CAHNITE, A NEW BORO-ARSENATE OF CALCIUM FROM FRANKLIN, NEW JERSEY

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The mineral here to be described was first observed and sketched by Mr. Lazard Cahn about 14 years ago in the form of a few minute implanted crystals. The specimens containing them were placed in the hands of the senior author for study and became part of the Holden Collection at Harvard University. The tiny white glassy crystals were very characteristically twinned and their form and angles suggested strongly a relation to the barium zeolite edingtonite but material for analysis or for any but the simplest chemical tests was lacking. However, the writer believed that he could show that barium was lacking and that in its stead there was calcium. It was therefore regarded as a calcium edingtonite and the name cahnite was proposed for it as a recognition of Mr. Lazard Cahn's indefatigable efforts to preserve and to make known to science the rarer Franklin minerals. This name appeared in the *American Mineralogist* for 1921 in the title of a paper[1] which was neither read nor printed.

Thus the matter stood until the spring of 1926 when Mr. George Stanton of Franklin rediscovered this mineral in moderate abundance in veins in massive ore, in the northern part of the mine.

Its identity remained at first concealed as the newly found material was poorly crystallized. The junior author had established its peculiar chemical nature before the characteristic twinned crystals were again found. Spectroscopic examination of one of the original crystals was then made at the Palmerton laboratory of the New Jersey Zinc Company by Mr. Nitchie which established the complete chemical identity of the two finds.

Cahnite crystallizes in the tetragonal system with sphenoidal symmetry. Measurements were made both on the first-found crystals and on the later ones, the quality of both lots being poor. While the measurements of different crystals agree fairly closely in value, all are unsatisfactory by reason of the etching of practically all crystal faces. The crystals are generally small, rarely exceeding 2 or 3 mm. in diameter and are always characteristically

[1] Holdenite and Cahnite, two new minerals from Franklin Furnace, New Jersey, *Am. Mineral.* **6**, 39, 1921.

twinned with the appearance, essentially, of interpenetrating tetrahedrons twinned with parallel axes as in sodalite. This mode of twinning causes the positive and negative sphenoids to be brought to parallel position in the two individuals and they therefore reflect simultaneously. The larger, more brilliant sphenoid has been taken as the positive form $p(111)$: the smaller faces as the negative form $o(1\bar{1}1)$. The better developed prism is truncated by the perfect prismatic cleavage, m, (110). The angular values given by the two best measured crystals follow.

Crystal 1. Forms $a(100)$, $p(111)$, $o(1\bar{1}1)$

	Observed Angles				Calculated Angles			
	ϕ		ρ		ϕ		ρ	
a	00°	02′	90°	00′	00°	00′	90°	00′
a	90	02	90	00				
a	180	02	90	00				
p	44	39	41	02	45	00	41	02
p	− 44	31	41	02				
o	−135	15	41	02	135	00	41	02
o	+135	16	41	02				

Crystal 2. Forms $a(100)$, Cleav. (110), $p(111)$, $o(1\bar{1}1)$

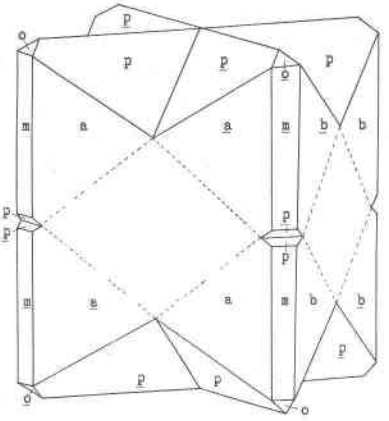
	ϕ		ρ		ϕ		ρ	
a	00°	00′	90°	00′	00°	00′	90°	00′
a	90	00	90	00				
cleav.	135	00	90	00	135	00	90	00
cleav.	−135	00	90	00				
(110)								
p	44	52	41	03	45	00	41	02
o	135	52	41	01	135	00	41	0

The average value of the sphenoid angles, ϕ 45°, ρ 41° 42′ yields the axial ratio $a:c=1:0.615$. $p_0=0:615$

Other signals were obtained from some of the crystals but they were variable in position and were undoubtedly from rounded etched faces, yielding no simple indices.

The figure shows an idealized twin crystal. One group approximated to this development but generally the twins are far less regularly formed. Characteristic for all however are the reentrant angles appearing on the prism face a, which is common to the two parts of the twin; and the rectangular crossing of the two sphenoid edges of p. The sharpness of the form is commonly lost by the rounding and facetting due to etching. In the latest find

of cahnite the etching is so extensive that the twin crystals are reduced to plates parallel to the basal plane, still however, showing reentrants on the bright prism faces.



Cahnite. Idealized Twin Crystal.

Cahnite is white and transparent with a notable glassy lustre. The optical characters, determined by Mr. Berman, are as follows:

Uniaxial, positive. Dispersion strong,

Refractive indices, $\omega = 1.662$; $\epsilon = 1.663$

The double refraction is therefore very low.

Due to the low birefringence and considerable dispersion of cahnite it exhibits abnormal interference colors somewhat similar to the same phenomena shown in torbernite as described by Bowen.[2] This striking effect makes the mineral easily recognizable under the microscope.

The hardness of cahnite is about 3 and the specific gravity 3.156. The very perfect cleavage parallel to the first order prism (110) is noteworthy. The appearance of the mineral is very much like that of the barite with which it is sometimes associated.

Material for the analyses was purified by hand picking, and for the largest sample, by the use of heavy solutions.

[2] Abnormal Birefringence of Torbernite, *Am. Jour. Sci.*, Vol. **48**, p. 195, 1919.

1. Analysis of a sample of cahnite of .1 gr. with slight impurities of hedyphane and calcite by L. H. Bauer.

2. Analysis of a sample of cahnite of .26 grams with slight impurity by L. H. Bauer.

3. Analysis of a very pure sample of .5 gram by L. H. Bauer.

4. Molecular ratio of 3.

5. Calculated composition of $4CaO.B_2O_3.As_2O_5.4H_2O$.

	1.	2.	3.	4.	5.
CaO	38.27	37.13	37.62	.671=4×.168	37.64
B_2O_3	10.14	11.64	11.86	.169=1×.167	11.74
As_2O_5	36.79	37.47	38.05	.166=1×.167	38.54
H_2O	11.75	11.78	12.42	.689=4×.172	12.08
PbO	1.15	trace			
MgO	0.24				
ZnO	trace	1.58			
CO_2	trace				
	99.99	99.60	99.95		100.00

The determination of boron was made by Chapin's modified distillation method on a separate portion in each case.

The close agreement of the three analyses made on different samples of cahnite is striking. The molecular ratio leads to the simple formula $4CaO \cdot B_2O_3 \cdot As_2O_5 \cdot 4H_2O$ or $Ca_4B_2As_2O_{12} \cdot 4H_2O$. Cahnite is thus an entirely new type of chemical compound among minerals.

Cahnite fuses quietly at about 3 yielding the green flame of boron. It is easily and completely soluble in dilute hydrochloric acid. In the closed tube, heated alone it yields water and becomes opaque but does not fuse; heated with potassium carbonate and carbon it yields an arsenic mirror.

Cahnite has been found only at Franklin. The first crystals occurred on specimens which probably came from the Parker Shaft. They present two distinct types of paragenesis. In one cahnite is implanted on the walls of cavities in beautifully crystallized axinite together with barite and pyrochroite. In the second type cahnite, calcite, and olive green willemite crystals are implanted on massive friedelite and barite or on garnet. One crystal on such a specimen, exceptional in being untwinned, is also the largest crystal of cahnite yet seen, measuring 6 mm. in diameter.

The specimens found by Mr. Stanton in 1926 came from pillar No. 229 north, 36 feet above the 700′ level of the Franklin Mine. The specimens are always associated with axinite which constitutes veins with narrow open cavities. Resting on this are rhodonite crystals, barite, hedyphane, sometimes in crystals, and willemite of either the usual prismatic habit or in thin plates with the base dominant. The cahnite is later than and implanted upon all these associated minerals. The only mineral to form after cahnite is datolite in the form of a coating of fibrous nature like what has been called botryolite at Arendal, Norway. This coats all other minerals in the veins although the cahnite crystals are generally free from it and clearly belong to the same period of deposition. Cahnite has also been found in a neighboring part of the mine associated only with rhodonite, on crystals of which it is implanted.

Still another association of the new mineral has come to light as this article is being written. Specimens from the picking table show small drusy cavities in franklinite lined with dodecahedral crystals of garnet. The garnet is pink on the free surfaces, and shows successively white and yellow bands towards the walls of the cavities. Tiny glass-clear crystals of cahnite are implanted on the garnet and show to the minutest detail the complete symmetry of the twin figured above. The only associated mineral is a brown to light yellow biotite mica in slender, long prismatic crystals projecting into the cavities.

The authors are indebted to Mr. Stanton for both gifts and oans of cahnite specimens for analysis and study.