SUMMARY

All selenium obtainable on the market, so far as examined, contains a trace of selenium dioxide. This dioxide appears under the microscope as small nearly opaque particles when the selenium is used as an index medium, and renders the material unsuited for such a purpose.

Several methods of purification have been attempted, and it has been found that the dioxide may be removed by distillation from a suitable container in an atmosphere of carbon dioxide. The distillate is then practically optically clear when melted into thin films such as are used in index determinations.

ELLSWORTHITE CRYSTALS FROM HALIBURTON COUNTY, ONTARIO[1]

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Some months ago the writer received from Charles G. Earle of Haliburton, Ont., a few ounces of small, loose crystals which electroscope tests showed to possess considerable radioactivity, and which were immediately suspected of being either ellsworthite or betafite. The crystals received are free from gangue but are more or less coated with a yellowish brown decomposition or resorption product, as well as with small crystals of apatite, which along with calcite may also be included in part or completely within the crystals themselves. One fragment of a crystal, however, was entirely free from any superficial coating or alteration and showed clean, sharp, bright faces. The crystals vary from slightly less than $\frac{1}{4}$ inch to $\frac{1}{2}$ inch in diameter and in general exhibit a rounded octahedral habit, with the octahedron most prominent in combination with small cube faces and with rather frequent occurrence of small faces of the dodecahedron and the tetragonal trisocta-

hedron $m(311)$. Fig. 1. Owing to the rounding of edges and smaller faces, the octahedron and cube are sometimes the only definitely distinguishable forms.   Several crystals however were in part sufficiently sharp and well developed to permit measurement and identification of the faces indicated in the figure.   Other crystals are simply rounded, small ball-like masses on which the faces cannot be definitely identified.

The color is black or brownish black, some crystals are darker than others; powder pale yellow; lustre adamantine; cleavage none, fracture subconchoidal to uneven; very brittle; hardness 4.5; specific gravity 3.705.   Small grains under the microscope are brown and infusible.
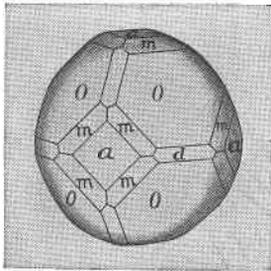

Fig. 1.
Typical crystal of ellsworthite. An attempt has been made to
indicate the characteristic rounded outline.

One or two of the crystals were still embedded in calcite, the others apparently had weathered loose in a vug. Mr. Earle states that the crystals were obtained from lot 10, conc. 12, Cardiff township, Haliburton county, Ontario. The writer has not seen the actual occurrence but from information supplied by Mr. Earle and from notes obtained on a visit to that locality some years ago it is evident that the crystals occur in high temperature calcite veindikes[2] of igneous origin which are characteristic of that neighborhood.   In the Haliburton-Bancroft area calcite is common as an apparently primary constituent of igneous rocks, occurring as small grains in the nephelite syenites and nephelite pegmatites and as larger masses, sometimes as much as 100 tons

[2] High temperature in contrast to ordinary fissure veins formed by circulating waters at or near ordinary temperatures, actually probably somewhere between 200° and 500°. The term veindike as proposed by Spurr seems very appropriate for this type of deposit representing the last residual material of a cooling magma.

in weight, in the microcline-quartz pegmatites.[3] In the Harcourt-Wilberforce section of this area calcite is seen not only as a constituent of ordinary granite pegmatites but it also occurs as vein-like dikes up to 8 feet wide which have the same relation as the ordinary pegmatites to the enclosing rocks. The filling of these calcite dikes generally is chiefly white to pink calcite but sometimes there is almost as much fluorite as calcite, the two commonly forming crudely banded intergrowths. The fluorite when freshly mined shows a very dark purple color, sometimes almost black, but it fades completely in a year's time when exposed to the light. This same dark purple fluorite also occurs in small quantities in the microcline-quartz-calcite pegmatites at Hybla and in ordinary pegmatite elsewhere in Ontario and Quebec. For example, I have very recently found it occurring as an apparently primary constituent in a zirconiferous, pegmatitic granite mass exposed in a new railway cutting about $\frac{1}{2}$ mile north of Kirks Ferry, Quebec. It seems that the dark purple color is characteristic for fluorite of igneous origin while that deposited by surface waters in true fissure veins, vugs, etc. is likely to be colorless to greenish. The dark purple color is quite likely due to exposure to the action of radioactive substances, as suggested by the experiments of Doelter.[4] Along with the calcite and fluorite are usually crystals of apatite and sometimes considerable masses of this mineral. The walls of the dikes are commonly lined with crystals of various pyroxenes, felspars—both potassic and sodic varieties—apatite, biotite, titanite, and sometimes a little allanite and zircon. The calcite dikes occur indifferently in granite or banded gneisses though they are never far from granite. In some cases they may be entirely enclosed in pegmatitic granite, in other cases they are at the contact of granite with banded gneiss. There is not the slightest doubt that they are just as much a product of the granitic intrusions of that region as are the microcline-quartz pegmatites themselves.

To return to the radioactive crystals under discussion, it appears that they occur in a calcite veindike of the type just described and are thus closely related in mode of occurrence and origin to the ellsworthite found in the pegmatitic calcite masses of the MacDonald mine at Hybla. As the original ellsworthite of Hybla has never been found in crystals the new material was particularly interesting.

[3] Ellsworth; Geol. Surv. Canada, Summary Report, Part CI, (1923).

[4] Das Radium und Die Farben.

The crystals selected for analysis were ground on a wet carborundum stone to remove any external coating, then crushed to small fragments and any foreign inclusions carefully picked out under the binocular. Finally the material was given a wash with dilute hydrochloric acid to remove any minute calcite grains or inclusions. It was then thoroughly washed and allowed to become perfectly dry in the air at room temperature before grinding. An analysis yielded the following results:

	PERCENT	MOL. WT.	BASES	ACIDS
PbO	1.73	222	0.0078	
(Pb=1.61)				
UO_2	1.56	270.2	0.0058	
UO_3	20.46	286.2	0.0714	0.0714
U = 18.41 = 21.70 U_3O_8)				
ThO_2	0.10	264	0.0004	
(Th 0.09 x 0.38 = 0.03				
U equivalent)				
(Ce, La, Di)$_2O_3$	1.49	330	0.0045	
(Yt, Er)$_2O_3$	0.12	230	0.0005	
FeO	0.22	72	0.0030	
Fe_2O_3	2.74	159.7	0.0171	
MnO	0.04	70.9		
Al_2O_3	0.12	102.2	0.0011	
BeO	0.02	25.1		
CaO	8.94	56	0.1596	
MgO	0.08	40.3	0.0020	
ZrO_2 not detected	0.00	122.6		
SnO_2	0.06	150.7		
TiO_2	15.06	80.1		0.1880
Cb_2O_5	23.44	266.2		0.0880
Ta_2O_5	9.97	443		0.0225
SiO_2	2.49	60.3		0.0413
P_2O_5	trace	UO_3 as base	0.2732	0.3398
F	"	UO_3 as acid	0.2018	0.4112
H_2O 110–130°	4.59 }		0.6222	
H_2O 130+	6.61 }			
Insol	0.21			
Ignition loss	11.54			
	100.05			

$$\frac{Pb}{U\ 0.38Th} = 0.094$$

Sp. Gr. = 3.705 at 18.93°

The analysis, unfortunately leaves one in some doubt as to whether this mineral is more closely related to ellsworthite or

betafite. This uncertainty is not lessened by the fact that Lacroix appears to have included two minerals of quite different composition under the name betafite as shown in the three analyses (reproduced below) upon which he bases the species.

ANALYSES OF BETAFITE BY M. PISANI (A. LACROIX-MINÉRALOGIE DE MADAGASCAR, TOME I, p.384). A, FROM AMBOLOTARA; B, FROM AMBALAHAZO; C, FROM AMBATO-LAMPIKELY.

	Per Cent A	Per Cent B	Per Cent C	Mol. Ratios A	Mol. Ratios B	Mol. Ratios C
PbO..........	—	—	—	—	—	—
UO_2..........	—	—	—	—	—	—
UO_3..........	26.60	27.15	28.60	.0929	.0948	.0999
ThO_2..........	1.30	1.12	1.25	.0049	.0042	.0047
$(Ce, La, Di)_2O_3$	0.60	1.00	1.20	.0018	.0030	.0036
$(Yt, Er)_2O_3$....	0.90	—	—	.0039	—	—
FeO..........	—	—	—	—	—	—
Fe_2O_3..........	2.87	0.50	1.38	.0180	.0031	.0086
MnO..........	—	—	0.25	—	—	.0035
Al_2O_3..........	2.10	1.50	0.50	.0205	.0147	.0049
BeO..........	—	—	—	—	—	—
CaO..........	3.45	3.12	11.61	.0616	.0557	.2073
MgO..........	0.40	trace	—	.0099	—	—
ZrO_2..........	—	—	—	—	—	—
SnO_2..........	0.30	0.37	—	.0019	.0025	—
TiO_2..........	18.30	16.20	17.30	.2285	.2022	.21ɔ0
Cb_2O_5..........	34.80	34.80	32.10	.1307	.1307	.1206
Ta_2O_5..........	trace	1.00	trace	—	.0023	—
SiO_2..........	—	—	—	—	—	—
K_2O..........	—	0.38	—	—	—	—
H_2O..........	7.60	12.50	5.20			
	99.22	99.64	99.39			
Sp. Gr..........	4.17	3.75	4.475			

UO_3 as base $\begin{cases} \text{Acids } -.3611 & .3377 & .3366 \\ \text{Bases } -.2135 & .1795 & .3325 \end{cases}$

UO_3 as acid $\begin{cases} \text{Acids } -.4540 & .4325 & .4365 \\ \text{Bases } -.1206 & .0847 & .2326 \end{cases}$

It may be seen that analyses A and B agree very closely in CaO content and approximate molecular ratios while C is much higher in lime and has a very different ratio of acids to bases. C in fact is practically identical with ellsworthite as originally described by Walker and Parsons. Whether UO_3 is calculated as acid or base makes a great difference in the molecular ratios obtained. It is customary to consider UO_3 as an acid, forming uranates, but whether this is always true in the case of the com-

plex titano-titantalo-columbate minerals is in the writer's opinion questionable. It seems probable that where the UO_3 was an original primary constituent of the mineral it should be considered as an acid, but that UO_3 resulting from autoxidation or normal oxidation of original UO_2 (which is a base) merely replaces the latter in the molecular network and should be calculated as a base. The difficulty is to distinguish the primary and secondary UO_3.

If it is agreed to consider the betafite is represented by analyses A & B and that C is ellsworthite, then the Haliburton mineral is probably more nearly related to ellsworthite with which it also agrees well in physical properties, mode of occurrence and origin.

The analyses of the original ellsworthite from Lot 18, Con. VII, Monteagle township, Hastings County, by E. W. Todd[5] are given for comparison.

	I (Lighter type)			II (Darker type)		
Nb_2O_3	34.22	.125		34.27	.125	
Ta_2O_5	4.32	.009		4.27	.009	
TiO_2	10.47	.131	.313	9.79	.122	.349
SnO_2	0.10	.001		0.25	.002	
SiO_2	2.54	.042		2.68	.047	
F	0.22 $(x\frac{1}{2})$	.005		0.49 $(x\frac{1}{2})$	.013	
UO_2	....			8.42	.031	
UO_3	18.50	.065		10.68	.037	
CaO	11.73	.209		13.62	.243	
MnO	0.43	.006		0.22	.003	
PbO	0.24	.001	.326	0.41	.002	.321
Rare Earths	0.21	.001				
Fe_2O_3	4.10 $(x\frac{3}{8})$	.038		3.80 $(x\frac{3}{8})$	.036	
Al_2O_3	0.42 $(x\frac{3}{8})$	.006				
H_2O	12.22	$.677 \div 2 = .338$		11.42	$.634 \div 2 = .317$	
	99.72			100.32		
Sp. Gr.	3.608			3.758		

THE SERPENTINE LOCALITY OF MONTVILLE, NEW JERSEY

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The name Montville, New Jersey, is familiar to all mineralogists and collectors throughout the world as the locality for the beautiful

[5] Walker & Parsons: Contributions to Canadian Mineralogy, 1923, p. 14.

[1] Published by permission of the Secretary of the Smithsonian Institution.