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PROFESSORS S. W. JOHNSON, GEO. J. BRUSH, AND
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Art. XXIII.—*Contributions from the Sheffield Laboratory of Yale College.* No. XVIII.—*On Sussexite,*[*] *a new borate from Mine Hill, Franklin Furnace, Sussex Co., New Jersey;* by George J. Brush.

In examining a specimen of a fibrous mineral, obtained at Mine Hill last year, I found that it was a fibrous silicate of zinc, and being desirous of further investigating the mineral, I requested my assistant, Mr. Wm. G. Mixter, on his recent visit to the locality, to obtain as much of the fibrous substance as possible, so that a quantitative analysis might be made of it. Mr. Mixter was fortunate in obtaining one specimen of what we at first sight took to be the fibrous silicate, but on examination of its pyrognostic characters it proved to be a new mineral, a hydrous fusible borate, reacting strongly with the fluxes for manganese. This interesting discovery led me at once to revisit the locality, and I there succeeded in obtaining enough of the new mineral to give the following characters. It is found in the franklinite vein at the opening on the north end of Mine Hill, associated with franklinite, zincite, willemite, tephroite, calcite and what appears to be a double carbonate of manganese and magnesia occurring implanted on, or imbedded in, the fibrous mineral in minute hemispherical forms; it has also associated with it a black hydrate of manganese, apparently the species manganite, and a pale pink carbonate which is probably rhodochrosite. The black manganite and the double carbonate have the appearance of being products of the alteration of the borate, since where associated with these the latter seems exceedingly friable and evidently in process of decomposition.

The pure mineral is whitish with a tinge of yellow or pink, is translucent on the edges and in thin fragments, and possesses a silky to pearly luster. The structure is fibrous, sometimes asbestiform, although in other specimens it seems to cleave much more readily in one direction than in a direction at right angles to this, yielding flat fibrous fragments. The mineral occurs in seams in calcite, sometimes with the fibers running transversely, and in other specimens quite long and parallel to the seam. The hardness is slightly above 3, scratching calcite, but not aragonite. Specific gravity=3·42.

On heating in the closed tube the mineral darkens slightly in color and yields water which reacts neutral to test-papers; but if turmeric paper is moistened with this water, then with

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[*] The discovery of this mineral was announced in the July number of this Journal, p. 140.

a drop of dilute chlorhydric acid and afterwards dried, it assumes the red color, characteristic of boric acid, and thus shows that at least a trace of this acid is driven off with the water. In the forceps the mineral fuses in the flame of a candle (F.=2) and B.B. in O. F. yields a black crystalline mass and colors the flame intensely yellowish-green. With borax and salt of phosphorus gives a deep amethystine bead in O. F., which in R. F., becomes colorless and transparent. With soda yields a green manganate.

It is readily dissolved in chlorhydric acid, and most specimens thus treated give off a minute quantity of chlorine, showing traces of a slight alteration of the protoxyd of manganese into a higher oxyd. On evaporation to dryness and resolution in acid, minute imponderable traces of silica were found. Qualitative analysis proved the presence of boric acid, manganese, magnesia, and water, with questionable traces of zinc and soda. A fragment of the mineral moistened with sulphuric acid and held in the flame of an ordinary Bunsen burner gave, when observed through the spectroscope, the characteristic spectrum of boric acid.

The exceedingly simple composition of the mineral rendered the quantitative determination of the bases comparatively easy. The mineral being dissolved in chlorhydric acid, the excess of acid was driven off and the manganese was thrown down by bromine in the presence of an excess of acetate of soda as hydrated sesquioxyd; this was re-dissolved and precipitated as ammonio-phosphate and weighed as pyro-phosphate.* The magnesia was separated from the filtrate from the oxyd of manganese, (after it was first ascertained that this solution was entirely free from manganese) as ammonio-phosphate and estimated as pyro-phosphate. The water was determined by igniting the powdered mineral in a glass tube closed at one end, about 10 inches in length with a calibre of ¼ of an inch. The length of the tube effected a complete condensation of the water, which was deposited on the interior five or six inches from the open end, and the tube and contents on being weighed proved to have suffered a loss of less than one milligram by the ignition. The water was then dried out at the ordinary temperature in vacuo over chlorid of calcium. To make entirely sure that no boric acid went off with the water, I ignited a portion of the mineral which had previously been thoroughly mixed with about five times its weight of calcined magnesia and then covered with a layer of pure magnesia. The results of this experiment

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* For details of this admirable method for the estimation of manganese see T. S. Henry, Phil. Mag., IV, xvi, 197; and W. Gibbs, this Journal, II, xliv, 216.

confirmed the water determination made by the above method. The boric acid was determined by Stromeyer's method as borofluorid of potassium. The results of the analyses are:—

	1.	2.	3.	4.	5.	6.	Mean.	Oxygen.
Boric acid,	----	----	----	---	---	31·89	31·89	22·82
Manganous oxyd,	40·08	40·20	40·01	---	---	---	40·10	9·04
Magnesia,	17·12	16·76	17·21	---	---	---	17·03	6·81
Water,	----	----	----	9·64	9·53	---	9·59	8·53
							98·61	

The analysis shows a loss of 1·39 pr. ct. doubtless due chiefly to the imperfections of the method employed for determining the boric acid. Calculating the loss as boric acid, the total amount of the acid is 33·28 pr. ct. and the oxygen ratio for $\dddot{B}$, $\dot{R}$ and $\dot{H}$ is 22·82 : 15·85 : 8·53 or 3 : 2·08 : 1·12. The ratio 3 : 2 : 1, although not according precisely with the analyses, is nevertheless probably the true ratio. It requires a change of but a few tenths of a per cent of water to make this ratio. In fact, in what appeared to be a fresher and less altered specimen than that above analyzed, I obtained but 8·93 pr. ct. of water, which would change the amount of boric acid calculated as loss to 33·94 pr. ct. Correcting the oxygen to correspond to these, we have for $\dddot{B}$, $\dot{R}$, $\dot{H}$, 23·27 : 15·85 : 7·94, or almost exactly 3 : 2 : 1, or considering the water basic, a ratio of 1 : 1, thus bringing out a most interesting relation between this species and native boric acid which has the formula $\dot{H}^3\dddot{B}$. Sussexite may be regarded an analogous compound in which $\frac{2}{3}$ of the water is replaced by manganese and magnesia, and we may write for its formula $(\frac{2}{3}(\dot{M}n, \dot{M}g)+\frac{1}{3}\dot{H})^3\dddot{B}$, or if the water be not considered basic it may be represented by $(\dot{M}n, \dot{M}g)^2\dddot{B}+\dot{H}$. The former I believe to be the correct view of the composition of the mineral.

In some of its physical and chemical characters sussexite resembles the mineral Szaibelyite from southern Hungary. This mineral is found imbedded in limestone in needle-like crystals, has a hardness of over 3, a density of 3, and is a hydrous borate of magnesia. One variety analyzed by Stromeyer gave the oxygen ratio of $\dddot{B}$, $\dot{M}g$, $\dot{H}$, 17 : 14·1 : 4, or of acid to bases including water of 17 : 18·1, or nearly 1 : 1, requiring but a slight change in the determination of water to make this also a mineral analogous in composition to boric acid, with which indeed it is already classified by Prof. Dana in the recent edition of his Mineralogy.* Another member of the group is Hydroboracite, a hydrous borate of magnesia and lime with the oxygen ratio of $\dddot{B}$, $\dot{R}$, $\dot{H}$, 4 : 3 : 1 or $(\frac{3}{4}(\dot{C}a, \dot{M}g)+\frac{1}{4}\dot{H})^3\dddot{B}$. Sussexite is at present a rare mineral, but as it occurs in a vein which is extensively

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* Dana's Mineralogy, 5th ed., p. 593.

mined, there is every reason to hope that it may become more abundant. Its pyrognostic properties are so very characteristic that it may readily be distinguished from any other mineral which it resembles in physical characters. In addition to fibrous willemite, I have also found chrysotile in fine fibers imbedded in the calcite of Mine Hill; it, however, requires but little familiarity with sussexite to distinguish it at a glance from these species.

New Haven, July 18th, 1868.

ART. XXIV.—*On an easy and very effective mode of showing the vibrations in Chladni plates, &c., to a large class, by the use of a calcium or electric lantern;* by JESSE S. CHEYNEY, A. M.

THE lantern is constructed as usual, except that the condensers project some distance in front of the box, which must not be too broad; and the object-glasses are elevated upon a brass stand on the end of a sliding bar two and a half inches wide, which slides smoothly and lightly in a groove cut for it under the bottom of the lantern, and can be clamped in any position required. In my earlier experiments, I used a somewhat different arrangement of the object glasses, but the plan above, which is a modification of one devised by Prof. Albert R. Leeds, of this city, works most satisfactorily.

The lantern thus constructed, is mounted like the telescope of a theodolite, on an axis turning in a pair of vertical posts, which rise out of a circular disc of wood 22 inches in diameter. This disc is fastened loosely at its center, by a bolt with a screw, to the top of the operating table, and thus can be turned completely round in a horizontal plane, and clamped by the screw where required.

On one end of the axis of the lantern, and outside of the upright post is a circle of brass 8 inches in diameter, by which the lantern can be clamped at any angle of elevation or depression by screws set in a pair of brass clamps on the post.

A "square prism," (made either solid of glass or hollow of brass with glass sides and filled with bisulphid of carbon) is mounted so that it can be slipped into the front of the object-glass-mounting and turned upon an axis as usual.

(1.) To show the vibrations in Chladni plates, a narrow clamp, carrying suitable glass plates, is screwed to the upper part of the front of the lantern, so that the center of the plate is directly before the center of the condensers. The lantern is now turned