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AND

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OF NEW HAVEN.

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fertile they are soon covered with vegetation which is often buried *in situ* by temporary advances in the glacier. Besides, insects die on the ice, and falling leaves are blown into its crevasses. If the theory of submergence be preferred, then aquatic fossils should be found, and one would hardly suppose that any violence of the currents would wholly destroy them. If we adhere to the theory of submergence we must of course refer the erosion and smoothing of the rocks to the violent action of floating ice. Without venturing any dogmatic opinion on these difficult points, it seems to me that the phenomena favor the following inferences.

1. The western boulder drift is a stratified water deposit.
2. A breadth of some 200 miles along its southern border rests on the Pliocene soil, small patches of which are also found a hundred miles north of Chicago.
3. The drift does not merge directly into the loess but is separated from it by a bed of soil.
4. The waters of the drift had at the north a great velocity, and a depth of over 800 feet above Lake Michigan, but as it passed southward the water lost its swiftness and deposited its sediment.
5. A considerable depth of stiller water remained after the cessation of the great current, long enough to deposit the thin stratum of orange loam.
6. The final retirement of the drift waters from this region was rather sudden, the water falling at least 1300 feet without leaving any beach lines.

81 Monroe st., Chicago, June 7, 1869.

ART. XIX.—*Contributions from the Sheffield Laboratory of Yale College.* No. XX.—*On Durangite, a fluo-arsenate from Durango in Mexico*; by GEORGE J. BRUSH.

THE stream-tin deposit of Durango in Mexico is well known among American mineralogists for the remarkable specimens of tin-stone, as well as for the beautiful crystals of topaz which it affords. Quite recently a bright orange-colored mineral has been found at that locality, and I am indebted to Mr. Henry G. Hanks, of San Francisco, for the opportunity of investigating it. Mr. Hanks generously placed at my disposal three small crystals, with the request that I would examine the mineral and describe the species should it prove to be new.

The crystals have a rhombic aspect; color, bright orange-red, almost exactly the shade of the Uralian chromate of lead;

streak, cream yellow ; lustre, vitreous. Cleavage distinct in two directions, corresponding to two of the planes of the crystals at an angle of  $110^{\circ} 10'$ , according to measurements by Mr. J. M. Blake, who makes the crystallization monoclinic. (See note on the crystallization of the mineral, at the close of this article.) Hardness = 5 ; specific gravity = 3.95-4.03.

When treated in the closed tube the mineral blackens at a moderate temperature, but regains its color on cooling ; at a higher heat it fuses easily to a yellow glass and gives a faint white sublimate ; this sublimate proved to be volatile, and the glass appeared dimmed from corrosive action. Not the least trace of moisture was perceptible in the closed tube. In the open tube the same reactions were observed, with the addition that blue litmus paper was reddened when inserted in the upper end of the tube. On charcoal fuses readily, and in R. F. gives a strong arsenical odor and coats the coal with a faint white volatile sublimate. With soda the arsenical odor is more marked, but in R. F. the assay affords no reducible metal. When fused with dry carbonate of soda and charcoal powder in a matrass yields a metallic ring of arsenic ; with borax and salt of phosphorus it gives only a reaction for iron, while with soda it yields a manganese-green. In the forceps, fuses with intumescence at 2 and gives a strong soda flame.

The mineral is only partially attacked by chlorhydric and nitric acids, but is completely decomposed by sulphuric acid, with evolution of fluohydric acid. A qualitative examination showed the presence of arsenic acid, alumina, iron, manganese, soda, lithia and fluorine. Search was made for other metallic acids, as well as for the rarer earths and metals, with a negative result ; it also proved to be free from phosphoric acid and chlorine.

The very small quantity of mineral which I felt at liberty to use for the quantitative determinations has prevented my making the examination as complete as I could desire ; but I have been able to obtain direct duplicate estimations of every constituent except fluorine. This last element must exist in considerable quantity in the substance, as the fluohydric acid evolved on attacking the mineral by sulphuric acid in a platinum vessel etched glass with great readiness and distinctness. The following results were obtained :

|                      | I.            | Oxygen. | II.   | III.  |
|----------------------|---------------|---------|-------|-------|
| Arsenic acid, .....  | 55.10         | 19.16   | 53.22 | ----  |
| Alumina, .....       | 20.68         | 9.63    | 20.09 | ----  |
| Ferric oxyd, .....   | 4.78          | 1.44    | 5.06  | ----  |
| Manganous oxyd, .... | 1.30          | 0.30    | 1.28  | ----  |
| Soda, .....          | 11.66         | 3.01    | ----  | 11.86 |
| Lithia, .....        | 0.81          | 0.43    | ----  | 0.70  |
| Fluorine, .....      | undetermined. |         |       |       |

In No. 1, the decomposition was effected by sulphuric acid, the arsenic acid was reduced to arsenous acid by sulphurous acid, and the arsenic precipitated by sulphydric acid gas as tersulphid; this last was re-dissolved in fuming nitric acid, and after freeing the solution from most of the acid by evaporation it was made ammoniacal and the arsenic acid precipitated by the ordinary magnesia mixture, and estimated as ammonia-arsenate of magnesia. The iron and alumina were thrown down by ammonia and subsequently separated by caustic soda; the small amount of manganese remaining with the iron was separated from it by converting the iron into basic acetate and oxydizing the manganese by means of bromine. A portion of the manganese also was found with the alkalis; these were weighed first as sulphates; the manganese was then separated by soda and the lithia determined as phosphate. The precipitates were examined as carefully as possible, considering their small amount, and found to be pure.

In No. 2, the decomposition was made by fusion with carbonate of soda. This was dissolved in water, acidulated with chlorhydric acid and reduced as before. The low amount of arsenic acid may be due to the fact that the soda fusion was made over a gas blast-lamp, and possibly a portion of arsenic acid was reduced to arsenous acid and volatilized; or the loss may be attributed to other accidental causes.

No. 3 was a qualitative-quantitative analysis in which only the alkalis were estimated; the soda and lithia were first weighed as sulphates, then converted into chlorids, and the alkalis separated by dissolving the chlorid of lithium in a mixture of absolute alcohol and ether. The alkalis examined with the spectroscope showed only the lines of sodium and lithium.

The oxygen ratio in No. 1, between the protoxyds, sesquioxys and arsenic acid is 3.74 : 11.07 : 19.16, or, very nearly, 1 : 3 : 5. This involves the assumption that the small amount of manganese exists as protoxyd, of which we have no proof, but it seems probable that this ratio is the true one, although it is impossible at present to determine the exact state of oxydation of the iron and manganese. This composition and ratio suggest an analogy between the new mineral and amblygonite, a fluo-phosphate of alumina, lithia and soda, and it may be viewed as an arsenic-acid amblygonite, containing a small percentage of iron and manganese and more soda than lithia.

The formula may be written  $(\frac{1}{2}R + \frac{1}{2}F)As$ , and, as in amblygonite, a portion of the oxygen is replaced by fluorine. A number of hypotheses showing the possible relation of the fluorine might be suggested, but until further investigation these

are unnecessary. I hope before long to be able to obtain a sufficient quantity of the mineral to continue the study of its composition. The results here given are sufficient to demonstrate it to be a new species, and I believe it to be the only observed native *fluo-arsenate*. I propose for it the name *Durangite*.

*Preliminary Note on the Crystallization of Durangite;* by  
JOHN M. BLAKE.

I defer, for the present, a detailed account of my observations on this mineral, with the hope that I may have an opportunity to examine other specimens better adapted for measurement, and the study of the habit of the species. The angular measurements, as well as the optical characters distinguish the species, and show that the crystals are monoclinic, and that they do not correspond either with amblygonite or the other anhydrous phosphates and arsenates, of which I have been able to find crystallographic descriptions, and belonging in the division to which the chemical characters appear to assign this mineral.

An approximation in all the angles, to those of keilhauite, and sphene, is interesting. The figure of keilhauite\* is so good a representation of the crystals of Durangite, that for present purposes it may be used for illustration, by making *I* the cleavage plane, and omitting *O* and the plane there marked  $-2i$ , which were not found, and adding  $4i$ , which occurs in sphene, and on Durangite is a small plane of infrequent occurrence.

ART. XX.—*Remarks on the Galvanic Battery;* by G. W. HOUGH, Director Dudley Observatory.†

THE constant use of Daniell's battery for nearly ten years, made us desirous of more fully understanding the mode of its action, and the cause of the decline in the strength of the electric current. For this purpose, during the past year, a series of experiments were instituted, with batteries of various forms. As they were undertaken solely for the purpose of securing the best form of battery for every day use, delicate instruments were not provided, and consequently great precision of measurement could not be obtained.

The Galvanometer consisted of a steel needle one and a half inches in length, attached to a light strip of brass, having a radius of five inches. This needle was mounted horizontally over a coil of silk-covered copper wire. The graduation of

\* See Dana's Mineralogy, 5th edition, p. 387.

† Abstract read at the Chicago meeting of the American Association.