1.52. Decrepitates and fuses with intumescence, giving green flame. Largely altered into *meyerhofferite*. From Mt. Blanco district, on Furnace Creek, near Death Valley, Inyo Co., Cal. Associated with *colemanite*.

Meyerhofferite. $2\text{CaO}\cdot 3\text{B}_2\text{O}_3\cdot 7\text{H}_2\text{O}$. Triclinic crystals prismatic, often tabular parallel to a (100). Fibrous. Cleavage, b (010). $H. = 2$. $G. = 2.12$. Colorless to white. Indices, 1.50–1.56. Fuses without decrepitation but with intumescence. Found with *inyoite* (which see) as an alteration product.

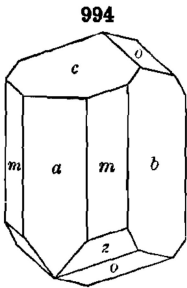
Pinnoite. $\text{MgB}_2\text{O}_4\cdot 3\text{H}_2\text{O}$. Tetragonal-pyramidal. Usually in nodules, radiated fibrous. $G. = 2.29$. Color sulphur- or straw-yellow. $\omega = 1.56$. From Stassfurt, Germany.

Heintzite. Hintzeite. Kaliborite. A hydrous borate of magnesium and potassium. In small monoclinic crystals, sometimes aggregated together. $H. = 4-5$. $G. = 2.13$. Colorless to white. $\beta = 1.525$. From Leopoldshall, Stassfurt, Germany.

Hulsite. $12(\text{Fe}, \text{Mg})\text{O}\cdot 2\text{Fe}_2\text{O}_3\cdot 1\text{SnO}_2\cdot 3\text{B}_2\text{O}_3\cdot 2\text{H}_2\text{O}$. Orthorhombic (?) as small crystals or tabular masses. $H. = 3$. $G. = 4.3$. Color and streak black. Fusible. Found in metamorphosed limestone at a granite contact at Brooks mountain, Seward Peninsula, Alaska. *Paigeite* is a similar mineral from the same locality with the composition, $30\text{FeO}\cdot 5\text{Fe}_2\text{O}_3\cdot 1\text{SnO}_2\cdot 6\text{B}_2\text{O}_3\cdot 5\text{H}_2\text{O}$.

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 (100) perfect; m (110) less so; $b\frac{1}{2}$ (010) 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 —. Ax. pl. $\perp b$ (010).

$Bx_a \perp b$ (010). $Bx_{a,r} \wedge c$ axis = $-56^\circ 50'$. $2V = 39^\circ$. $\alpha = 1.447$. $\beta = 1.470$. $\gamma = 1.472$.

Comp. — $\text{Na}_2\text{B}_4\text{O}_7\cdot 10\text{H}_2\text{O}$ 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 Cal., abundant in Lake Co., at Borax Lake and Hachinama, 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., Nev.

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

Use. — Borax is used for washing and cleansing; as an antiseptic and preservative; as a solvent for metallic oxides in soldering and welding; as a flux.

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. Optically +. $\alpha = 1.500$. $\beta = 1.508$. $\gamma = 1.520$.

Comp. — A hydrous borate of sodium and calcium, probably $\text{NaCaB}_5\text{O}_9 \cdot 8\text{H}_2\text{O}$ = 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, Chile. In Nev., 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, Italy.

Hydroboracite. $\text{CaMgB}_6\text{O}_{11} \cdot 6\text{H}_2\text{O}$. Resembles fibrous and foliated gypsum; color white. $\beta = 1.587$. From the Caucasus Mts.

Sulphoborite. $2\text{MgSO}_4 \cdot 4\text{MgHBO}_3 \cdot 7\text{H}_2\text{O}$. In colorless prismatic orthorhombic crystals. $H. = 4$. $G. = 2.38-2.45$. Optically —. $\beta = 1.540$. From Westeregeln, and Wittmar, Germany.