

space group arrangement in all but one direction. In the latter the sequence of layers or of units is heterogeneous to a certain extent. It may, however, as in specimens 9 and 10 approach a definite ratio of 1:1=biotite units:vermiculite units.

X-ray diagrams are necessary to distinguish vermiculite from hydrobiotite.

SUSSEXITE FROM IRON COUNTY, MICHIGAN

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In 1930 seamanite, a new manganese phosphoborate was reported from the Chicagon Mine in Iron County, Michigan.¹ Associated with the seamanite, but occurring in thin veinlets from 1mm. to 3mm. wide, was a white to yellowish-buff colored mineral which upon subsequent examination was shown to be sussexite. The sussexite occurs in the veinlets as irregular matted masses of fibers with the fibers lying parallel to the plane of the vein. These veins run through both the red "soft ore" hematite and the highly altered and porous cherty gangue. The gangue separates easily from the veins leaving thin sheets of the felted fibers of sussexite. Small cavities or vugs within the veins are lined with yellow, transparent crystals of seamanite and in many instances they are implanted directly upon the sussexite. All the specimens in our possession were collected for the seamanite although the sussexite is by far the more prevalent mineral.

Sussexite has a hardness of 3+ and a specific gravity of 3.0 to 3.1. It is slowly soluble in cold concentrated mineral acids and in hot dilute acids. The elongation is negative, extinction parallel, and the indices of refraction for sodium light are: $\alpha=1.642$, $\beta=1.713$, and $\gamma=1.721$ (all ± 0.003). The fibers are flattened so that most of them yield α and β . Those resting on an edge give γ and exhibit a pronounced color dispersion which is greater than that of the methylene iodide mixtures used for the index determinations.

The analysis given in Table 1 was made upon selected material which was crushed and washed with cold dilute hydrochloric acid to remove small acicular crystals of seamanite and microscopic cube-like rhombohedrons of calcite. Boron was determined by titration in the presence of mannitol, and the other oxides by ordinary gravimetric methods. H_2O+110° was determined by the direct method recommended by Penfield using separate samples of approximately one gram each. It is interesting to point out that

H_2O+110° was also determined by ignition in a covered crucible, the samples however changed to a black color due to the oxidation of the manganese. The two samples gave values which were 0.46 and 0.38 per cent lower than the average values obtained by the Penfield method, which may be attributed to an increase in weight due to the oxidation of the manganese. The two samples upon which the direct method was used checked to 0.05 per cent.

In measuring the indices of refraction slight variations were found in the indices of the material chosen from different veinlets. Manganese determinations made upon these samples showed a variation in MnO content from 38 to 42 per cent. The analysis

TABLE 1

Insoluble	0.69
SiO ₂	0.89
MnO	40.42
MgO	14.57
CaO	0.35
Fe ₂ O ₃ +Al ₂ O ₃	0.29
B ₂ O ₃	33.24
H ₂ O+110°	8.91
MnO	99.36
MgO	
CaO	
1.1923	:B ₂ O ₃ :H ₂ O
0.7581	
0.0131	
1.9635:1.0000:1.0420	

given in Table 1 represents, then, only the composition of the particular vein from which the sample was selected and is slightly higher than the mean value for MnO. The indices of refraction given are those of the analyzed material.

An x -ray diffraction photograph was taken by Mr. M. V. Denny of this laboratory with an eight inch camera using Mo K α radiation. Table 2 gives a comparison of the diffraction lines of the Iron County sussexite with those obtained by Gruner² upon Franklin Furnace sussexite. The better diffraction pattern and the more complete optical data obtained indicates that the material from Iron County is better crystallized than was the Franklin Furnace specimen. Diffraction patterns taken from two specimens of material from our museum labelled sussexite from Franklin Furnace showed that neither of these specimens is sussexite.

In the last three years three borate minerals have been reported from the iron ranges of Michigan—seamanite, magnesiosussexite,³ and sussexite. This region has never been examined to any extent mineralogically and such an examination should reveal further evidence of hydrothermal mineralization. In the past few years the question of the possible hydrothermal leaching of silica and the resultant concentration of iron ores has become quite contro-

TABLE 2

Iron County	Franklin Furnace
3.33 w	
3.11 w	
2.89 w	
2.74 s	2.70 m
2.66 w	
2.61 w	2.60 w
2.46 m	2.45 m
2.40 m	
2.25 w	2.24 vw
2.14 s	2.10 vw
2.045 m	2.023 vw
1.860 w	
1.775 m	1.763 w
1.735 m	
1.600 m	
1.540 m	1.535 vw
Values in Å	
Intensities s = strong	
m = medium	
w = weak	
vw = very weak	

versial. The exponents of leaching by the downward movement of surface waters have used the supposed absence of hydrothermal minerals⁴ as an argument against hydrothermal leaching. These borates are of a type that would escape casual observation or might even pass as veinlets of gypsum or some other common fibrous mineral. Our present state of knowledge permits no conclusions to be drawn as to the abundance or distribution of these minerals, and until we know more of the mineralogy of the iron districts no conclusions should be drawn as to the relationship of hydrothermal minerals to the problem of the origin of the iron ores of Michigan.

REFERENCES

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A COMPARISON OF ULTRA VIOLET SOURCES FOR PRODUCING FLUORESCENCE IN MINERALS

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ABSTRACT

The properties of several sources of ultra violet light are compared as to intensity and wave lengths. Curves giving the radiation characteristics of various sources, and the transmission characteristics of certain filters are included.

One of the most interesting and spectacular of the properties of minerals is displayed in the phenomenon of fluorescence. Recently interest in this subject seems to have been particularly stimulated by the introduction of new sources of exciting radiation capable of producing fluorescence in a variety of minerals. The writer has been interested in comparing the characteristics of the various energy radiating devices available for studying fluorescence, and it is believed that such a comparison should be useful to others who are interested in these phenomena.

There are three general types of radiant energy which have been used to excite fluorescence in minerals. Cathode rays, which consist of electrons moving at extremely high velocities, produce fluorescence in a number of substances, but there are a number of practical difficulties connected with their use. X-rays, which are electro-magnetic waves of very high frequency, cause fluorescence in a number of minerals, but devices for producing them are expensive and the number of minerals that respond to them is limited. The most spectacular effects of all are produced by ultra violet light, that is to say light of shorter wave length than the visible range. For practical purposes ultra violet includes all light from the limit of the visible spectrum at about 4000 A.U. down to 1600 A.U., which is the shortest wave length transmitted through