LEIGHTONITE, A NEW SULPHATE OF COPPER FROM CHILE

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ABSTRACT

Leightonite, $CuO \cdot 2CaO \cdot K_2O \cdot 4SO_3 \cdot 2H_2O$, is a new mineral from Chuquicamata, Chile. It is triclinic, pseudo-orthorhombic, with multiple twinning on (100) and (010). Approximate elements: $a:b:c = 0.7043:1:0.4578$; α, β, γ, near 90°. No cleavage; $H=3$; $G=2.95$. Biaxial, negative; X near b[010], Y near c[001], Z near a[100]; indices (Na): $nX=1.578$, $nY=1.587$, $nZ=1.595$, all ± 0.002; $2V$ about 60°; $r>v$, fairly strong. Occurs in pale blue prismatic crystals and in fibres filling cross-fibre veins.

The mineral here described for the first time has been known for some years to the geological staff of the Chile Exploration Company at Chuquicamata as probably a new species. It was first found in cross-fibre veins; and on the basis of an incorrect analysis it was doubtfully assigned to the species syngenite. A more accurate analysis by Mr. Carter of the mine staff later showed that this determination was erroneous. Specimens of the mineral and a copy of the later analysis were brought to Cambridge in 1935 by Mr. M. C. Bandy, who made a preliminary study of its crystal form and optical properties. Better material for the crystallographic study, collected and studied optically at the mine by Mr. O. W. Jarrell, was kindly turned over to the Harvard Mineralogical Laboratory for fuller description. My colleagues in the laboratory have all had a hand in the study of this mineral; the writer should have credit for but a small part in the description here presented.

Crystallography. Leightonite, as the new species will be named, is triclinic, as shown by optical examination. The crystals have the appearance of holohedral orthorhombic individuals, but this is the result of combined lamellar twinning on the vertical axial planes of a nearly rectangular triclinic lattice. The faces are consequently multiple in character, giving somewhat blurred signals in which it was not possible to separate the images from the various sub-parallel planes of the twinned complex. For morphological description the crystals are therefore necessarily referred to orthorhombic elements which must be close to the actual triclinic elements of the lattice.

The crystals are mostly slender blades or laths elongated with [001] and flattened on (100), with prominent curved surfaces cutting away more or less of the front edges of the prism and giving to the doubly terminated individuals a sort of hourglass appearance. Such a crystal is shown in Fig. 1; Fig. 2 shows a crystal in which the curvature is absent. Rarely the crystals are equidimensional, as in Fig. 3, and then they are of better quality. Numerous crystals were measured by Mr. Bandy, Dr.

Peacock and the writer. The best measurements are collected in Table 1; the elements, calculated from 80 faces of 5 forms, constitute the basis of the angles in Table 2.

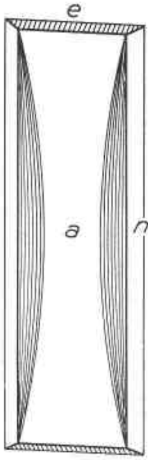

FIG. 1.

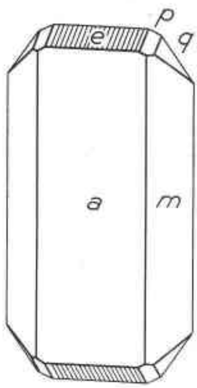

FIG. 2.

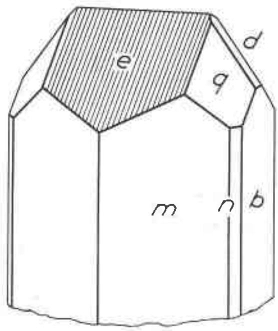

FIG. 3.

CRYSTALS OF LEIGHTONITE

TABLE 1. LEIGHTONITE: MEASURED ANGLES

Forms	Mean		Range		No. of faces	Quality
	ϕ	ρ	ϕ	ρ		
n 130	24°58′	90°00′	23°49′–25°23′	—	11	poor
m 110	54 54	90 00	54 00 –55 30	—	36	fair
d 031	0 00	53 47	—	—	1	poor
e 101	90 00	32 52	—	32°45′–33°03′	9	poor
p 111	55 12	38 12	55 15 –55 55	37 45 –38 43	5	poor
q 131	25 34	56 45	25 00 –26 00	56 04 –57 04	18	good

TABLE 2. LEIGHTONITE—$CuO \cdot 2CaO \cdot K_2O \cdot 4SO_3 \cdot 2H_2O$
Triclinic (pseudo-orthorhombic)

$a:b:c = 0.7043:1:0.4578$; $p_0:q_0:r_0 = 0.6500:0.4578:1$
$q_1:r_1:p_1 = 0.7043:1.5385:1$; $r_2:p_2:q_2 = 2.1844:1.4198:1$

Forms	ϕ	$\rho=C$	ϕ_1	$\rho_1=A$	ϕ_2	$\rho_2=B$
b 010	0°00′	90°00′	90°00′	90°00′	—	0°00′
a 100	90 00	90 00	—	0 00	0°00′	90 00
n 130	25 19½	90 00	90 00	64 40½	0 00	25 19½
m 110	54 50½	90 00	90 00	35 09½	0 00	54 50½
d 031	0 00	53 56½	53 56½	90 00	90 00	36 03½
e 101	90 00	33 01½	0 00	56 58½	56 58½	90 00
p 111	54 50½	38 29	24 36	59 25	56 58½	69 00
q 131	25 19½	56 39	53 56½	69 04	56 58½	40 58½

Forms. $b\{010\}$ is present only on the crystals of a single specimen one of which is shown in Fig. 3. On these crystals the face is of excellent quality.

$a\{100\}$ is usually broad, determining the habit of the lath-shaped crystals, Figs. 1 and 2.

$n\{130\}$ is a weak form, seen only on the rare crystals of equidimensional habit.

$m\{110\}$ is always present and is the dominant form on prismatic crystals. The faces are bright but often irregularly faceted giving then poor signals.

$d\{031\}$ was observed only once as a poor narrow face, Fig. 3.

$e\{101\}$ is always present with distinct faces deeply striated as shown in Figs. 1 and 2. This form merges insensibly into a steeper curved surface which appears to be the result of partial solution and is not measurable.

$p\{111\}$ is seen only as narrow line faces between q and e.

$q\{131\}$ is the dominant pyramid, producing by its intersection with e the striation on the faces of the latter.

Optical properties. The crystals are pale watery blue to greenish blue, translucent, and faintly pleochroic in tints of blue.

	n(Na)	
X near b [010]	1.578 ⎫	Negative
Y near c [001]	1.587 ⎬ ± 0.002	$2V$ about 60°
Z near a [100]	1.595 ⎭	$r>v$, fairly strong

In a section parallel to (010) a crystal shows twin lamellae parallel to c[001] with extinction $Y{:}c[001]=3°$. In a section parallel to (001) the lamellae are parallel to b[010] and the extinction is $X{:}b[010]=3°$ to 5°. On (100) a crystal shows an internal hourglass structure conforming to that shown by the exterior. Prehnite shows a similar effect. When the crystals are finely crushed each fragment shows twinning effects. These observations lead to the conclusion, already stated, that every crystal of leightonite is a complex of twin lamellae resulting from combined twinning on the subrectangular planes (100) and (010) of a triclinic structure.

Physical properties. Cleavage none. H=3. G=2.95 (by suspension in methylene iodide and bromoform).

Chemical composition. Leightonite is a hydrous sulphate of copper, lime and potash, with the empirical formula: $CuO\cdot 2CaO\cdot K_2O\cdot 4SO_3\cdot 2H_2O$.

Occurrence. Leightonite occurs at Chuquicamata, Chile, in the great open cut. O. W. Jarrell reports that it is found quite abundantly on the east and west sides of the open pit near the south end. It appears to be limited to a zone within 50 meters of the original surface and is found in

TABLE 3. LEIGHTONITE: ANALYSES

	1	2	3	4		5
CuO	12.2	11.24	11.97	0.1505	$=1\times 0.1505$	12.39
CaO	17.3	17.50	18.41	0.3283	$=2\times 0.1641$	17.45
K_2O	13.8	13.62	13.93	0.1479	$=1\times 0.1569$	14.68
Na_2O	tr.	0.98	0.56	0.0090		
SO_3	48.8	50.75	49.33	0.6162	$=4\times 0.1541$	49.87
H_2O at 105°	0.2	5.98	5.71	0.3170	$=2\times 0.1585$	5.61
H_2O at 900°	6.8					
Insol.	0.5					
	99.6	100.07	99.91			100.00

1. Cross-fibre material. Carter, analyst.
2. Cross-fibre material. Gonyer, analyst.
3. Crystals. Gonyer, analyst.
4. Molecular proportions from analysis 3.
5. Composition of $CuO \cdot 2CaO \cdot K_2O \cdot 4SO_3 \cdot 2H_2O$.

borderland material, never in rich ore. Leightonite was formed only under conditions of low acidity. Its associates are chiefly atacamite and kröhnkite, never antlerite. It forms networks of crystals in cracks, cementing rock fragments; and it completely fills cross-fibre veins. The mineral is similar in appearance to kröhnkite but has a paler blue color.

Name. Leightonite is named in honor of Dr. Tomas Leighton, Professor of Mineralogy at the University of Santiago, Chile.