ferroselite sample from the Virgin mine. Thanks are also due to John Moscal of the Phillips Electronic Instrument Co. and C. M. Taylor of the Materials Analysis Co., who performed the electron microprobe analyses, and to Professor E. N. Cameron, who kindly lent the germanium standard.

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NEW DATA ON SARMIENTITE

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Sarmientite, $Fe_2(AsO_4)(SO_4)OH \cdot 5H_2O$, was discovered by V. Angelelli in the locality of La Alcaparrosa, Department Barreal, San Juan province, Argentina, and described by Angelelli and Gordon (1941) who performed the optical and morphological study.

While studying some arsenates and sulfates, a specimen of sarmientite from the original locality was investigated at our laboratory; the present note records the results.

On optical examination the sample appeared to be homogeneous and free of impurities formed by very small crystals up to 20 μm long.

Before the wet analysis was undertaken, a spectrochemical analysis revealed, in addition to the major elements: Ca, Cu (0.1%); Al, Mn (0.01–0.1%) and Si, Mg (0.001%).

The quantitative chemical analysis of the specimen now studied agrees with that given by Angelelli and Gordon (Table 1).

In the electron microscope, crystals showing a habit similar to that described by Angelelli and Gordon are seen (Fig. 1). After long exposure to the electron beam, the crystals alter visibly and crack.

X-RAY DIFFRACTION DATA

After a very long search, three crystals permitting single crystal work were found. Rotation, Weissenberg and precession methods were employed to determine the dimensions of the unit cell. These values, slightly modified after data derived from X-ray powder patterns, are

TABLE 1. CHEMICAL ANALYSES OF SARMIENTITE
Wt. %

	Analysis in Angelelli and Gordon	Present study
As_2O_5	22.68	23.00
SO_3	18.28	19.10
Fe_2O_3	36.57	33.63
FeO	n.d.	1.43
CaO	0.27	n.d.
H_2O	22.86	22.60
Total	100.66	99.76

$a=6.55$, $b=18.55$, $c=9.70$ Å, $\beta=97°39'$, monoclinic $P2_1/c$, $a:b:c=0.353:1:0.529$, cell volume 1168.08 Å^3, $Z=4$. The Weissenberg photographs were taken with c the rotation axis; precession photographs were obtained with c and a the precessing axes. Exposures times were 200–300 hours (Cu/Ni).

The spacings and intensities given in Table 2 were derived from diffractometer charts. The calculated d values were obtained and indexed by means of a Bull G.E. 625 computer.

Extinctions in the single crystal photographs lead to space group

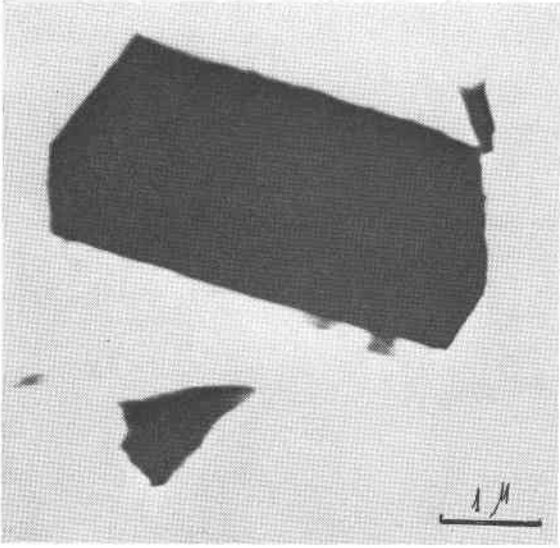

FIG. 1. Electron micrograph of a sarmientite crystal.

TABLE 2
X-RAY POWDER DATA FOR SARMIENTITE

hkl	*d*(obs)[a] Å	*d*(calc)[b] Å	*I*	*hkl*	*d*(obs)[a] Å	*d*(calc)[b] Å	I
020	9.29	9.275	100	052	2.93	2.937	7
011	8.53	8.535	22	211		2.921	
021	6.68	6.675	9	$\bar{2}02$	2.87	2.873	16
110	6.13	6.127	35	230		2.874	
120	5.31	5.318	15	142		2.863	
031	5.21	5.201	27	$21\bar{2}$	2.84	2.839	10
$12\bar{1}$	4.87	4.885	38	033		2.845	
040	4.64	4.637	90	$23\bar{1}$		2.847	
012		4.653		160	2.792	2.791	4[b]
130	4.47	4.477	18	$22\bar{2}$	2.734	2.745	10
121		4.453		$13\bar{3}$	2.726	2.727	18
022	4.26	4.268	80	$16\bar{1}$		2.723	
$11\bar{2}$	4.02	4.036	32	231	2.668	2.669	18
140	3.76	3.774	9	240		2.659	
$12\bar{2}$		3.777		062	2.60	2.600	48
112	3.56	3.570	10	152		2.598	
141	3.43	3.424	40	$23\bar{2}$		2.606	
$13\bar{2}$		3.437		202	2.526	2.538	6
042	3.33	3.337	35	212		2.514	
200	3.24	3.246	9	241	2.492	2.494	7
150	3.22	3.221	8	133		2.500	
$20\bar{1}$		3.207		$24\bar{2}$	2.436	2.442	9
132	3.13	3.136	20	250		2.443	
$15\bar{1}$		3.117		$21\bar{3}$		2.428	
220	3.06	3.064	70	$25\bar{1}$		2.426	

[a] Values obtained using CoKα = 1.7889 Å, Fe filter. Diffractometer.
[b] The calculated *d* values were obtained by means of a Bull G.E. 625 computer.

$P2_1/c$. The morphology (Angelelli and Gordon, 1941) suggests that the crystals belong to class $2/m$.

The calculated density is 2.58 for a unit cell containing four formula units of $Fe_2(AsO_4)(SO_4)OH \cdot 5H_2O$. The density measured by Angelelli and Gordon is 2.58.

INFRARED SPECTRUM

The infrared absorption spectrum shown in Figure 2 was obtained in a Perkin Elmer model 337 grating spectrophotometer. A sample of 1.5 mg was mixed and ground with 210 mg of KBr.

Hydroxyl and water bands appear in the regions near 3.0 and 6.1 μm respectively.

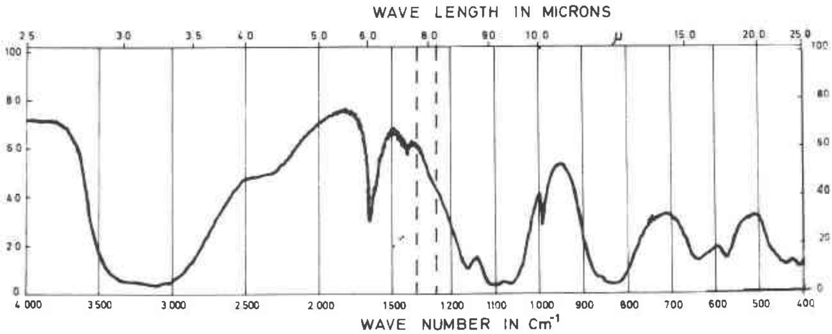

FIG. 2. Infrared absorption spectrum of sarmientite.

The following bands correspond to the vibrations of the sulfate ion, according to Adler and Kerr (1965); three intense bands in the 8- to 10-μm region which correspond to the τ_3 vibrations; a weak band slightly above 10 μm which represents the ν_1 vibration; two bands in the 15- to 18-μm region are attributed to the ν_4 mode, and a band at 22 μm, to the ν_2 mode. The bands in the 11- to 13-μ region are attributed to vibrations of the arsenate ions.

THERMAL PROPERTIES

The weight loss of sarmientite on heating was determined by means of a thermogravimetric balance. A 204 mg sample, was heated from room temperature to 980°C, at 5°C/min. The resulting curve is shown in Figure 3. The loss in weight between 200 and 685°C is 22.95 percent;

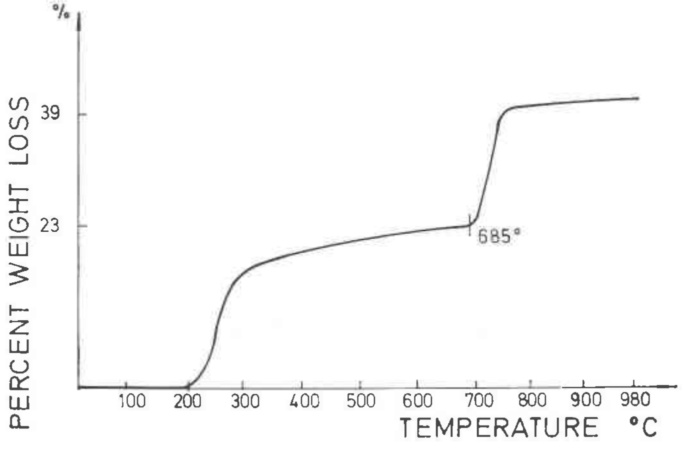

FIG. 3. Thermogravimetric curve of sarmientite.

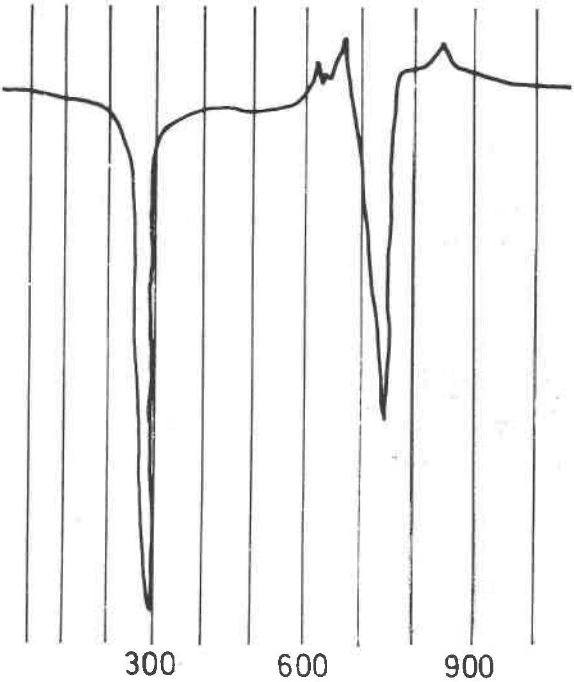

Fig. 4. Differential thermal analysis curve of sarmientite, temperature in °C.

most of this loss occurs between 200 and 300°C, and represents the water content; it agrees closely with the water determination in the chemical analyses (Table 1). A loss of weight of 16.4 percent occurred between 685 and 980°C; it agrees reasonably well with the SO_3 determination in the chemical analyses.

A differential thermal analysis of sarmientite yielded the curve of Figure 4 in which are shown major endothermic peaks at 200–300°C (loss of water) and at 700–800°C (loss of SO_3) and small exothermic peaks at 600–700°C and 850°C which probably represent recrystallization processes.

When heated at 300°C for one hour sarmientite yields a buff colored product, amorphous to X-rays. A sample held at 650°C for two hours lost all the SO_3; a reddish-brown, crystalline material, remained. The spacings in Å and the relative intensities of the strongest lines, as obtained from a diffractometer chart are: 3.04 (100), 3.13 (50), 3.26 (50), 2.99 (30), 2.49 (30), 3.68 (30), 3.53 (30). The line at 3.68 Å belongs to hematite; the spacings of the remaining lines correspond to those of strong lines in the angelellite pattern (Weber, 1959).

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JOHACHIDOLITE, A REVISED CHEMICAL FORMULA

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Iwase and Saito (1942) described a new mineral which was discovered in nepheline veins in limestone at Johachido, Kankyohokudo, Korea, which they named after the locality. The impossible formula given, $H_6Na_2Ca_3Al_4F_5B_6O_{20}$, has appeared in several books dealing with mineralogy or the chemistry of boron compounds. Only the analysis appears in Dana (1951). A balanced formula, $Na_2Ca_3Al_4B_6O_{14}(OH)_5F_5$, is given in Hey (1962), and Strunz (1957) offers the formula $Ca_3Na_2Al_4H_4[(F,OH)BO_3]_6$, but neither represent the analysis well. A new calculation seemed necessary.

Since impurities due to nepheline, $NaAlSiO_4$, and apatite, $Ca_5(PO_4)_3F$, probably make some contribution[1], column 2 presents the amended analysis. The atomic proportions were calculated on a basis of total anions = 45 (column 3), this being the smallest number whereby an approximately integral number of cations in each group could be ac-

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[1] Private communication from M. H. Hey.