

On the type locality and other occurrences of awaruite (FeNi_3) in Westland, New Zealand

K. A. RODGERS

Department of Geology, University of Auckland, Private Bag, Auckland 1, New Zealand

AND

M. H. HEY

Department of Mineralogy, British Museum (Natural History), Cromwell Road, London, SW7 5BD, England

SUMMARY. Awaruite is not known from Awarua River or Awarua Bay, Westland, New Zealand, but was first described from alluvial sands of the Gorge River and soon thereafter, *in situ* in serpentinite from the same valley. The name is a misnomer.

AWARUITE (FeNi_3) was first described by Skey (1885) as constituting a sample of heavy black sand given by alluvial miners to the Government Warden of the Jackson's Bay District, South Island, New Zealand. Unfortunately, in this and subsequent publications, Skey (1886, 1887) and his superior Hector (1887*a, b, c*, 1891) were somewhat imprecise and more than a little ambiguous concerning the locality of the original awaruite sample and indeed of other samples containing the same alloy that Skey reported on. Ulrich (1890) tried to correct this position but his effort was obscured by allegations of piracy and ignorance made by Hector (1887*a*, 1891) when Ulrich (1887*a, b*), endeavoured to publicize the existence of this mineral which he had recognized as 'not being the *second* (as Mr Skey supposed), but really the *first* nickel-iron alloy of telluric origin' (1890, p. 620). While it is unlikely that these events could have contributed overly to any subsequent confusion about the occurrence of this mineral, nevertheless in a number of mineralogical compilations, indices, monographs, and reviews there appears to be a widespread misconception and lack of agreement concerning the original locality of this mineral and even of its distribution within that general area (e.g. Dana, 1909, 1932, 1944; Williams, 1960; Reed, 1965; Ramdohr, 1950, 1969; Donnay and Ondik, 1973).

Historical summary. When William Skey, the New Zealand Government analyst, gave the first account of his discovery, the title of his paper *On a New Mineral (Awaruite) from Barn Bay* contained

the sole references to the mineral name, the naming, and a specific locality in the entire paper. This paper was read before the Wellington Philosophical Society in October 1885 and published in the *Transactions and Proceedings of the New Zealand Institute* in Volume 18—dated in sequence by cataloguers as 1885 but with a publication date, in fine print, of May 1886. Two alluvial samples are referred to in the body of the paper: 'No. 1' (p. 401) consisted entirely of the new alloy awaruite, for which an analysis was given; the second sample was impure.

The contents of this original paper were repeated, inside quotation marks, but without the all-important original title in the *21st Annual Report on the Colonial Museum and Laboratory 1885-1886* published in or about June or July 1886. Appended was an additional paragraph giving the analytical results on three further samples (Lab. No. 4196). The first, from Barn Bay, showed no nickel; a second from Callery's Creek contained some 4% awaruite; the third, from the Gorge River, yielded 45.36% awaruite and fragments of serpentinite, which, in a footnote, was noted as proving to be the matrix of the alloy. Confusingly, in an attached schedule of analysed specimens for 1885-6 sample 4196 was given simply as coming from Barn Bay but earlier, in the same schedule, a sample 4106 was listed as 'Awaruite . . . Gorge River'.

In the *22nd Annual Report* Skey (1887, p. 47) confirmed that a 'ferriferous serpentinite' is the matrix of awaruite but while an analysis (No. 4357) was given, no locality information occurs in the text or the appended analyses schedule. However, sample 4358/17 was a serpentinite also containing awaruite and was given as coming from 'Red Hill, near Big Bay' but no analysis was provided. On p. 51 of the same report Skey refers to 'Further

specimens of nickeliforous sand' as having 'been received from the Gorge River, Jackson's Bay' of which one analysis is given (No. 4379) containing 23.67% awaruite.

The locality names referred to above are scattered over some $60 \times 20 \text{ km}^2$ of country in south Westland and north-west Otago. Further, the Gorge River does not flow into Jackson's Bay (nowadays Jackson Bay), into Barn Bay, or into Awarua Bay (= Big Bay), while Awarua Bay (and the Awarua River) are separated from the Red Hills by the catchment of Pyke River. It is clear Skey was not particularly concerned about geographic niceties nor, it seems, was Sir James Hector, Skey's superior as Director of the Colonial Museum and Geological Survey, whilst he was engaged in his initial outraged polemics with Professor Ulrich. In 1887a Hector stated that the mineral was named after the locality (as indeed does Reed, 1965) while in 1887b (p. 12) he talks of the discovery 'in the auriferous sands of Barn Bay' ... adding in 1887c (p. xlix) ... 'and afterwards in the solid serpentine rock'.

However, in the wake of Ulrich's (1890) paper it appears that Hector had done his homework and in the course of drawing attention to inaccuracies in Ulrich's map (brought about by 'relying on hearsay information') he refers to awaruite as 'occurring in the alluvia of some of the river valleys'. By 1892, in the first comprehensive list of minerals and mineral localities in New Zealand, Hector is quite specific (p. 106):

AWARUITE!—Gorge River, S.W. coast. In serpentine. Analysis (Skey):

Nickel	67.63
Cobalt70
Iron	31.02
Sulphur22
Silica43

100.00 (! = rare).

The analysis is that of Skey (1885), sample No. 1.

This change of stance by Hector probably owes less to Ulrich's second-hand evidence than to information provided by his own geologist Park (1887) who, following exploration of the area in 1886 at Hector's behest, states 'The new nickel alloy (awaruite) found in the wash of the Gorge and Hope Rivers, both of which cut through the mineral belt in the upper part of their course was traced to a serpentine matrix in which it occurs as dispersed grains' (p. 137).

Ulrich's (1890) paper was intended to both publicize awaruite's existence and to bring together scattered and unpublished information on the

mineral's occurrence and distribution in the general region. Regrettably he failed to take account of the earlier Geological Survey work! He acknowledged that his data were entirely derived from information and specimens received from two students of his (Henderson and Butement), the District Warden (Macfarlane), the District Chief Surveyor (Mueller, who provided the base map), and Paulin¹ (an alpinist and prospector whose five-year sortie in the region yielded much of the geological information given on the map). It was this map as much as the text that was to continue to arouse Hector's ire but on p. 629 Ulrich states:

The first sample of the Awaruite-bearing black sand examined by Mr Skey was supposed to have come from Barn Bay (p. 619); but it was subsequently proved to have been washed from the drift of the Gorge River. The Valley of this river has since generally been considered to be the only place of occurrence of the mineral, and is, indeed, the one in which it has so far been proved to exist in largest quantity.

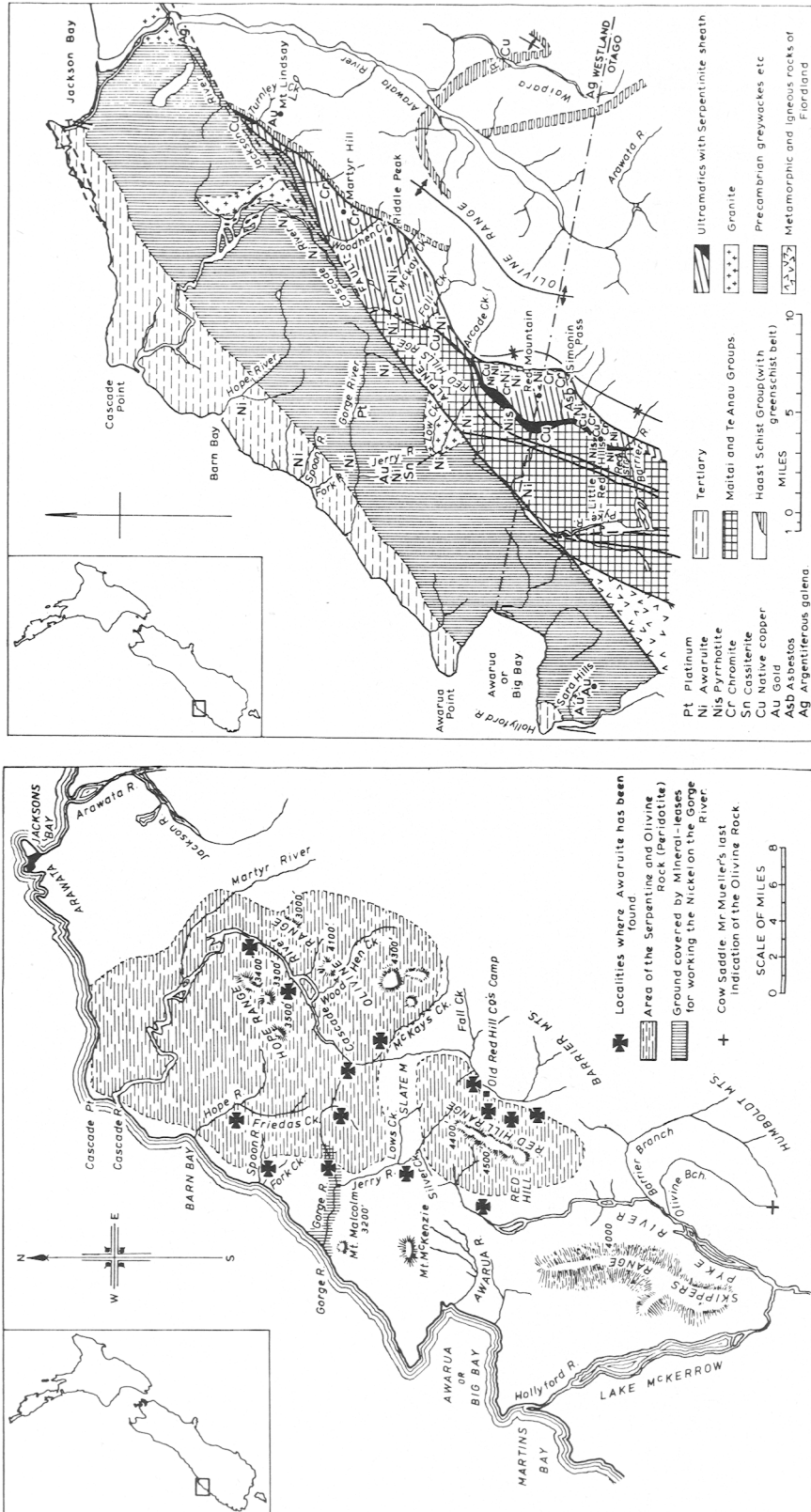
He goes on to discuss Paulin's findings as shown on fig. 1.

The entire situation is admirably and succinctly reviewed by Morgan (1927) who in *Minerals and Mineral Substances in New Zealand* states quite explicitly that the alloy 'occurs as water-worn grains in the sands of Gorge River, Hope River, Cascade River and other streams draining the Red Hill' ... 'Range, north-west Otago; it occurs also in the serpentine of the Red Mountain [*sic*] as silvery-white specks' ... 'So far as can be ascertained, the mineral has not been found in the watershed of the Awarua River, or near Awarua or Big Bay' ... 'The name "awaruite" is therefore to some extent a misnomer'. That this was the original position has been confirmed by the recent recovery of William Skey's handwritten records. Data given for two washes numbered 4106 (1, 2) are those published in 1885.

In conclusion it should perhaps be stated: Awaruite was first described from alluvial sands of the Gorge River (No. 4106) but soon thereafter, *in situ* from the same valley (No. 4196/3); awaruite has not been recorded unequivocally from Awarua River, or Awarua Bay (= Big Bay), or Jackson's Bay, or, for that matter, Barn Bay.

An excellent review of our current knowledge of the distribution of the mineral is given in Williams (1974) although he cites Skey's analysis of the mineral incorrectly and appears to confuse two of Skey's samples (see fig. 2).

¹ Paulin (1894) gave an account of his travels in, what he termed, the Awaruite District. In these he gives a general statement that 'All over this district I have found magnetic nickel ore, called Awaruite'.



FIGS. 1 and 2. FIG. 1 (left). Geological sketch-plan and locality map of West Coast, New Zealand, between Jackson's River and Hollyford Valley, as given by Ulrich (1890) who ascribes it to Paulin and Mueller. It was this map that raised Hector's ire. Not all the crosses are correctly sampled. FIG. 2 (right). Geological sketch map of same area as in fig. 1 as given in Williams (1974) who ascribes it to Mutch (in press). (Recent fieldwork and geochemical sampling by J. R. Carlson and A. Happy in the Jerry River, Low Creek, and Gorge River area cast doubt on the accuracy of the geology shown on this map in this region! (pers. comm. 1979)).

REFERENCES

- Dana (E. S.), 1909. *Descriptive Mineralogy*, 6th edn., with App. I and II, Chapman and Hall, London.
- 1932. *A Textbook of Mineralogy*, 4th edn., Chapman and Hall, London.
- Donnay (J. D. H.) and Ondik (H. M.), 1973. *Crystal Data Determinative Tables*, 3rd edn. U.S. Nat. Bur. Stand.
- Hector (J.), 1887a. *Nature*, **35**, 513-14.
- 1887b. 22nd Rep. Colonial Mus. Lab. N.Z. (for 1886-7).
- 1887c. Rep. Geol. Explor. N.Z. **18**, i-li (for 1886-7).
- 1891. Rep. Geol. Explor. N.Z. **20**, i-lviii (for 1889-90).
- 1892. Rep. Geol. Explor. N.Z. **21**, 100 (for 1890-1).
- Morgan (P. G.), 1927. *N.Z. Geol. Surv. Bull.* **32**.
- Palache (C.), Berman (H.), and Frondel (C.), 1944. *Dana's System of Mineralogy*, 7th edn., **1**, Chapman and Hall, London.
- Park (J.), 1887. Rep. Geol. Explor. N.Z. **18**, 121-36 (for 1886-7).
- Paulin (R.), 1894. *N.Z. Alpine J.* **1**, 333-41.
- Ramdohr (P.), 1950. *Mineral. Mag.* **29**, 374.
- Reed (J. J.), 1965. *N.Z. J. Geol. Geophys.* **8**, 999-1087.
- Skey (W.), 1885. *Trans. N.Z. Inst.* **18**, 401-2.
- 1886. 21st Rep. Colonial Mus. Lab. (for 1885-6), 31-64.
- 1887. 22nd Rep. Colonial Mus. Lab. 37-67 (for 1886-7).
- Ulrich (G. H. F.), 1887a. *Proc. Geol. Soc. in Q. J. Geol. Soc.* **43**, 3-4.
- 1887b. *Nature*, **35**, 190.
- 1890. *Q. J. Geol. Soc.* **46**, 619-32.
- Williams (G. J.), 1974. *Economic Geology of New Zealand*. Australas. Inst. Min. Metall., Monogr. Ser. **4** (revised edn.).
- Williams (K. L.), 1970. *Am. Mineral.* **45**, 450-3.

[Manuscript received 23 October 1978;
revised 4 September 1979]