Jacobsite from the Tamworth district of New South Wales.

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[Taken as read November 2, 1950.]

TWO new occurrences of the rare manganese mineral jacobsite ($MnFe_2O_4$) have come to light in the course of mineragraphic studies carried out as part of the research programme of the Mineragraphic Section of the Commonwealth Scientific and Industrial Research Organization. The jacobsite occurs as a constituent of small bodies of high-grade manganese ore at Weabonga, near Danglemah, and at the Mount Sally mine, about 6 miles west of Danglemah, both in the Tamworth district of New South Wales.

The deposits occur in altered sediments, within a mile or two of a granite contact.[1] They are irregular lenticular veins ranging from a few inches to several feet in thickness, between altered slate walls. The veins do not exceed a length of 200–300 feet. The lode material consists of manganese oxides, chiefly psilomelane and pyrolusite, associated with quartz, rhodonite, and iron oxide. The manganese oxides are mainly supergene, and although the deposits are of high grade near the surface, it is doubtful whether they can be worked below the depths of 50–60 feet, owing to the increase in the amount of rhodonite and quartz relative to manganese oxides at this depth.

In the Weabonga ore the jacobsite occurs as narrow seams and lenticles, about 0·5 cm. across, and 3·0 cm. long enclosed in, and partly replaced by, pyrolusite and psilomelane. The seams consist of clusters of small crystals, which in the central parts of the seam show well-shaped octahedral form, with smooth facial contacts (fig. 1). Towards the margin of the seam, and where in contact with pyrolusite or psilomelane, the crystals are corroded and rounded (figs. 1 and 2), and at the margins of the seams small corroded grains of jacobsite are isolated as residuals in larger areas of pyrolusite and psilomelane (fig. 2).

The range in grain-size of the jacobsite crystals is from about 0·15 mm. across (large unreplaced grains) to about 0·01 mm. across (small residuals). Away from the immediate edge of the seams and clusters of

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[1] C. L. Knight, Mineral resources of Australia, Summary Rept. no. 7, Manganese, Bureau Min. Res., Geol. Geophys., Australia, 1947, p. 13.

jacobsite the pyrolusite and psilomelane are free from inclusions of this mineral.

The Mount Sally occurrence is similar. Here the jacobsite seams are 1·0–2·0 cm. long and 0·2–0·3 cm. wide, with the individual octahedra of jacobsite ranging from 0·025 to 0·055 mm. across. Psilomelane is the dominant enclosing mineral, and the proportion of jacobsite seams is rather less than in the Weabonga ore.

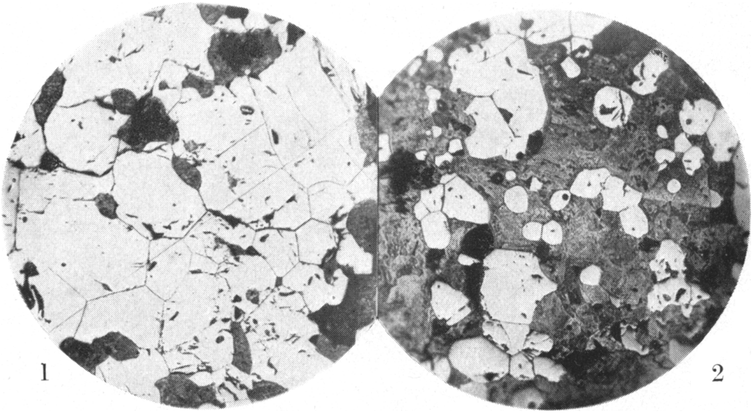

FIG. 1. Centre of a jacobsite seam, showing the crystal outlines of jacobsite grains (white outlined by black lines) where they are in contact with one another, and their embayed character where they are in contact with psilomelane and pyrolusite (black). Etched with $SnCl_2$. ×60.

FIG. 2. Marginal portion of the same seam of jacobsite as in fig. 1, showing more advanced replacement of the jacobsite (light) by the psilomelane and pyrolusite (black). Etched with $SnCl_2$. ×60.

The jacobsite is strongly magnetic. It takes a polish readily, and in polished sections exhibits its characteristic grey colour with an olive-yellow tint, which distinguishes it from magnetite or other strongly magnetic minerals. It is isotropic, and is negative to all standard etching reagents, but tends to be slightly tarnished brown with stannous chloride. In all these respects it exactly resembles a specimen (779*a*) of jacobsite presented by Dr. J. A. Dunn, from the Beldongri mine, in the Central Provinces of India,[1] except that the yellow tint is slightly less pronounced. It is harder than the pyrolusite and psilomelane, and this

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[1] J. A. Dunn, A study of some microscopical aspects of Indian manganese-ores. Trans. Nat. Inst. Sci. India, 1936, vol. 1, no. 7, pp. 103–124 (p. 108). [M.A. 7–157.]

combined with its crystalline form permits it to be broken free from the other minerals, when it can be concentrated magnetically.

Several grams of the Weabonga jacobsite were separated with a hand magnet from crushed ore, and passed through a 100-mesh sieve. The minus 100-mesh fraction was cleaned as far as possible with a magnet, leached with dilute HCl, and dried at 60° C. A portion of the final product was mounted in a bakelite briquette and polished. Examination under the ore microscope revealed that it consisted essentially of jacobsite and psilomelane, with some finely microcrystalline pyrolusite intergrown with the psilomelane. A micrometric analysis of the opaque constituents gave jacobsite 91·4, psilomelane (and pyrolusite) 8·6 volume per cent. The differences in specific gravity of these minerals are so slight that these figures may be taken as weight percentages.

A chemical analysis of the powder has been made by Mr. G. C. Carlos in the C.S.I.R.O. Mineragraphic Laboratory, with the following result:

Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	insol.	H_2O.	Total.
62·67	nil	32·97	0·08	nil	0·19	3·70	99·61

Allowance can be made, within narrow limits of error, for the 8·6 % of psilomelane (plus pyrolusite) in the analysed powder by assuming (1) that all the impurity was psilomelane and (2) that its manganese content is similar to the ideal composition of psilomelane given in Dana's System of mineralogy, 7th edit., 1944, vol. 1, p. 669. Psilomelane on this basis contains 7·4 % MnO, and 72·8 % MnO_2:

$$\frac{7\cdot 4}{100} \times 8\cdot 6 = 0\cdot 64 \text{ MnO}$$

$$\frac{72\cdot 8}{100} \times 8\cdot 6 = 6\cdot 26 \text{ MnO}_2\text{, equivalent to } 5\cdot 11 \text{ MnO.}$$

The total MnO contributed by the 8·6 % of psilomelane to the chemical analysis is thus indicated as 5·75 %, leaving for jacobsite Fe_2O_3 62·67, MnO 27·22, MgO 0·08.

Assuming that the H_2O of the analysis belongs to the psilomelane or is otherwise adventitious, and recalculating to 100 %, gives the composition of the jacobsite as that shown in column 1 below.

It is thus apparent that the composition of the Weabonga jacobsite, like the jacobsite of Nordmark,[1] corresponds closely to that of the theoretical $MnFe_2O_4$; and that it contains notably less magnesium than the jacobsite from Jakobsberg, the type locality. In this respect it

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[1] L. J. Igelström, Sur la jacobsite de Nordmark et sur les jacobsites en général. Bull. Soc. Franç. Min., 1887, vol. 10, p. 185.

resembles the Indian jacobsite, but is otherwise different in that it contains more iron and less manganese. Since much of the jacobsite in the Beldongri mine is intimately intergrown with ex-solution lamellae of hausmannite, it seems likely that the analysed specimen, which was optically homogeneous, still retained some hausmannite in solid solution, whereas the Weabonga jacobsite does not.

	1.	2.	3.	4.	5.
Fe_2O_3	69·7	69·24	69·4	68·25	59·31
FeO	nil	—	—	—	—
Mn_2O_3	—	—	—	4·03	8·36
MnO	30·2	30·76	30·6	20·72	32·20
MgO	0·1	—	—	6·41	0·13

1. Jacobsite from Weabonga, New South Wales.
2. Composition of $MnFe_2O_4$.
3. Jacobsite from Nordmark, Sweden (Igelström, 1887).
4. Jacobsite from Jakobsberg, Sweden (Dana's System of mineralogy, 6th edit., 1892, p. 227.
5. Jacobsite (779*a*) from Beldongri mine, Central Provinces, India. Calculated from the composition given by Dunn (loc. cit., p. 110).

A jacobsite so closely corresponding to the ideal composition $MnFe_2O_4$ is of interest in view of the statement by Mason[1] that although jacobsite has generally been considered as manganese ferrite, none of the published analyses of jacobsite corresponds to the theoretical $MnFe_2O_4$.

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[1] B. Mason, Mineralogical aspects of the system $FeO–Fe_2O_3–MnO–Mn_2O_3$. Geol. För. Förh. Stockholm, 1943, vol. 65, pp. 97–180 (p. 157). [M.A. **9**–32.]