

The uraninite occurs in blackish grains less than 0.2 millimeter in diameter. Most of the grains are rounded, and have a dull lustre, but a few are euhedral, showing excellent development of the cube and possessing an almost brilliant lustre. Identification was made from single grain *x*-ray diffraction photographs, *x*-ray fluorescence analyses, and qualitative chemical tests.

A further sample of the sand has been requested, from which it is hoped that a sufficient quantity of the mineral can be extracted for quantitative chemical analyses and, possibly, an age determination.

BENJAMINITE

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Benjaminite was originally described by Shannon (*U. S. Nat. Mus., Proc.*, **65**, art. 24, 1925) on specimens from the property of the Aikinite Mining Company near Round Mountain, Nye County, Nevada. The specimens had been collected and offered for study by a Mr. H. G. Clinton of Manhattan, Nevada. It was concluded from the name of the mining company that the material was aikinite and indeed it not only greatly resembled aikinite physically but gave the qualitative tests and polished section reactions for that mineral. However, Mr. Clinton later reported high silver assays from the material and Shannon confirmed the presence of this element by chemical tests. He derived the formula $Pb_2(Ag,Cu)_2Bi_4S_9$ from two partial and two complete chemical analyses and on this basis proposed a new mineral, benjaminite. Shannon reported that the mineral resembled massive tetrahedrite except that it showed a moderately good cleavage in one direction and that it was the only abundant metallic mineral in a quartz matrix. Associated minerals were muscovite, pyrite, molybdenite, chalcopyrite, fluorite and minor covellite and chalcocite.

I was fortunate to obtain the loan of Shannon's type material (U.S.N.M. 95058) from Dr. George Switzer and a Harvard specimen (HMM 85749) from Professor Clifford Frondel. Shannon's material consisted of a number of quartz-rich fragments, some of which had obviously supplied sections for Shannon's metallographic studies. The specimens closely resembled Shannon's description and I assumed that the abundant metallic mineral in the form of veins was the benjaminite. However it gave an *x*-ray powder photograph identical with that of aikinite ($PbCuBiS_3$) from Beresovsk. Subsequent investigation showed that all the material with the moderately good cleavage was aikinite and this constituted almost the whole of each vein. Thus Shannon's first impression was correct. It is likely that the cleavage and the silver

TABLE 1. BENJAMINITE: X-RAY POWDER DATA

CuK α =1.5418Å; Ni filtered

<i>I</i>	<i>d</i> (meas.)	<i>I</i>	<i>d</i> (meas.)	<i>I</i>	<i>d</i> (meas.)
7	3.47	6	2.00	$\frac{1}{2}$	1.453
$\frac{1}{2}$	3.18	1	1.943	$\frac{1}{2}$	1.410
$\frac{1}{2}$	2.95	$\frac{1}{2}$	1.845	2	1.322
10	2.82	3	1.752	2	1.271
1	2.18	1	1.705	1	1.157
$\frac{1}{2}$	2.07	2	1.633		

content influenced him to propose a new mineral. A cleavage was not attributed to aikinite in Dana (1892) and his polished section studies did not reveal the presence of a second, silver-bearing mineral.

Upon further examination of the material I noted a minute quantity of a second metallic mineral which gave an x-ray powder pattern distinct from that of known metallic minerals. This mineral occasionally showed a crystal face or cleavage on which a set of fine striations was just visible. A fragment was oriented on the Weissenberg goniometer to rotate about an axis in the plane of the crystal face and parallel to these striations. The rotation photograph yielded the lattice period 8.12Å, but with a strong pseudo-period of 4.06Å. The first layer proved too faint to resolve. However, resolutions of the zero and second layers were obtained which indicated a monoclinic pseudo-cell with dimensions a' 13.34, b' 4.06, c' 20.25Å, $\beta=104^\circ$. The extinction conditions for this cell ($h0l$ present with h even, hkl present with $h+k$ even) are characteristic for base-centering.

The material was insufficient in amount to attempt to obtain the usual physical and chemical data. It is probable however, that it is the mineral which contributed the Ag content to Clinton's assays and Shannon's analyses. It appears to be so sparse that close-sectioning would be necessary to intersect it and this probably accounts for Shannon's oversight. Although the name benjaminite was applied to a mixture of two minerals in which aikinite predominated it is reasonable to retain

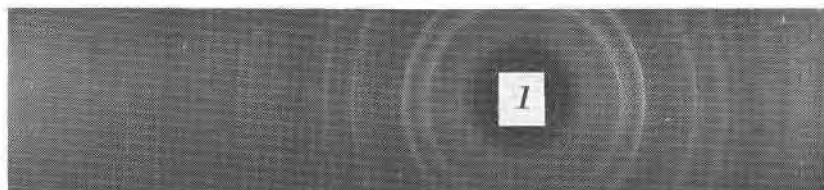


FIG. 1. X-ray powder photograph of benjaminite; Cu/Ni radiation, camera diameter 57.3 mm, actual size print.

the name for the Ag-bearing mineral which inspired his investigation. It is hoped that the powder data of Table 1 and the contact print of the powder pattern (Fig. 1) will result in locating sufficient material to permit a more complete description of this rare sulpho-salt.

A NOTE ON CONE AXIS AND UPPER LEVEL PRECESSION PHOTOGRAPHS

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I. Accuracy of Parameters Obtained from Cone Axis Photographs

In the determination of the unit cell constants of triclinic crystals with the Buerger precession camera, it is useful to be able to measure the d^* spacing normal to a particular zero-level plane with a reasonable degree of accuracy. Together with the shear obtained from the displacement of an upper-level net, this gives a complete description of a possible unit cell (*cf.* Buerger, *The Photography of the Reciprocal Lattice*, 1944; Fisher, *Am. Mineral.*, **37**, 1007-1054, 1952), which can then be transformed as

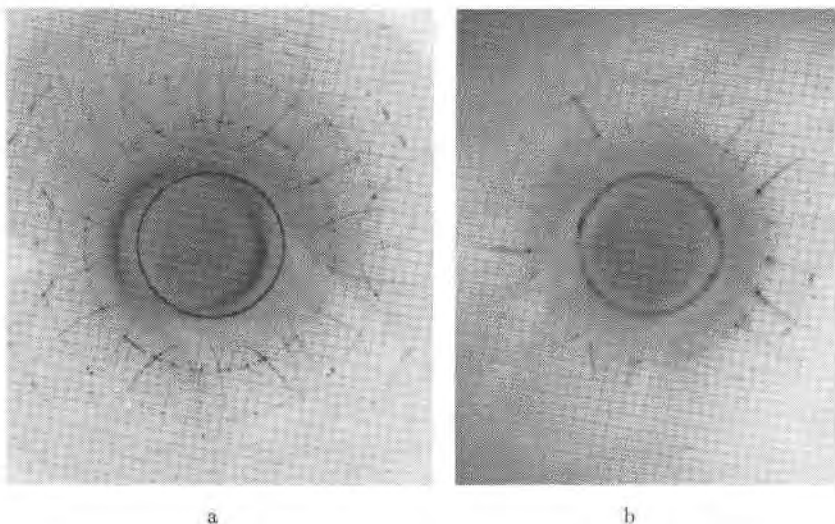


FIG. 1. Cone-axis photographs ($\mu = 20^\circ 00'$) of (a) pyrobelonite, (b) melanovanadite. (unfiltered Mo radiation)

desired. The direct determination of d^* from measurements of the diameters of the rings on a cone-axis photograph is not very accurate because (a) the crystal-to-film distance usually is known only approxi-

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