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A meteorite of unique type from Western Australia: The Mount Egerton stony-iron

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Summary. A unique meteorite, the existence of which has been known since 1941 but which had been lost, has now been relocated in the form of fragments in two separate collections. Though material available is limited to small fragments, it is sufficient to reveal the principal characteristics of the parent mass, which was a variable body composed of stony material not dissimilar from that of the unbrecciated enstatite–achondrite of *Shallowater*, Texas, U.S.A., and nickel-iron not dissimilar from the 'pseudo-octahedrite' of *Horse Creek*, Colorado, U.S.A. There is evidence suggesting that it was a stony-iron of a hitherto unrecorded type, and that silicate material predominated.

AMONGST the meteorites listed by Prior and Hey (1953) are four from Western Australia that in late 1962 (when work was commenced on a catalogue covering all meteorite collections in the State—McCall and de Laeter, *in press*) could not be located in any collection. Inquiries have, however, led to the relocation of three out of four of these 'lost' meteorites in minor collections; the fourth, *Korrelocking*, remains untraced. The two stony meteorites *Dalgety Downs* and *Loongana* (now renamed *Forrest Lakes*) were found to be represented by very small fragments at the Government Chemical Laboratories, Perth. *Dalgety Downs*, erroneously referred to as a stony-iron (mesosiderite) (Prior and Hey, 1953, p. 97; Mason, 1962, p. 122) is now represented by a large store of material (480 lb) recovered in 1963 from the original site by B. H. Mason and E. P. Henderson (McCall and de Laeter, *op. cit.*) while another olivine–hypersthene chondrite, *Forrest Lakes* (*Loongana*; McCall and de Laeter, *op. cit.*) is at present only represented by the very small fragments referred to above. The third and by far the most important of the relocations is that of the *Mount Egerton* meteorite

(Prior and Hey, 1953, p. 248). Though the material now held in collections is very scanty enough is available to show that this is a unique meteorite occurrence.

The locality of the find by the late Mr. T. Gaffney and the late Mr. H. Pegler, in 1941, was given as twelve miles from Mount Egerton (fig. 1) on one of the headstreams of the Gascoyne River (Anon., 1944). The exact location is, unfortunately, not known, though this indicates a position to the south of the mountain summit and between it and the Mount Egerton No. 3 Well. The lack of definition of the site, and the fact that both finders are deceased and only an aged aboriginal survives of the people concerned in the immediate find, make it improbable that a further recovery will be made when the site is visited, as is intended, in the near future. The approximate position of the site is 24° 46′ S, 117° 42′ E (the position of Mount Egerton summit).

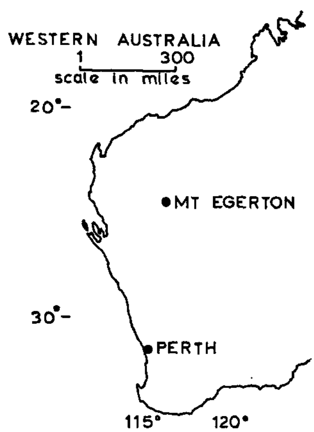


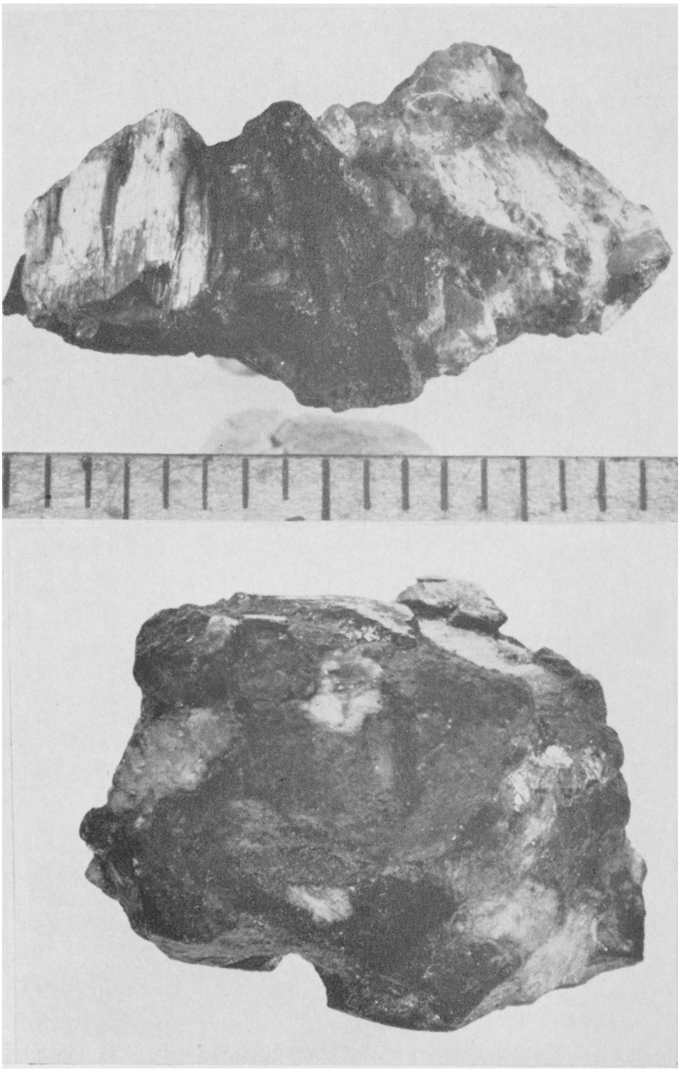
Fig. 1. Sketch-map showing the approximate location of the Mount Egerton find.

After a year during which inquiries proved entirely fruitless, the necessary clue to the location of the fragments was discovered by Mr. W. H. Cleverly of the Kalgoorlie School of Mines, and this led to Mrs. C. Pegler, widow of one of the men associated in the find. One set of fragments was found in Mrs. Pegler's collection. A second set was found in the collection of the School of Mines, Kalgoorlie, labelled 'Siberia'. Examination of book entries revealed an accession in 1941 of an exactly similar set of specimens from Mr. Pegler of Mount Egerton. Comparison of these specimens with those of Mrs. Pegler reveals such a degree of similarity—the enstatite inclusions are of identical character and the etch patterns, of a type only once recorded before, are identical—that no reasonable doubt of the provenance of both sets of specimens from Mount Egertcaon n now be entertained. The specimen called Siberia, taken by H. H. Nininger from the Kalgoorlie collection (as part of an exchange transaction), is clearly also from Mount Egerton. How the name 'Siberia' came to be applied is obscure: it is relevant, however, to note that another meteorite specimen alongside this specimen in the

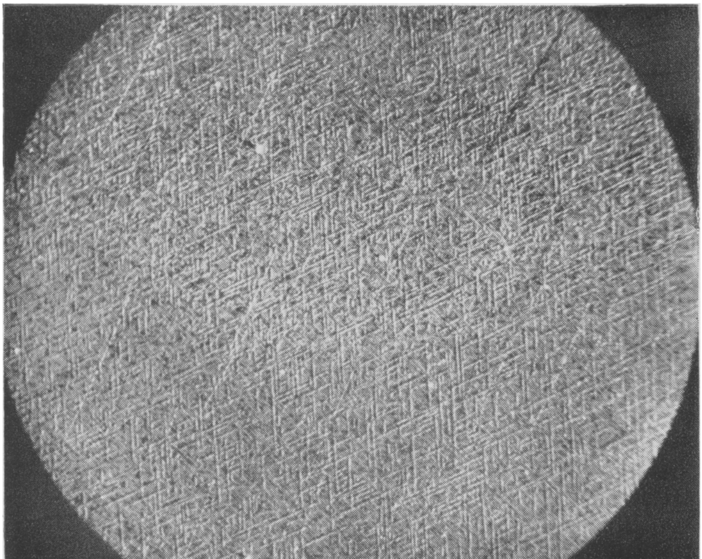
Kalgoorlie collection was labelled 'Ashburton Downs' and is now revealed to be part of the *Dalgety Downs* recovery—again record of accession from the original finder at the date of the find is to be found in the accession list and the description of the accession matches the mislabelled specimen. Clearly someone attempted to label unlabelled specimens on the basis of imperfect recollections of their provenance.

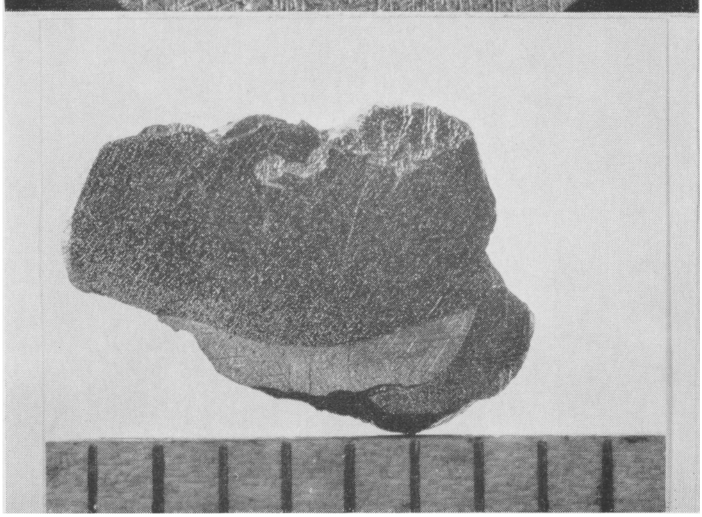
The total weight of material known from Mount Egerton is 250 g (approximately)—of this 179 g are held in the Western Australian Museum, the balance, except for the fragment in the Nininger collection, being held at the School of Mines, Kalgoorlie. There are twelve fragments in all. The two largest, both from the collection of Mrs. Pegler, weigh 77 and 43 g—the latter being slightly the larger (figs. 2 and 3). These large fragments are rich in silicate while the smaller fragments are predominantly composed of iron but still with significant silicate inclusions.

These metallic fragments are of nickel-iron including areas of snow-white enstatite, not unlike feldspar in appearance. Specks of troilite and schreibersite are inset in the nickel and chemical tests have revealed traces of sulphide (Anon., 1944). There is an ultra-fine etch pattern revealed (figs. 4, 5, 6, and 7) on application of the usual nitol reagent to a polished surface, consisting of very fine networks of lines traversing the kamacite. No troilite is evident, and this etch pattern is highly anomalous when one considers the specific gravity of the metal (7·514 measured on a specimen with not more than 1% silicate) and the nickel–iron ratio (6·38 % nickel as measured by H. Bowley (Anon., 1944)) compatible with this figure. Though these lines were first recorded as Neumann lines this is probably an erroneous identification—E. P. Henderson in a written communication to the writer states that these are not Neumann lines and suggests possible explanations, mentioning among these the unique Horse Creek 'pseudo-octahedrite' (Prior and Hey, 1953, p. 158). That iron meteorite revealed ultra-fine and very regular networks of lines on etching—lines here and there broadening like those of the Mount Egerton iron fraction; the pattern resembles an octahedral etch pattern, but the nickel content is only 5·87 % (Goldberg, Uchiyama, and Brown, 1951), not far from that of the Mount Egerton material. The Horse Creek pattern has been attributed to schreibersite exsolution, but Dr. E. P. Henderson informs me that this type of anomalous etch pattern is regarded by P. Ramdohr as due to the incorporation of Si in the metal phase; this explanation seems far more likely than the original one, since Si is known to be present in the metal phase of

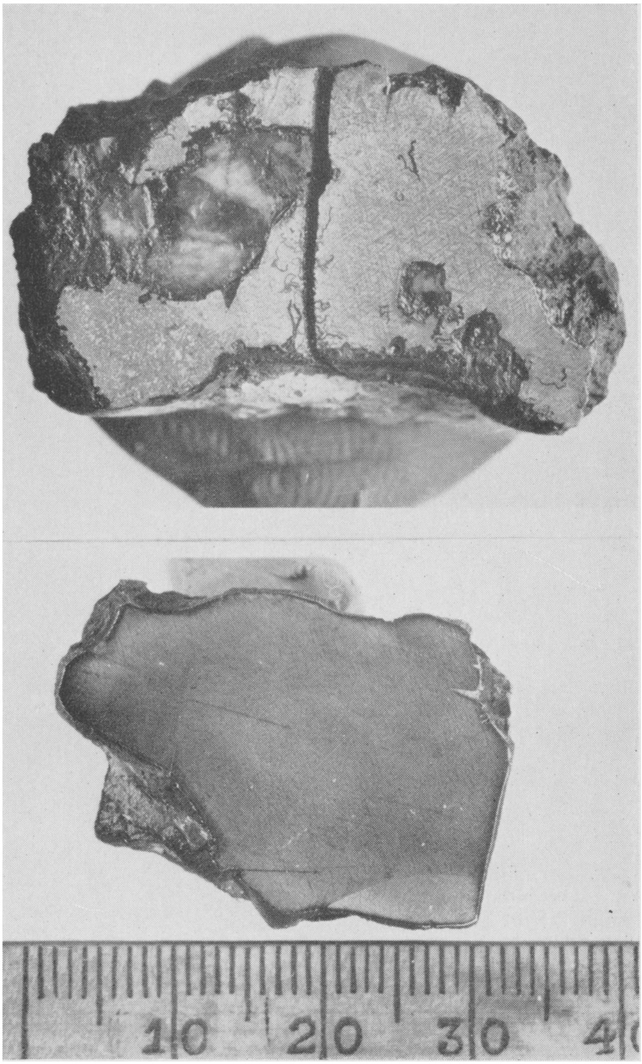


FIGS. 2 and 3: FIG. 2 (top). Enstatite-rich pegmatoid fragment (43 g), showing well-crystallized snow-white enstatite and dark interstitial iron. Scale in inches and tenths. Western Australian Museum specimen No. 12287. FIG. 3 (bottom). Intermediate fragment (77 g) showing smaller white enstatite crystals liberally inset in nickel-iron. Scale as above. Western Australian Museum specimen No. 12287.





FIGS. 4 and 5: FIG. 4 (top). Metallic fragment—photomicrograph of polished section showing the ultra-fine, geometrically regular etch pattern. The lines show clear-cut in this area of the surface. × 13. Western Australian Museum specimen No. 12287. FIG. 5 (bottom). Metallic fragment showing clear-cut etch pattern—fine lines forming a geometrical network and cutting across the abrupt curving boundaries of the coarser fields of 'granularity'. *Scale in inches and tenths.* Western Australian Museum specimen No. 12175.



Figs. 6 and 7: Fig. 6 (top). Metallic fragment showing slightly less clear-cut intersecting lines in the etch pattern and prominent enstatite enclaves. ×3·5. School of Mines, Kalgoorlie, specimen No. 8506. Fig. 7 (bottom). Metallic fragment—photograph of a polished surface showing the fine nature of the reticulation of lines, and also the coarse granularity, the surface being divided into contrasting fields bounded by abrupt curving margins. The fine lines cut across these margins almost undisturbed. Scale in cm and mm. Western Australian Museum specimen No. 12287.

enstatite–chondrites (Ringwood, 1961; confirmed chemically by D. I. Bothwell, priv. comm.).

The Mount Egerton pattern is presumably due to the same cause, and an electron probe study of the metal is now on hand.

Besides this etch pattern there is an additional, more coarse etch pattern evident, a form of 'granularity'—the surface is divided into contrasting fields with clear-cut, curving boundaries (figs. 5 and 7). The fine-line pattern often traverses these boundaries undisturbed but may show slight disturbance at the boundary. They seem to represent some form of shock effect. The division into fields is not unlike the pattern of the Dalgaranga octahedrites (Nininger and Huss, 1960, p. 631) but in this case the fields do not seem to possess such distinct, aberrantly oriented etch-patterns of their own (figs. 5 and 7).

The heaviest fragment (fig. 3) shows a coarser crystallization of the silicate and it is more abundant than in the small fragments. The largest fragment of all is dominantly composed of silicate in pegmatoid crystallization (crystals up to 4 cm long), with only interstitial nickel-iron (not more than 20 % of the mass by volume) (fig. 2). The silicate is pure enstatite with α 1·651, γ 1·658. This identification has been confirmed by B. H. Mason using X-ray diffraction and optical techniques. Dr. S. S. Pollock of the Mellon Institute, Pittsburgh, reported further on the enstatite—the writer had recorded some obliquity of extinction and Dr. Pollock has found that, though X-ray studies revealed that most of the grains were of normal enstatite, some grains show a slightly disordered structure. In this Mount Egerton, perhaps significantly, resembles the *Norton County* brecciated enstatite–achondrite (Mason, 1962, p. 108). Such a disordered state could be due to shock.

The original report on *Mount Egerton* suggests that coarse, silicate-rich material such as is illustrated in fig. 2 predominated in the original recovery and it is therefore impossible to dismiss this as simply an unusual iron meteorite with silicate inclusions. It seems best interpreted as a variable meteorite (in the manner of the Brenham pallasite, which reveals subordinate wholly metallic areas (Mason, 1963)); the mass is envisaged as composed of contrasting areas of pegmatoid, silicate-rich material (up to 80 % enstatite by volume) and subordinate nickel-iron rich material (averaging 10–15 % enstatite by volume). Support for this interpretation is to be found in the small size of the iron fragments recovered—unusually small for an iron meteorite recovery but compatible with interstitial provenance in a disrupted mass predominantly composed of silicate. The original report makes the fact that the silicate fragments were the larger quite clear—it mentions a fragment of 158·3 g weight. It should be noted that it also records a total of 3·7 kg of material so we are far from being in possession of the whole reported recovery. A point that may be made is that prospectors such as Messrs. Pegler and Gaffney will always concentrate on metallic material—it is quite possible that they left a large mass of unpromising looking enstatite crystals at the site of the find.

Neither the composition of the silicate nor the texture agrees with descriptions of *mesosiderites* and indeed nothing could be more unlike the *Mount Egerton* material than a large mesosiderite recovered at Mount Padbury Station, 60 miles from Mount Egerton, in March 1964. Yet the mesosiderites must be considered its nearest relations amongst the stony-irons.

It was suggested by Dr. Mason (verbal communication) even before these relocations were made that this record suggested something like the unique *Shallowater* enstatite–achondrite (Prior and Hey, 1953, p. 344), the only unbrecciated occurrence of this mineralogical type (Mason, 1962, p. 108), and it is true that, but for the very considerable nickel-iron content, *Mount Egerton* might well be classified as an enstatite–achondrite (unbrecciated). It is also, perhaps, closely related to the *Horse Creek* iron (p. 5). The high nickel-iron content of Mount Egerton seems to preclude classification as an achondritic stony meteorite, though the nickel–iron ratio is much the same as that typical of nickel-iron forming minor residues in enstatite–achondrites, and Dr. Mason (verbal communication) has noted that the *Pesyanoe* enstatite–achondrite, held in Moscow, contains a patch of nickel-iron, suggesting that these unusual stones may well have a variable character, and are aggregated with metallic patches in the original mass. If a large lump of dominantly stony material should be recovered from Mount Egerton showing that the considerable iron recovery represents a fortuitous feature, it may yet have to be referred to the achondrite group, but meanwhile it must be regarded as a stony-iron occurrence.

Our knowledge of two of the four major classificatory subdivisions of stony-irons stems from unique recoveries; we also have another unique recovery from Western Australia—*Bencubbin*, often called a mesosiderite but of unusual texture, mineralogy, and composition, and even reported to contain chondrules (Lovering, in Moore, 1962). This meteorite seems to defy classification according to the accepted system (McCall and de Laeter, *op. cit.*). And so it seems not unlikely that there exist in space other rare stony-iron types of the existence of which we know nothing—in default of fortuitous recovery. The type described here represents, perhaps, one such type, which has now, by chance, yielded fragments for scientific study.

Acknowledgements. Messrs. W. H. Cleverly, J. R. de Laeter, E. P. Henderson, and B. H. Mason all contributed to this successful search, and it was the first who, through his perseverance, brought to light the evidence that resulted in solution of the problem of the missing material. Mrs. C. Pegler of Scarborough, Western Australia, treated the writer's persistent inquiries with great kindness and patience, giving him access to this valuable material. Dr. Mason advised the writer throughout the investigation, confirming the original silicate identification. Dr. S. S. Pollock reported further on this material at the suggestion of Dr. Mason, and Dr. E. P. Henderson advised the writer on the nature of the unusual etch pattern—from a study of photographs since the material could not be sent through the post.

References

ANON., 1944. Rep. Dep. Min. Western Australia for 1942, p. 76.

GOLDBERG (E.), UCHIYAMA (A), and BROWN (H.), 1951. Geochimica Acta, vol. 2, p. 10.

LOVERING (J.), 1962, in Researches on Meteorites, ed. C. B. Moore, John Wiley, New York.

McCALL (G. J. H.) and DE LAETER (J. R.), Catalogue of Western Australian Meteorite Collections. Spec. Publ. Western Aust. Mus., no. 3 (in press).

MASON (B. H.), 1962. Meteorites, John Wiley, New York.

—— 1963. Amer. Mus. Novitates, no. 2163.

NININGER (H. H.) and HUSS (G. I.), 1960. Min. Mag., vol. 32, pp. 619–39.

PRIOR (G. T.) and HEY (M. H.), 1953. Catalogue of Meteorites, 2nd edn, British Museum (Natural History), London.

RINGWOOD (A. E.), 1961. Geochimica Acta, vol. 25, p. 1.

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