

name since it is only the end member of the series, does not conform to the facts. Troilite and pyrrhotite are too distinct in their properties to be considered in the same series. In some of our later textbooks the formula for pyrrhotite is stated as FeS . No analysis of pyrrhotite shows this to be the case; on the contrary all of the analyses conform to the generally accepted formula $\text{Fe}_n\text{S}_{n+1}$. The formula $\text{Fe}_{11}\text{S}_{12}$, which approximately agrees with the composition of most pyrrhotites, if considered as $\text{FeS}+\text{S}$ in solid solution, contains 3.22% excess sulfur. It seems quite improbable that this small excess held as solid solution would convert non-magnetic, easily soluble troilite into magnetic, insoluble pyrrhotite. The magnetic property and general composition of pyrrhotite certainly indicate a chemical difference from the other iron sulfides and in fact, suggest an analogy to magnetite. The ferrous and ferric oxides alone are non-magnetic but in combination form a strongly magnetic compound. Pyrrhotite is considered wholly a ferrous sulfide while its magnetism suggests the presence of the ferric molecule and a formula such as Fe_3S_4 would still conform to the general formula $\text{Fe}_n\text{S}_{n+1}$. Carrying out this idea which is offered merely as a suggestion, Fe_3S_4 might be considered as an end member for pyrrhotite and variations in composition be ascribed to excess percentages of the ferrous sulfide, perhaps present as solid solution.

CERULEOFIBRITE, A NEW MINERAL¹

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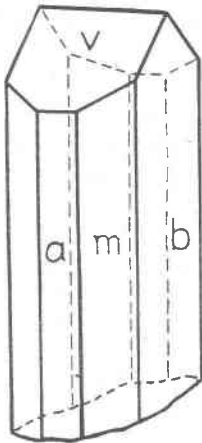
Several specimens of cuprite, in the Mineralogical Museum of the University of Michigan, contained a blue, fibrous mineral which has proven to be a new species. The proposed name, ceruleofibrite, is from the Latin *caeruleus*, blue, and *fibra*, a fiber.

These specimens were purchased from the Foote Mineral Company, and were labelled from "Bisbee, Arizona." They are composed chiefly of cuprite, containing disseminated flakes of copper, associated with azurite, chrysocolla, and small crystals of brochantite. Another specimen, obtained from Ward's Natural Science Establishment which was in reality ceruleofibrite, was labelled "conellite on cuprite," the locality being given as Lowell, which is in the Bisbee district.

¹ Paper read at the annual meeting of the Mineralogical Society of America, Amherst, Mass., December 29, 1921.

The ceruleofibrite occurs in tufts of very narrow radiating fibers in small cavities, or as compact masses with a fibrous structure, disseminated thru the cuprite. The individual fibers are of a pure bright blue color, and are transparent; the more compact masses have a somewhat blackish blue color. The streak is light blue, and the luster silky. The hardness is approximately 3; the specific gravity, as determined with the pycnometer, is 3.54.

Under the microscope the fragments appear as long needles, but at times sections across the fibers may be seen. The color of the fragments is light blue, and there is a very slight pleochroism to be noted. The extinction in all sections is parallel; the mineral being therefore orthorhombic. The indices of refraction, as determined by the immersion method, are, for sodium light, $\alpha=1.736$, $\beta=1.737$, $\gamma=1.741$; all $\pm .002$; and $\gamma-\alpha=0.005$. The mineral is positive, and the calculated value of $2V=53^\circ$. The orientation is $X=a$, $Y=b$, $Z=c$; the plane of the optic axes must accordingly be parallel to b (010), and $Bx_a=Z$. In those needles lying on the brachypinacoid face, a perfect cleavage at 32° with the elongation of the needles was observed.



Termination of ceruleofibrite crystal greatly magnified

The acicular crystals of ceruleofibrite average 3–4 mm. in length, and have a diameter of only a few hundredths of a millimeter. It was impossible to measure them on the goniometer, so the angles were approximately determined on the microscope, using a magnification of 430 diameters. By mounting the needles vertically on wax, and focusing on their terminations, it was possible to measure the angles between the faces of the prism zone. The outline of that zone was rectangular, with the pinacoid b (010) the largest face, its corners cut by the unit prism m (110), while the pinacoid a (100) was very small, the most always present. Several of the needles showed a macrodome; this was taken to be v (101), and the cleavage at 32° with the

elongation of needles lying on the brachypinacoid is parallel to this form. The axial ratios and measured angles of ceruleofibrite correspond very closely to those for brochantite, and indicate that the minerals are isogonic.

TABLE 1

Axial ratios	CERULEOFIBRITE <i>a:b:c</i> =0.78:1:0.49	BROCHANTITE <i>a:b:c</i> =0.7739:1:0.4871
100∧110	38°	37° 44'
010∧110	52°	52° 16'
110∧ $\bar{1}\bar{1}0$	76°	75° 28'
110∧ $\bar{1}10$	104°	104° 32'
101∧ $\bar{1}01$	64°	64° 22'

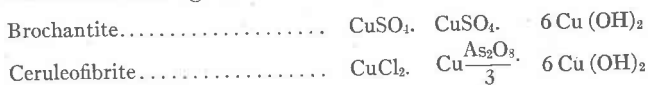
Ceruleofibrite dissolves readily in cold dilute HCl or hot dilute HNO₃, but is insoluble in water. The solutions react for copper and chlorine, and faintly for arsenic. An attempt to reduce a ferric chloride solution by means of a solution of absolutely pure ceruleofibrite failed, and showed all the copper of the mineral to be bivalent, tho the presence of admixed cuprite usually causes some reaction for cuprous copper. Heated in the closed tube the mineral becomes first green and finally black; it gives up water at a moderately high temperature, and a yellowish sublimate containing arsenic. The mineral gives an azure color to the flame.

A quantitative analysis was made: water being determined in an ignition tube; chlorine as silver chloride; copper was determined both volumetrically and gravimetrically; arsenic was precipitated as magnesium ammonium arsenate, and weighed as the pyroarsenate. Chlorine and copper were determined in duplicate, and gave close checks. The result of the analysis is given in the first column of table 2. The molecular ratios (second column) show the formula to be: $\text{CuCl}_2 \cdot \frac{1}{3} \text{Cu}_3\text{As}_2\text{O}_8 \cdot 6 \text{Cu}(\text{OH})_2$, which of course may be tripled. The theoretical composition for this formula is given in the third column. CuO in the analysis is high due to the presence of a very small amount of cuprite. Deducting the excess of this constituent and the material insoluble in acid, and recalculating to 100% gives the results in column 4, which agree very closely with the theoretical values.

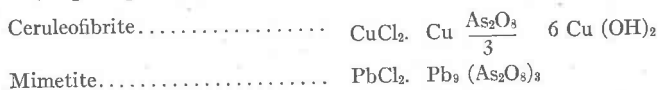
TABLE 2

	1	2	3	4
CuO.....	73.8	.927 8.3=8	72.7	72.7
Cl.....	7.5	.212 1.9=2	8.1	8.2
As ₂ O ₅	7.5	.033 .3= $\frac{1}{3}$	8.7	8.2
H ₂ O.....	11.7	.650 5.8=6	12.3	12.7
Insoluble.....	0.3
Less O=Cl.....	1.7	1.8	1.8
Sum.....	99.1%	100.0%	100.0%

By doubling the formula of brochantite its composition is found to be somewhat analogous to that of ceruleofibrite:



This accords with the isogonic relation noted above. The composition of this very basic copper chloroarsenate is unique in that in it one atom of copper is combined with arsenic acid to one with chlorine, while in the only other case of such a combination, the minerals of the apatite group, nine atoms of metal combine with arsenic (or phosphoric) acid to one with a halogen;



It is suggested that an examination of Bisbee cuprites in other collections might reveal more specimens of ceruleofibrite.

NOTES ON SAND CALCITE FROM SOUTH DAKOTA

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It was the writer's privilege last summer to visit the Rattlesnake Butte locality in South Dakota where great quantities of sand calcite crystals may be obtained, and, as this locality would doubtless be very interesting to mineralogists who might be in the vicinity, some notes on it are presented here.

Rattlesnake Butte, or the Devil's Hill, is situated on the Pine Ridge Indian Reservation approximately 23 miles (37 km.) straight south of the town of Interior, Jackson County, S. D. This is on the Black Hills line of the Chicago, Milwaukee, and St. Paul Railway, about 80 miles east of Rapid City; Interior is also on the George Washington Highway. To reach the Rattlesnake Butte locality from Interior, one goes about one mile west on the Washington Highway, then south on a reservation road, crossing White River about two miles from town, then in general following the main travel, avoiding the first two right forks, and keeping to the right after they are passed for about 15 miles, then going through a gate where there are three forks, taking the middle branch. About a mile further one takes the right fork. This is near the top of a hill overlooking the valley of Bear in the Lodge Creek, and the Snake Butte Hills can be seen from here as a