AB, whose angle-point is the extremity of the diameter perpendicular to AB. Each of these two figures will be related to the orthogonal projection on the base in the same way as shown in the drawing for the parallel-perspective figure.

AN AMERICAN OCCURRENCE OF SARCOPSIDE

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In 1868 M. Websky published a description of a new mineral, which he named sarcopside.[1] It occurred under a thin covering of vivianite in a pegmatite dike intruding a gneiss formation, near Michelsdorf in the Eulengebirge, Silesia, associated with hureaulite. This has been regarded, however, by Dana and others as closely related to, if not an impure variety of, triplite, and specific rank has not been assigned to it.

A recent examination of a mineral found in Deering, N.H., in 1916, led the author to believe it to be sarcopside, with which it agreed closely in blowpipe and physical properties. A quantitative analysis of this mineral was therefore made, which not only confirmed this belief, but also indicated that it actually represents an independent species.

This first American occurrence (the second known for the mineral) is in a small pegmatite dike, cutting a gray schist composed of sillimanite, muscovite and garnet. This dike has been prospected for mica, and it was on the dump that two small specimens of sarcopside (approximately 3 x 3 x 2 cm. and 2 x 2 x 1 cm.) were found. The pegmatite was composed largely of orthoclase and quartz, with opaque apple-green beryl, black tourmaline, large plates of muscovite and flakes of biotite, and rather large opaque red garnets. No other phosphates than sarcopside were noted, altho no exhaustive search was made.

Sarcopside is a mineral of fibrous appearance, occurring i irregular slab-like masses. It has a distinct cleavage approx mately perpendicular to the fibers, and another less distinc parallel to the fibers. The fibers extended continuously acro the specimens at hand. The fracture is splintery to fibrous. H. = 4. Sp. Gr. = 3.64, (average of five determinations on the Jolly balance; Websky gives sp. gr. = 3.69–3.73). Luster silky and glistening. Color, when unaltered, flesh-red to lavender; altering on exposure to blue, green, or brown. Translucent in thin splinters. Streak light straw yellow. Alters quite easily on surface to a material resembling and perhaps identical with "blue vivianite."

The optical properties of sarcopside have not been previously recorded, and it was thought essential, to confirm its specific

[1] *Z. Deutsche Geol. Ges.*, **20**, 245, 1868.

rank, to determine some of these. Under the microscope the cleavage fragments appear to be flat fibers of two kinds; first, a group in which the perfect cleavage makes an angle of 90° with the elongation of the fibers; and a second group in which this angle measures 84° ± 1°. This second group is composed of those fibers which are broken off in such a way that the flat side is parallel to the imperfect cleavage; the others have their flat sides approximately perpendicular to both cleavages, due to an irregular fracture in that direction. The extinction angle measured from the elongation of the fibers is in the first case 45°, while in the second set the extinction is 6°–7°. The mean refractive index is 1.725 ± 0.005, by the immersion method. The birefringence is very weak, the rather thick cleavage fragments showing upper 1st and lower 2d order interference colors, while the more finely powdered material shows 1st order gray.[1]

The blowpipe reactions are identical with those of triplite, for it contains the same elements, tho in different proportions, as shown below.

The material selected for analysis appeared perfectly fresh, transparent and homogeneous under the microscope. The analysis of the New Hampshire mineral is compared with that of Websky in tables 1 and 2.

TABLE 1

Analyses of Sarcopside

	1*a*.	1*b*.	1*c*.		2*a*.	2*b*.	
Fe_2O_3..	1.77– 1.62	1.70	.021		8.83	.110	
FeO..	39.91–39.83	39.87	.554	.822 = 7.03	30.53	.424	.884 = 7.22
MnO..	10.90–10.75	10.83	.152		20.57	.290	
CaO..	4.42– 4.33	4.38	.078		3.40	.060	
MgO..	0.68	0.68	.017		——	——	
P_2O_5..	33.44–33.08	33.26	.234	=2.00	34.73	.245	=2.00
F....	4.35	4.35	.229	=1.96	undet.	——	
H_2O..	1.54– 1.52	1.53	—		[1.94]	—	
insol..	3.39– 3.04	3.22	—		——	—	
		99.82			100.00		
	less O=F	1.83					
		97.99					

1a. Duplicate analyses of sarcopside from Deering, N. H., by author.
1b. Average analysis of same.
1c. Molecular ratios of same.
2a. Analysis of sarcopside from Michelsdorf, Silesia, by M. Websky.
2b. Molecular ratios of same.

In both of these analyses the author has changed Fe_2O_3 to its equivalent of FeO, in calculating the molecular ratios; for undoubtedly the ferric iron was formed by the oxidation of

[1] Websky suggested that the crystal system is monoclinic; the present data do not conflict with this view, yet in the lack of information as to the orientation of the fragments, the system must be regarded as not definitely determined.

original ferrous iron. All ferrous iron and manganese phosphates alter very readily and give poor molecular ratios if not calculated in this way. The acid-insoluble of the American mineral is nearly all silica, with a few minute flakes of mica. The larger percentage of Fe_2O_3 in Websky's sarcopside is explained by the presence in his material of "particles giving a green streak[1] indicating that alteration had proceeded further than in the New Hampshire mineral, which is very nearly unaltered in the interior.

Websky derived a complicated formula which may be reduced to the generalized formula, $4R_3P_2O_8.RF_2.Fe_2O_3.H_2O$, where R is Mn, Fe, or Ca. In the New Hampshire mineral all the water is driven off below 110° and is to be regarded as non-essential and the fluorine present is sufficient to satisfy the molecular ratio; hence the author believes the formula to be $2R_3P_2O_8.RF_2$. Websky did not determine the fluorine, tho recognizing its presence, and arrived at his formula by a "consideration of the fluorine present."[2] He determined water by difference, and therefore fluorine is contained in the percentage assigned to water, and if equivalent oxygen is deducted enough fluorine could easily be present to give the formula $2R_3\ P_2O_8.RF_2$ or $R_7F_2(PO_4)_4$ with R = Fe, Mn, Ca, and Mg. How well the recalculated analyses agree with the theory for this formula is shown in table 2.

TABLE 2

COMPOSITION OF SARCOPSIDE

	1.		2.		3.	
FeO	44.51	61.58	38.48	62.45	62.19	62.19
MnO	11.64		20.57		——	
CaO	4.70		3.40		——	
MgO	0.73		——		——	
P_2O_5	35.72		34.73		35.09	
F	4.67		——		4.70	
	101.97		——		101.98	
O = F	1.97		——		1.98	
	100.00		——		100.00	

1. Analysis of sarcopside from New Hampshire, after removing water and insoluble matter, converting ferric to ferrous oxide, and recalculating to 100%.
2. Websky's analysis of the material from Silesia, with ferric converted to ferrous oxide.
3. Theoretical composition of sarcopside, if R = Fe only. Agreement between the values obtained and those calculated is excellent.

In refutation of the view of many authorities that sarcopside is merely altered triplite, it should be noted that the material

[1] Dana, *System Min.*, Ed. 5, App. 1, p. 14.
[2] *Neues Jahrb. Min. Geol.*, **1868**, 606.

analyzed by the author had been altered but very little. It may be well to consider, too, the properties that distinguish sarcopside from triplite. Chemical analysis shows the formula of sarcopside to be $2R_3P_2O_8.RF_2$, as compared to that of triplite, $R_3P_2O_8.RF_2$; in both of them R is Fe, Mn, Mg, or Ca. Triplite is massive, with a small conchoidal fracture, resinous to adamantine luster; color brown to blackish brown; and has a yellowish gray to brown streak. Sarcopside is fibrous; with a fibrous to splintery fracture; silky and glistening luster; color flesh red to lavender; and streak light straw yellow. Of great importance in distinguishing the two is the mean refractive index, which is 1.660 in triplite and 1.725 in sarcopside. The author believes on this evidence that sarcopside is entitled to rank as an independent species.

The relation between the formula of sarcopside and those of other minerals containing the same elements is brought out in table 3.

TABLE 3

COMPARISON OF FORMULA TYPES OF FLUOPHOSPHATES OF FE'' AND MN

Ratios			Typical Representatives	Related Minerals
R''	F,OH	(PO_4)		
3	0	2	Graftonite	———
5	1	3	(Apatite group)	———
7	2	4	Sarcopside	Ludlamite, $Fe_7(OH)_2(PO_4)_4 + 8H_2O$.
2	1	1	Triplite	Triploidite, $Fe_2(OH)(PO_4)$.
5	4	2	———	Dihydrite, $Cu_5(OH)_4(PO_4)_2$.
3	3	1	———	Pseudomalachite, $Cu_3(OH)_3(PO_4)$.

It is noteworthy that sarcopside lies midway between triplite and apatite (or at least a theoretical Fe-Mn-apatite) in composition. It is possible that the unnamed ferrous fluophosphate from Stoneham, Maine[1] may be the missing member of the apatite group; or it may lie midway between sarcopside and that group, and possess the ratio 12:3:7. On the other hand both this mineral and the so-called "griphite" may well be impure forms of sarcopside, which they approach far closer than they do triplite, with which they are usually grouped. Another interesting fact is that just as triplite has its hydroxyl representative, triploidite, so sarcopside has ludlamite (which contains, however, water of crystallization, and therefore does not correspond exactly).

The material at hand is very limited, but the author intends to investigate this locality more thoroly in the near future, paying special attention to the possibility of more sarcopside and of other iron and manganese phosphates occurring there.

[1] Dana, *System Min.*, Ed. 6, 778, line 45.