

Owyheeite from Rivertree, New South Wales.

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Summary. Optical and other microproperties of owyheeite $\text{Pb}_5\text{Ag}_2\text{Sb}_6\text{S}_{15}$ are presented and details given of a new locality for this rare sulpho-salt. Apparent rotation of the plane of polarization (3.5°), microhardness (112 V.H.N.), and polarization effects are all very similar to those of the other feather ores, jamesonite and boulangerite. An intimate association with pyrargyrite is further noted.

THE rare sulpho-salt owyheeite ($\text{Pb}_5\text{Ag}_2\text{Sb}_6\text{S}_{15}$) recorded previously from only a few localities: Star City, Nevada (Burton, 1868),¹ Owyhee and Boise Counties, Idaho (Shannon, 1921), and Slocan, British Columbia (Warren, 1947–48), occurs widely distributed in small amounts in the Wongabah Mine at Rivertree in the northern New England District of New South Wales. Three distinct stages of sulphide deposition are recognizable at Rivertree: pyrite and arsenopyrite were deposited first followed by blende, galena, tetrahedrite and minor amounts of chalcopyrite, and, finally, a silver-rich stage yielding pyrargyrite, second generation galena, owyheeite, and traces of diaphorite; of these latter minerals owyheeite is predominant.

Robinson (1949) carried out X-ray studies on material from Owyhee County and established orthorhombic symmetry with cell dimensions a 22.82, b 27.20, c 8.19 Å. Robinson also lists d spacings and intensities.

The Rivertree owyheeite occurs as minute crystal aggregates of a silver-grey colour and fibrous habit, averaging 0.1 mm in length, filling the interstices between and wrapping around euhedral arsenopyrite crystals. The owyheeite tends to replace the arsenopyrite while still retaining an acicular crystal habit (fig. 1).

X-ray powder diffraction measurements on Rivertree owyheeite (table I) gave results that agree almost exactly with those of Robinson except that a weak line at 4.19 and a moderately strong line at 2.90 are not present on the Rivertree powder photograph.

It was impossible to obtain a pure sample for chemical analysis but analysis was carried out on a piece of material consisting of arsenopyrite

¹ This occurrence was originally described as argentiferous jamesonite.

with interstitial owyheeite (cf. fig. 1). The sample was crushed and much arsenopyrite removed by means of a Franz isodynamic separator. Apart

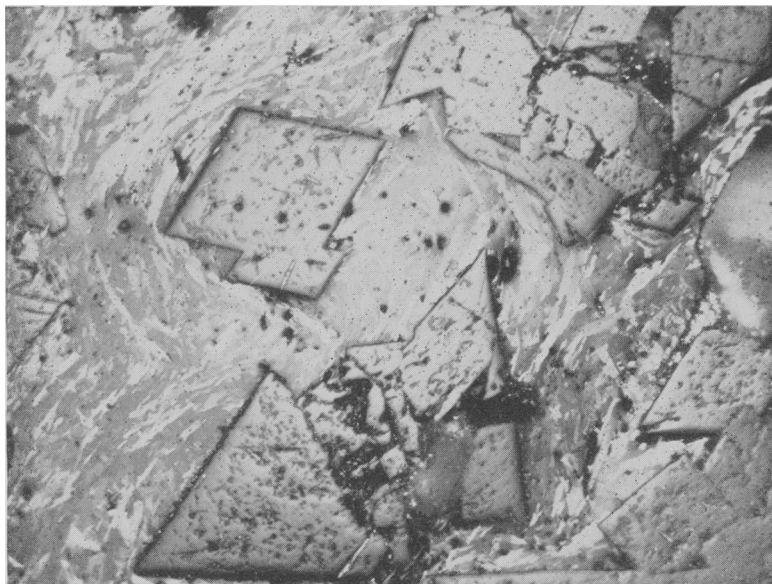


FIG. 1. Feather-like crystals of owyheeite, showing strong anisotropy, wrapping around, and in part replacing, euhedral arsenopyrite. Wongabah Mine, Rivertree, New South Wales. Reflected light, crossed polars. $\times 50$.

TABLE I. X-ray powder diffraction data for owyheeite ($\text{Pb}_5\text{Ag}_2\text{Sb}_6\text{S}_{15}$), Wongabah Mine, Rivertree, New South Wales. Co-K α radiation; intensities estimates.

<i>d.</i>	<i>I.</i>	<i>d.</i>	<i>I.</i>	<i>d.</i>	<i>I.</i>
4.04	5	3.14	10	2.39	5
3.92	20	3.01	20	2.33	5
3.82	10	2.84	60	2.28	5
3.69	20	2.75	5	2.23	40
3.56	10	2.69	5	2.13	30
3.49	70	2.61	10	2.10	10
3.37	40	2.55	5	2.05	60
3.25	100	2.45	5		

from sulphur and the possibility of some Sb substituting for As in the arsenopyrite the presence of the latter mineral would not interfere with the estimation of the components of owyheeite. After deduction of arsenopyrite corresponding to 15.9 % Fe, the analysis gave: Pb 39.5,

Ag 9.4, Sb 31.0, S 19.6 %, Cu and Fe n.d., total 99.5 %; this agrees closely with Shannon's original analysis (1921) and with the theoretical composition for $Pb_5Ag_2Sb_6S_{15}$.

Detailed optical studies of polished sections were carried out with the following results, which add to those of Ramdohr (1934): Colour in white light with lower polar, white with slight olive tint; against arsenopyrite owyheeite shows a distinct bluish-green shade; in juxtaposition with tetrahedrite owyheeite is lighter in colour though its olive tint is similar to that of tetrahedrite. Reflection pleochroism is strong—similar to jamesonite, from white to olive-white, being more distinct in oil than in air.

Anisotropy is very strong especially in oil. The strongest colour is a straw or brownish white; other colours are greyish-white and pale blue-grey changing to dark blue just before extinction. Twinning parallel to the elongation is exhibited occasionally. Perfect and sharp extinction can be obtained in most orientations suggesting very little dispersion of extinction.

Maximum apparent angle of rotation of the plane of polarization in white light using a C.T.S. microscope fitted with Wright's ocular, and measuring grains showing maximum anisotropy, gave: $A_r = 3.5^\circ$ and in cedar oil ($n\ 1.515$) $A_r = 4.5^\circ$. The rotation angle in air is in the same general range as determined by Cameron *et al.* (1961) for the other feather ores: boulangerite $A_r = 3.3^\circ$ and jamesonite $A_r = 3.2^\circ$ (measured at wavelength 589 $m\mu$).

The conoscopic properties (Cameron and Green, 1950; Lawrence, 1960) are not very striking, a feature equally shared by other feather ores. Dispersion of rotation due to surface reflection weak, isogyres are blackish with pale blue in the concave and the remainder of the field cream, thus DR_r weak $v > r$. Dispersion of rotation due to anisotropy barely discernible—very pale blue in the concave parts of indistinct isogyres, remainder of field virtually uncoloured. These determinations indicate an indeterminate dispersion of anisotropy $DA_r = v \gtrsim r$ (cf. case 3, Lawrence, *op. cit.*, or fig. 10c Cameron and Green, *op. cit.*). It bears emphasis that both forms of dispersion are weak and are by no means imposing.

Reflectivity in white light using a pyrite standard and photoelectric cell gave a value, in air, of 40.5 %. The figure is for an aggregate of crystals of random, but mainly prismatic, orientation. This composite value may, however, be useful in future determinative mineragraphy—at least to place the mineral in the group containing the other feather-

ores, jamesonite and boulangerite. It is noteworthy that this reflectivity value is in the same range as those listed by Bowie and Taylor (1958) and by Cameron *et al.* (1961), for other feather-ores, though somewhat higher than zinckenite (cf. table II).

TABLE II. Microhardness and reflectivity of owyheeite compared with other feather-ores.

			% Reflectivity in air for white light.*	Microhardness in Vickers hardness number.*	
				Mean.	Range.
Boulangerite	...	...	40.6	166	157-183
Owyheeite	...	...	40.5	112	98-129
Jamesonite	...	...	38.0	99	96-105
Zinckenite	...	...	32.3	178	162-207

* Values other than those for owyheeite are from Bowie and Taylor (*op. cit.*). No values for meneghinite are extant.

Microhardness indentation tests gave a hardness value ranging from 98.0 V.H.N. to 129.0 V.H.N. for a 100 g weight. The higher value is considered to be nearer the true hardness; the lower values were probably influenced by the inhomogeneity of the crystal aggregate.

All indentations were made on prismatic surfaces. The microhardness of owyheeite is compared with those of other feather-ores in table II.

Uytenbogaardt (1951) notes that it is difficult to distinguish owyheeite in polished section. However it should be possible to identify owyheeite as one of the feather-ores where the typical 'feathery' fabric between crossed polars, together with the polarization colours of the feather-ores, are rather characteristic.

Reflectivity measurements are not diagnostic. Boulangerite and zinckenite give higher microhardness but this test would not distinguish between owyheeite (98-129 V.H.N.) and jamesonite (96-105 V.H.N.). Conoscopic observation affords nothing of determinative value.

It would appear that X-ray diffraction measurement is the only reliable means of identifying this mineral and, in particular, in distinguishing owyheeite from jamesonite. Paragenesis should be a useful adjunct in identifying the mineral—the only feather-ore in which silver is an essential component. Thus owyheeite is generally found in intimate association with pyrargyrite (fig. 2) with which it may form a pseudo-graphic intergrowth. An association with diaphorite or other

lead-antimony-silver sulphides may indicate owyheeite as a coexisting feather-ore.

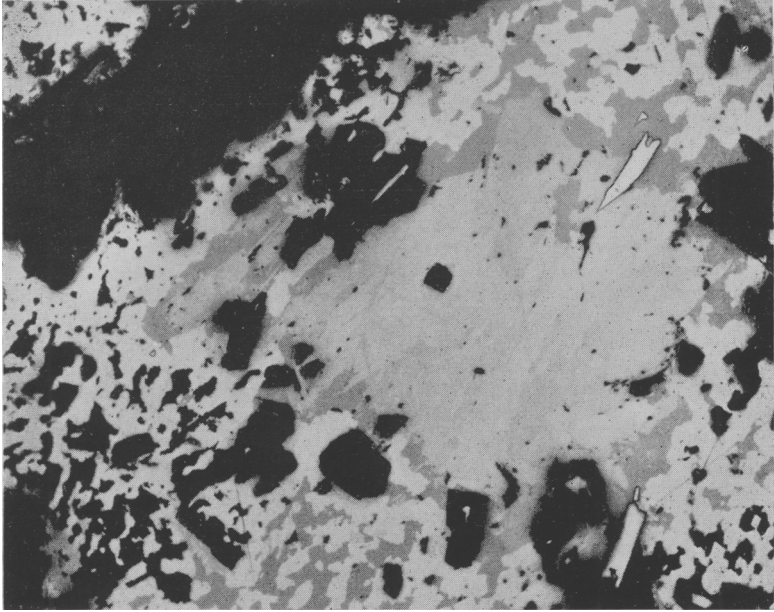


FIG. 2. Owyheeite (central light-grey area) showing marked bireflection, surrounded by pyrrargyrite (medium grey) in sub-graphic intergrowth with galena (whitish). The white angular grains are arsenopyrite, the black areas are quartz. Wongabah Mine, Rivertree, New South Wales. Reflected light, polarizer only. $\times 50$.

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