NOTULAE NATURAE

NUMBER 205 OF APRIL 9, 1948

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

SANMARTINITE, A NEW ZINC TUNGSTATE FROM ARGENTINA

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This new mineral was discovered through the study of a sample of tungsten ore from the Sierra of San Luis, which the miners call " dull wolfram ". It was found in a small, now abandoned, prospect situated in Los Cerrillos, 7 kilometers to the southwest of San Martin, in the Department of San Martin in the Province of San Luis. The miners say that it is also found in Los Patos, in the " estancia " belonging to Roldán, and in the mines " Los Avestruces " and " El Peñón ", all in the region of San Martin.

The name of this new zinc member of the wolframite group has been taken, therefore, from the region where it was found—which in its turn, bears homage to the great liberator General Don José de San Martín.

Geological Occurrence.—The wolframite zone of San Martin occurs in preCambrian crystalline schists (gneisses, mica schists and injected mica schists) intruded by irregular bodies of granite and dikes of pegmatite and lamprophyres (kersantites), the latter generally running north-south according to the main strike of the schists. The predominating tungsten ore deposits are those of scheelite, with a quartz gangue, with associated tourmaline, muscovite, pyrite, and chalcopyrite, and occasionally beryl and sphalerite; many of the deposits occur in the selvages of kersantite dikes.

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The sanmartinite was found on opening a quartz vein with a strike N 70° S, intercalated between a light-colored granite and a pink pegmatite. This quartz vein, 50 to 60 cm. wide contained small masses of sanmartinite surrounded by white to grayish quartz, the latter being sometimes ferruginous.

While usually compact, the sanmartinite may be quite porous, and in color varying from dark brown to dark gray depending upon the amount of admixed scheelite. The quartz surrounding the sanmartinite and scheelite often contains acicular crystals of tourmaline.

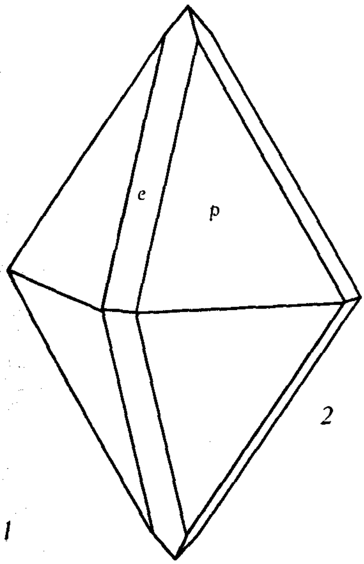
Under the microscope the scheelite appears in relatively well-developed bipyramidal crystals (fig. 2) with wavy extinction. This calcium tungstate appears to be replaced by the sanmartinite, as is further noted below. Tiny vugs in the ore show druses of sanmartinite, with small crystals of scheelite and colorless, often radiating, crystals of willemite (fig. 3).

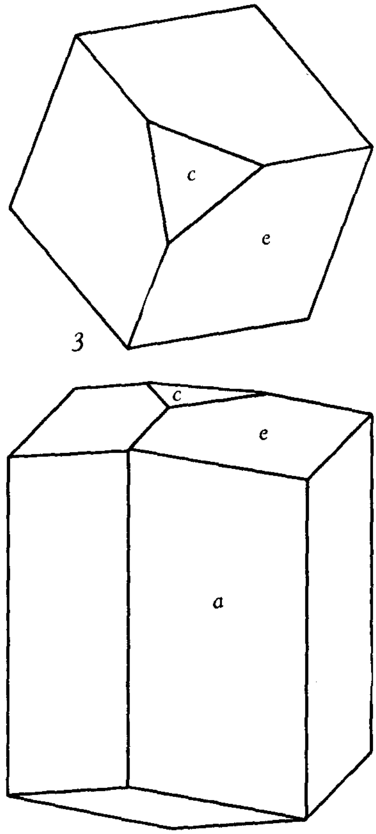
The genetic position of the sanmartinite vein corresponds to the general type of scheelite deposits of the San Martin region, which are considered meso- to hypothermal and related to the granitic intrusions and their satellites. Judging from the microscopical observations, the origin of the sanmartinite should be attributed to zinc and iron bearing solutions, perhaps of an ascendent nature, which replaced pre-existing scheelite.[3]

Physical Properties.—Fine granular masses of sanmartinite, when pure are dark brown to brownish black in color, but microscopic crystals are reddish brown with red reflections, and are more or less translucent. They resemble dark zinc-blende, and have a resinous luster. Under the microscope the minute prismatic crystals (of the order of 60 μ) are seen to form reticular aggregates, and the minute, parallel, clino-pinacoidal cleavage surfaces reflect simultaneously, resulting in a specular effect. The reticular aggregation suggests that replacement occurred along the (111) cleavage planes of scheelite, a theory borne out by the fact that the clinopinacoidal cleavages of the minute crystals are parallel to the (111) planes of residual scheelite.

The specific gravity was kindly determined by Miss Judith Weiss by weighing a gram of clean fragments in CCl_4, and a value of 6.697 was obtained.

[3] In the "Los Cóndores" mine, in the province of San Luis, beautiful specimens of scheelite crystals, pseudomorphous after ferberite (reinite), were found whose origin is ascribed to ascending solutions. (Angelelli, V. y Chaudet, A.-La ferberita, variedad reinita, de la Mina "Los Cóndores", San Luis; Revista Minera T. XII, enero-junio 1941.





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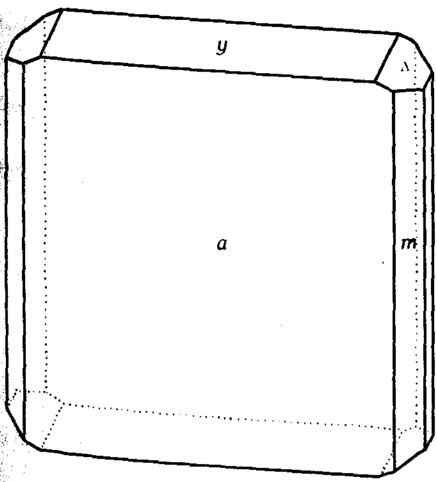
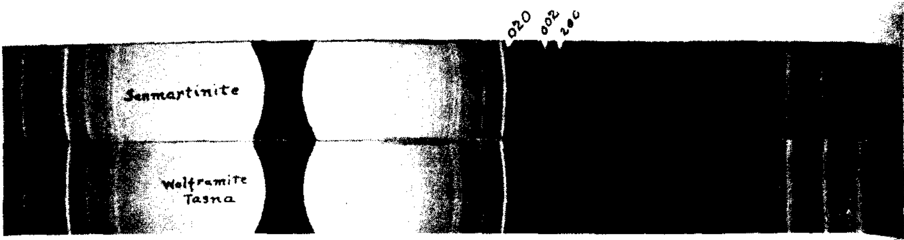


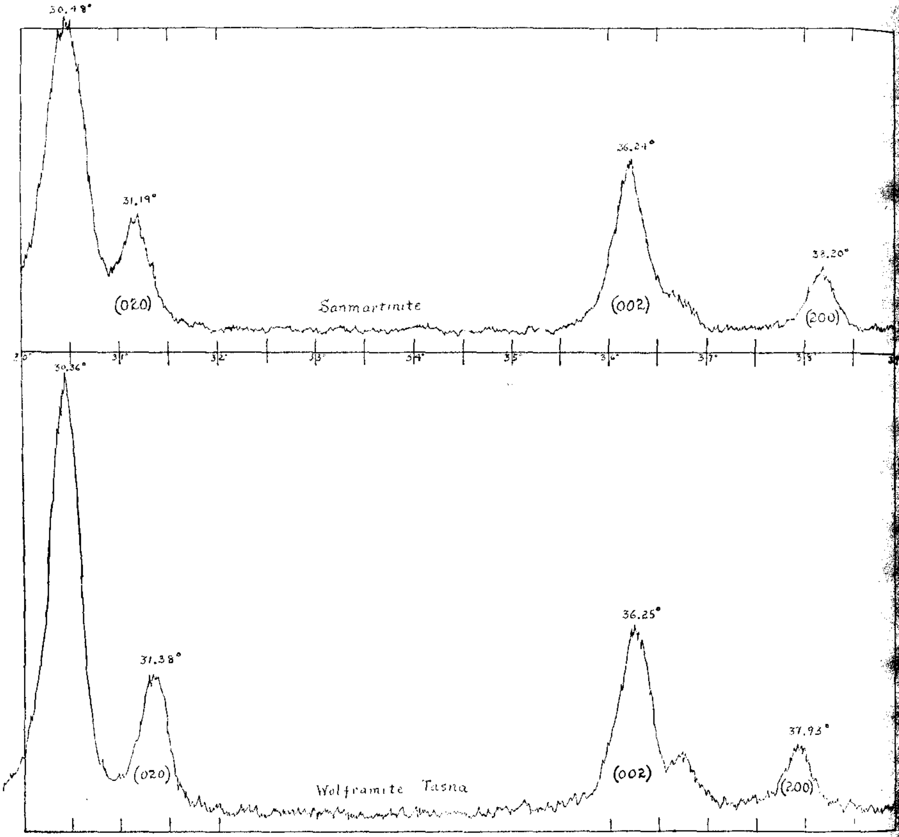
Fig. 1.—Sanmartinite; forms (Table I): *a* (100), *b* (010), *m* (110), Λ (112), and *y* (102).

Fig. 2.—Scheelite; forms: *e* (011), and *p* (111).

Fig. 3.—Willemite; forms: *c* (0001), *e* ($01\bar{1}2$), and *a* ($11\bar{2}0$); *r* ($10\bar{1}1$) and *z* ($01\bar{1}1$) were also identified on other crystals.



Figs. 4-5.—X-ray films of powders of sanmartinite and of wolframite from Tasna, Bolivia; taken with a G.E. powder camera of 450 mm. circumference, filtered Cr radiation.



Figs. 6-7.—X-ray spectrographs of principal reflections of sanmartinite and wolframite (from Tasna, Bolivia) taken with a North American Philips recording X-ray spectrometer by Mr. Jack L. Abbott. Nickel filtered Cu radiation, scanned at ¼ RPM.

Crystallography.—Minute crystals of sanmartinite have the usual habit of members of the wolframite group, that of being tabular parallel to *a* (100), and with the forms commonly occurring on wolframite (Table I, and fig. 1).

The lattice constants of sanmartinite were compared with those of crystals of wolframite from Tasna, Bolivia, from X-ray data obtained from powdered samples, using both a G.E. powder camera, and a Philips recording X-ray spectrometer. These data are summarized in Table II and figs. 4-7.

Chemical Composition of Sanmartinite.—Chemical analyses of the new mineral are shown in Table III, while Table IV presents the data used in calculating the chemical composition.

Sanmartinite is a member of the wolframite group, with zinc as the predominating cation. The low density and low molecular weight, and low value obtained for WO_3 indicate that about one-sixth of the tungsten positions in the lattice are vacant.

Presuming that the space group assigned to wolframite is correct,[4] the formula for sanmartinite can be written:

$[(Zn, Fe, Mn, Ca) W_{1\text{-}1/6}O_4]_2 [P2/c]$, with $(Zn, Ca) O : (Fe, Mn) O = 2:1$.

Acknowledgments.—We are indebted to Dr. I. Fankuchen for the privilege of taking the powder X-ray graphs (fig. 4-5) in his excellently equipped laboratories at the Polytechnic Institute of Brooklyn, as well as the preliminary X-ray spectrographs; and especially to Mr. Jack L. Abbott of the North American Philips Company for the X-ray spectrographs (fig. 6-7), and to Mr. Fred Behr of the F. J. Mullowney X-ray Company, Trenton, N. J. (agents for Philips), for additional X-ray spectrographic data.

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[4] Bunin, S. M., Klimov, A. I., and Umansky, M. M. (Roentgen analysis of a crystal of wolframite). J. Phys. Chem., Acad. Sci. U.S.S.R. 1940, vol. 14, pp. 844-845 (thru Mineralogical Abstracts XXVI, 1942, p. 289). The original paper was not seen.

TABLE I. ANGLES OF SANMARTINITE

	Sanmartinite Measured Angles ϕ	ρ	Wolframite Calculated Angles [5] ϕ	ρ
a (100)	90° 00′	90° 00′	90° 00′	90° 00′
b (010)	00 00	"	00 00	"
m (110)	50 55	"	50 27	"
λ (112)	51 45	34 28	50 53	34 29
y (102)	90 00	28 30	90 00	28 03

a:b:c = 0.8255 : 1 : 0.8664; β 90° 28′

p_0 = 1.0495; q_0 = 0.8664; μ 89° 32′

TABLE II. X-RAY POWDER DATA

	I. Sanmartinite		II. Wolframite Tasna, Bolivia	III. Wolframite X-ray data [4]	IV. Wolframite (Morphology) Goldschmidt [5]
d_{200}	spectrometer	2.356	2.371		
	film	2.348	2.367		
d_{020}	spectrometer	2.869	2.852		
	film	2.857	2.844		
d_{002}	spectrometer	2.479	2.480		
	film	2.470	2.470		
a_0	spectrometer	4.712	4.742	4.78	
b_0	"	5.738	5.704	5.73	
c_0	"	4.958	4.960	4.98	
a_0/b_0	"	.8212	.8313	.835	a/b .8255
c_0/b_0	"	.8641	.8696	.870	c/b .8664

TABLE III. CHEMICAL ANALYSES OF SANMARTINITE

	I	II	III
WO_3	72.62	71.70	71.20
ZnO	18.18	15.74	11.70
CaO	1.48	1.54	6.32
FeO	7.24	8.28	7.74
MnO	1.73	1.00	0.74
Insoluble	0.24	1.10	1.80
	101.25	99.36	99.50

Formula ratios

	I		II		III	
WO_3	.313		.309		.307	
ZnO	.223	.374	.193	.344	.164	.395
CaO	.026		.022		.113	
FeO	.101		.115		.108	
MnO	.024		.014		.010	

I. Analysis by Horace Hallowell; II-III: preliminary analyses in the laboratory of the Dirección de Minas y Geología, Buenos Aires.

[5] Goldschmidt, Krystallographische Winkeltabellen

TABLE IV. ATOMS IN SANMARTINITE

I Analysis I recalculated to 100%		II Analysis I recalculated as % elements		III (From II) Percentages / atomic weights		IV Atoms present per cell (Z = 2) (From III)	V Required if all atoms were present
WO_3	71.73	O	20.77	1.296	.0123 × 10.5	7	8
		W	56.88	.309	.0124 × 2.5	$1\frac{2}{3}$	2
ZnO	17.95	Zn	14.43	.220	.246 = .0123 × 2 (Zn + Ca)		
CaO	1.46	Ca	1.04	.026		2	2
FeO	7.15	Fe	5.56	.099	.123 = .0123 × 1 (Fe + Mn)		
MnO	1.71	Mn	1.32	.024			
	100.00		100.00				
VI.	V (calculated from III and X-ray spectrometer data)					134	
VII.	M (calculated from III) ($O_{10.5}W_{2.5}Zn_{1.8}Ca_{0.2}Fe_{0.8}Mn_{0.2}$)					534	617
	M (calculated from X-ray spectrometer data)					541	
VIII.	ρ (calculated from X-ray spectrometer data) .... $\rho = 1.66020\ M/V$					6.62	7.44
	Sp. gr. by weighing					6.70	