ART. X.—*On some Selenium and Tellurium minerals from Honduras;* by EDWARD S. DANA and HORACE L. WELLS.

THROUGH the kindness of Mr. Henry S. Durden, of the State Mining Bureau in San Francisco, we have received a number of specimens of minerals containing selenium and tellurium, two of which have proved to be of unusual interest. The presence of selenium in some of them had been already determined by Mr. Charles G. Schneider before they were sent to us, but further than that the examination had not gone. The locality from which they were obtained, as Mr. Durden informs us, is the El Plomo mine, Ojojoma District, Department of Tegucigalpa, Honduras.

The mineral, to which our attention was first directed, proved upon blowpipe examination to contain selenium and tellurium, while the metals proper were absent. It presents itself in massive forms only, with indistinctly columnar structure and shows a perfect cleavage parallel to a prism of 60°. The color is blackish gray, the streak black. It is disseminated through a gangue consisting chiefly of quartz with some barite. An analysis (Wells) of the mineral proved it to contain selenium and tellurium only. The separation of selenium and tellurium was effected by the very convenient method of Divers and Shimosé.* In carrying out this method, it was found that the selenium obtained by a single separation sometimes contained quite a large quantity of tellurium, but the latter could be readily removed by one or two repetitions of the process.

The results obtained are as follows, after deducting 65·68 per cent of gangue consisting of about 43 per cent of silica and 19 per cent of barite with a little gypsum and a trace of alumina:

Se	29·31
Te	70·69
	100·00

The mineral is, therefore, intermediate between selenium and tellurium in composition, and contains these elements in very nearly the ratio of 2 : 3; though we do not attach any importance to the ratio, for the mineral obviously represents simply an isomorphous mixture of these two elements. It is of great interest, however, since it is the nearest approach to native selenium which has yet been found in nature.† The mineral most closely allied to it is a native tellurium from Faczebaja in which Foullon found 6·7 per cent of selenium. It seems to us, therefore, to deserve to be given a somewhat prominent position and we propose to call it *Selen-tellurium.* It is interesting to note here the recent observations of Muthmann‡ showing among other new points the existence of an allotropic form of metallic selenium in hexagonal-rhombohedral crystals, closely isomorphous with metallic tellurium. Our mineral is shown by its hexagonal cleavage to belong with these, as was to have been expected.

Associated with the selen-tellurium are a few minute transparent crystals having a pale yellow color and adamantine luster, which have the appearance of tellurite. The quantity is so extremely small as to make an examination unsatisfactory and we defer the matter in the hope of obtaining additional material.

Quite distinct from the yellow crystals just mentioned, is a greenish yellow mineral which is also obviously an oxidation product and which is present more abundantly. It is best shown in two or three specimens, having the aspect of a quartzose conglomerate and containing patches of a grayish metallic mineral which proved to be nearly pure tellurium. Through this it is

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* Jour. Chem. Soc., xlvii, 439.

† We pass over Del Rio's unconfirmed statement, in regard to the occurrence of native selenium in Mexico, as not deserving of serious consideration.

‡ Zeitschr. für Kryst., xvii, 356, 1890.

scattered in points and narrow veins. It is soft, with hardness from 2 to 2·5 and is easily crushed to powder. The surface, when exposed, is small mammillary and but little structure is discernible even under the microscope, although a tendency to separate into distinct scales is noted. The action on polarized light is very feeble. The mineral is intimately mixed with the gangue and it was only by using extreme care that it was found possible to separate a sufficient quantity of material for analysis, the purity of which could be regarded as beyond all question. This was finally accomplished, however, and an analysis made with the following results. Of the whole amount obtained, viz: 0·32 grams, 0·12 gr. was taken for a water determination and the remainder 0·20 gr. for the other determinations. The results, considering the small quantities used, are very satisfactory. The analysis is as follows:

				Ratio.				
Water	$7·67 \div 18 = ·426$			3·55		4·06		4
TeO_2	$47·20 \div 157 = ·301$	}	·315	2·62	or	3·00	or	3
SeO_2	$1·60 \div 111 = ·014$	}						
Fe_2O_3	$19·24 \div 160 = ·120$			1·00		1·14		1
Insol.	23·89							
	99·60							

These ratios are not quite exact, but there can be no doubt that it is a normal ferric tellurite of the composition $Fe_2O_3 . 3TeO_2 . 4H_2O$ or $Fe_2(TeO_3)_3 + 4H_2O$. The slight excess of Fe_2O_3 shown by the ratio very probably comes from the reddish ochreous material associated with it.

The calculated composition, with $\frac{1}{21}$ of the Te atoms replaced by Se, is:

Calculated for $Fe_2O_3\ \frac{20}{7}\,TeO_2\ \text{-}\frac{1}{7}\text{-}\ SeO_2 . 4H_2O$.	
TeO_2	64·41
SeO_2	2·28
Fe_2O_3	22·97
H_2O	10·34
	100·00

Analysis Deducting Insol. Res.	
TeO_2	62·34
SeO_2	2·12
Fe_2O_3	25·41
H_2O	10·13
	100·00

That the mineral is a ferr*ic* tellur*ite* is evident since it gives off no chlorine when boiled with HCl, nor does it give any reaction for ferrous iron when dissolved in cold HCl.

Two other tellurium-iron minerals have been thus far described: these are Genth's* *ferrotellurite* and the *emmonsite* of Hillebrand.† Our mineral is like ferrotellurite in color, but, if the results of Genth's qualitative trial can be accepted as conclusive, his mineral was a ferrous tellurate, which sepa-

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* Proc. Acad. Nat. Sci. Philad., xvii, 119, 1877.

† Proc. Colorado Sci. Soc., ii, 1885.

rates it widely from the Honduras ferric tellurite. Emmonsite corresponds in composition more closely, being also a ferric tellurite, and we were inclined at first to think that the two minerals might be identical. Through the kindness of Dr. Hillebrand we have had an opportunity to inspect the original emmonsite, and furthermore Dr. Hillebrand has made a new chemical examination of the scanty amount of material at hand, the results of which are appended to our paper. Our own examination did not extend beyond a microscopic study of the cleavage plates, but these while confirming the points made by Mr. Cross in regard to the cleavages and chief optical characters, proved that in appearance the Honduras mineral and emmonsite are widely different. Moreover, Dr. Hillebrand's recent results show that the two minerals differ both in ratio of tellurium to iron, and also in amount of water. The Honduras mineral consequently cannot be united with either of the minerals named, and although our knowledge of its physical characters is imperfect, the simplicity and exactness of the chemical formula shows that it deserves to rank as a definite mineral species. We propose, therefore, to call it *Durdenite* after the gentleman to whose kindness we are indebted for all the material we have had to use.

NOTE ON EMMONSITE BY DR. W. F. HILLEBRAND.

I have attempted a re-analysis of emmonsite with the extremely limited quantity belonging to Mr. Cross, which he kindly consented to sacrifice for the purpose. Unfortunately the analysis was not entirely successful, but what was done upholds the correctness of my former analysis and seems to prove that the two minerals are distinct. The weight taken for analysis was ·0764 grams. The water was determined in this by heating in a boat with a plug of dry sodium carbonate filling the tube in front, and collecting the water in a calcium chloride tube. The weight found was ·0032 grams, or 4·2 per cent. This, under the circumstances, is as near as could be expected to my original determination (3·28 per cent), which was made on less pure material, and shows that emmonsite is distinct from the Honduras mineral, which has over 10 per cent of water. After dissolving the ignited mineral, a rather considerable portion of the solution was unfortunately lost, but the relation of the iron and tellurium in what remained was estimated; the result being $Fe_2 : Te = 1 : 3{\cdot}75$. This is very near that originally found, i. e., $1 : 3{\cdot}65$. I did not detect any zinc in this analysis, which is confirmatory of the opinion formerly expressed that it was present as an admixture in some form.

In regard to the behavior of emmonsite on heating it may be added that even at as low a temperature as 100° C. it becomes brownish, but regains its green color on cooling without having suffered loss in weight. In an unpowdered condition it decrepitates rather violently on further heating, and, as originally stated, fuses readily to a red-brown liquid. In regard to the evidence as to the condition of oxidation of the iron and tellurium in emmonsite afforded by boiling the mineral with hydrochloric acid, I would add that my former experiment was carefully made and the products of distillation were collected in a solution of potassium iodide. No evolution whatever of iodine was observed. While this would not prove the entire absence of a ferrous tellurate, it does prove conclusively, as indicated in my original paper, that the mineral is chiefly a ferric tellurite. This being true, it would be reasonable, even without other evidence, to conclude that the mineral is simply a ferric tellurite and not a combination of ferric tellurite with ferrous tellurate.

Washington, May 31, 1890.