THE GOSNELLS IRON – A FRAGMENT OF THE MOUNT DOOLING OCTAHEDRITE

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A 1.5 kg iron found in 1960 at Gosnells, near Perth, Western Australia, belongs to Wasson's chemical group I-An3 and is structurally unusual, being best described as a heat-altered granular coarse octahedrite. It is chemically and structurally very similar to the Mount Dooling iron, found in 1909 about 400 km away, and has a fracture surface which fits the Mount Dooling mass very closely. The Gosnells fragment was probably transported by human agency, though it is not known when or by whom.

DETAILS OF THE FIND

An iron meteorite weighing approximately 1500 g was recovered by Mr. Robert Dodd of Perth, Western Australia, in June 1960, from a site close to the blue metal quarry on the Darling Fault Scarp some 19 km S.E. of Perth, lat 32° 05′ S.; long 116° 01′ E. Figure 1 is a map of the area. The country is open bush with grass thickening in winter and burnt off in summer. There is thin forestation in meagre soil over granitic rocks. A recent search of the area for additional meteorite material was unfruitful.

Mr. Dodd gave the meteorite to Mr. F. Soklich, a local gemstone dealer, who is the present owner of the main mass (1446 g). Mr. Soklich donated to the Western Australian Museum, Perth, three small pieces of 8.6 g, 4.9 g, and 4.6 g. Casts of the main mass are also held in the Museum.

DESCRIPTION

The mass is a flange apparently broken off along one edge, and shaped like a flattened horn, Fig. 2. It has large regmaglypts up to 5 cm across. Its

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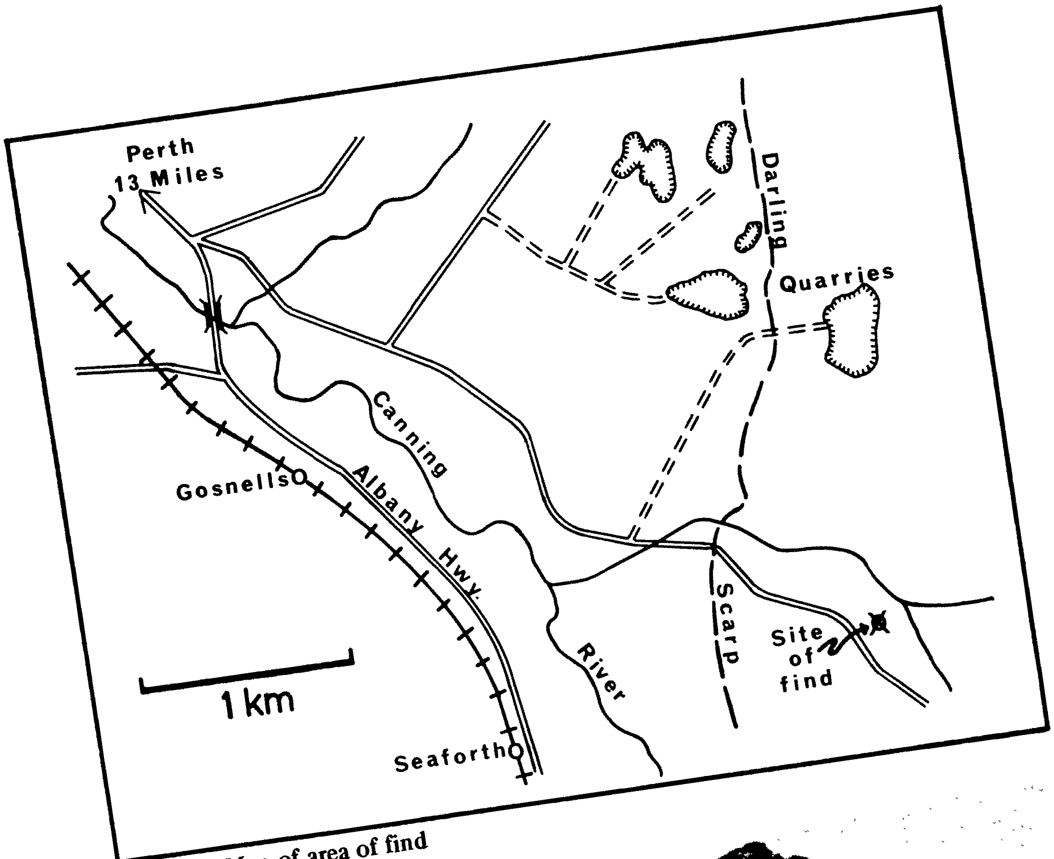

Fig. 1. Map of area of find

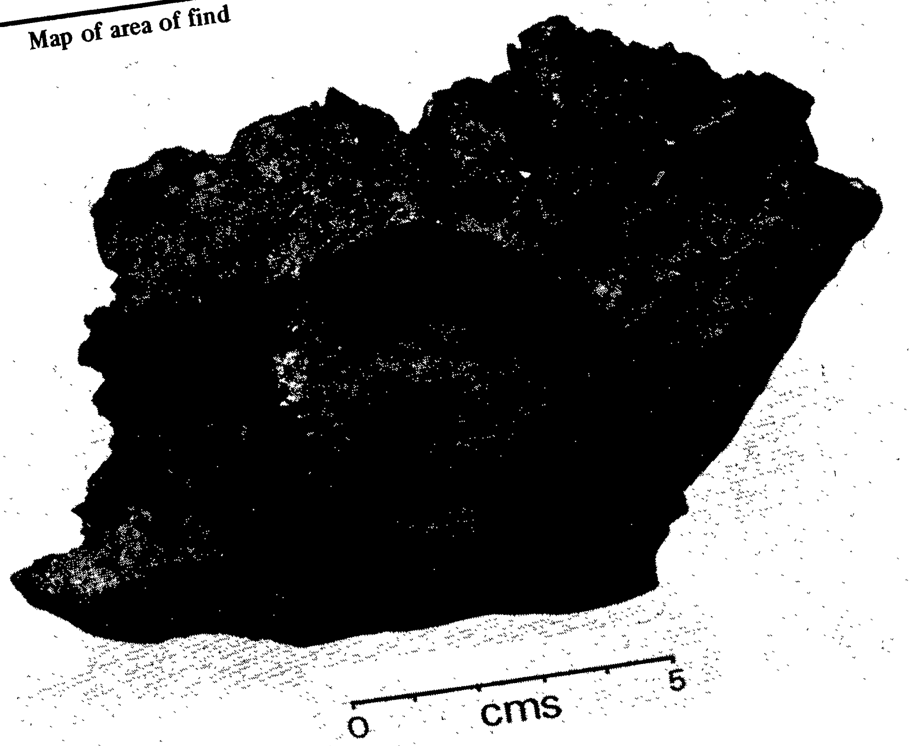

Fig. 2. The Gosnells meteorite

specific gravity is 7.6 g cm^{-3}. The fracture surface shows oblique intersecting planes etched out by weathering.

Figure 3 shows a polished and etched face with two distinct types of kamacite structure. The coarse-grained kamacite consists of somewhat irregular elongated grains typically a few mm across, orientated in a poorly developed Widmannstätten pattern. In some places there are cracks following grain boundaries. The second type of kamacite consists of much smaller approximately equiaxed grains.

Microscopic examination of the coarse kamacite, Fig. 4, reveals abundant Neumann deformation bands, somewhat bent in places, especially near cracks and close to the ablated outside surfaces. Iron-nickel phosphide is present as ubiquitous small rhabdites in both types of kamacite and as larger, less numerous, schreibersite grains. Very occasional small areas of coarse plessite enclosed by taenite were found. Troilite was not observed.

CLASSIFICATION

Table 1a gives the Co, Ni, Ga, and Ge concentrations in the Gosnells meteorite, determined by X-ray fluorescence spectrometry on flat, polished, inclusion-free surfaces (Thomas and De Laeter, 1972).

Wasson (1970) defined chemical group I as those irons which fall within the ranges 6.4-8.6% Ni, 56-100 ppm Ga, and 190-520 ppm Ge. Members of this group are mostly coarse octahedrites. The Ni and Ga concentrations in Gosnells are slightly low for a group I iron, but Wasson defined three

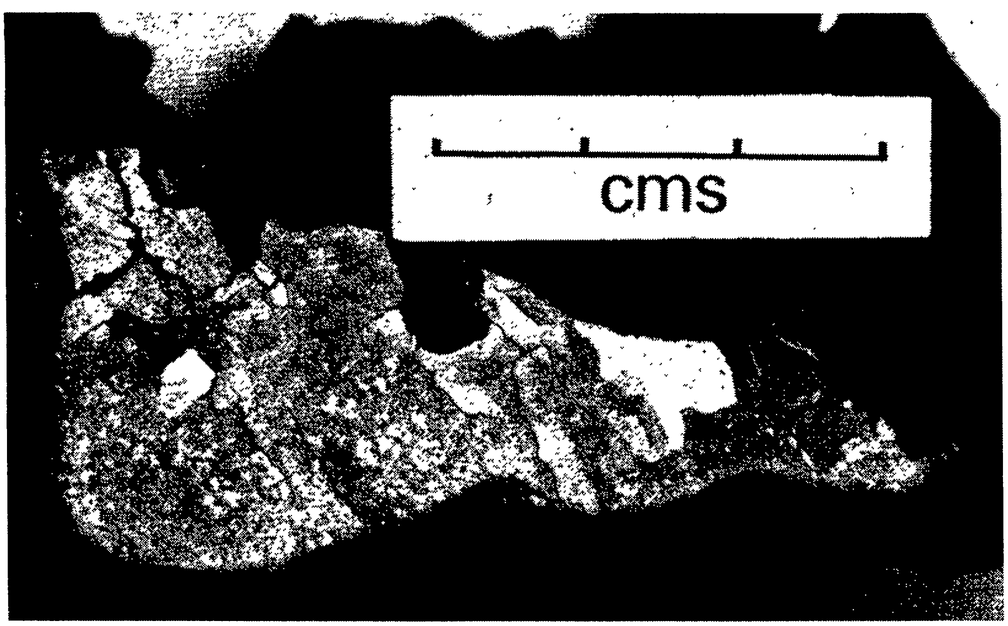

Fig. 3 Polished and etched face of Gosnells meteorite

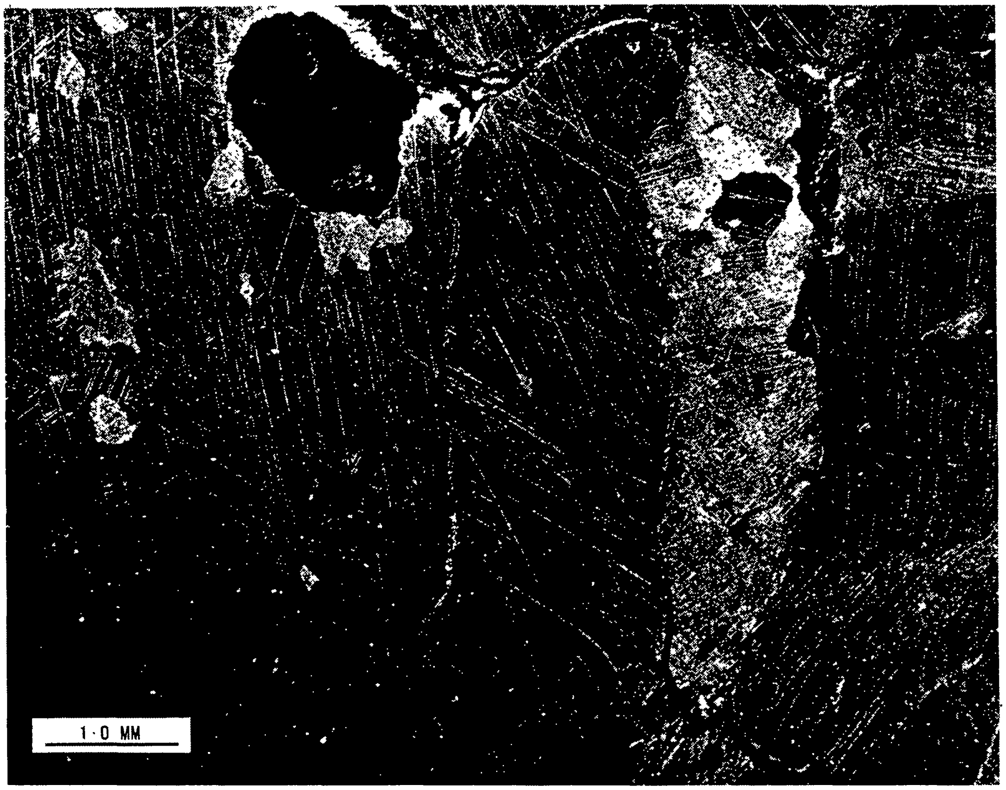

Fig. 4 **Neumann bands in kamacite**

Table 1
Analyses

	Ni (%)	Co (%)	Ga (ppm)	Ge (ppm)	Reference
(a) Gosnells	6.1	0.45	51	249	new analysis
(b) Mount Dooling	6.1	0.45	60	233	new analysis
	6.26	–	52	234	Wasson (1970)
	6.2	–	55	243	Reed (1972)

additional classes of anomalous irons related to group I, and of these Gosnells falls into group I-An3.

The nickel content of Gosnells is that of a very coarse octahedrite, and the vestigial taenite supports this classification. However, even the coarse-grained kamacite is of considerably smaller grain size than is normal for this type. The Gosnells meteorite is thus somewhat anomalous, and is best described as a heat-altered granular coarse octahedrite.

The fine kamacite granulation is a typical heating effect. It is too extensive to have been produced by atmospheric friction and was probably the result of "cosmic" heating prior to entry into the atmosphere. The coarse kamacite probably arose from partial recrystallisation of originally larger kamacite grains due to the same cosmic heating. The structural difference can be ascribed to lower temperature. The shock that produced the Neumann bands postdated the heating. The cracks probably occurred during flight through the atmosphere, on landing, or were produced by subsequent weathering.

Wasson listed ten irons in group I-An3, including the Western Australian meteorite Mount Dooling, found about 400 km from Gosnells. In view of their chemical similarity it was decided to investigate the possibility of a connection, despite the distance separating the places where they were found.

MOUNT DOOLING

Some recent analytical data for Mount Dooling are given in Table 1b. Agreement between the analyses of Mount Dooling and Gosnells for Co, Ni, Ga and Ge is within experimental error.

The two are also very similar in structure: Fig. 5 shows an etched face of Mount Dooling with the same coarse and fine-grained kamacite as in Gosnells, Fig. 3. Both have abundant rhabdite, somewhat distorted Neumann bands, and very occasional taenite/coarse plessite areas. Electron microprobe analysis showed the nickel content of the kamacite in both meteorites to be 6.3 ± 0.2%.

Simpson (1912) classified Mount Dooling as a medium to coarse octahedrite, the kamacite lamellae being 1 to 2 mm wide (average 1.2 mm), and Hey (1966) classified it as a medium octahedrite. However, like Gosnells it is structurally anomalous, and should preferably be described as a heat-altered granular coarse octahedrite.

Figure 6 shows that a cast of Gosnells fits the fracture surface on the main mass of Mount Dooling remarkably closely. There can be no doubt that they are parts of the same meteorite.

According to Simpson (1912) the Mount Dooling meteorite was discovered in 1909 by Mr. A. P. Brophy while prospecting for gold about 5 miles E. of Mount Dooling in the North Yilgarn Block, Western Australia, lat 29° 57′ S.; long 119° 43′ E.). Unfortunately, Mount Dooling cannot be found in maps of the area, nor does it appear in Mines Department records. There is, however, a "Dooling Soak" surrounded by a hillock of stones about a mile across. A point 5 miles E. of this would be at lat 30° 02′ S.; long 119° 43′ E. There is also a hill named "South East Peak" in the Mount Manning Range, about 3 miles N. of Dooling Soak, and another hill now called "North West Peak" 5 miles further N. A point 5 miles E. of the latter peak coincides with the coordinates given by Simpson. It is probable that "Mount Dooling" refers to one of these peaks or to Dooling Soak.

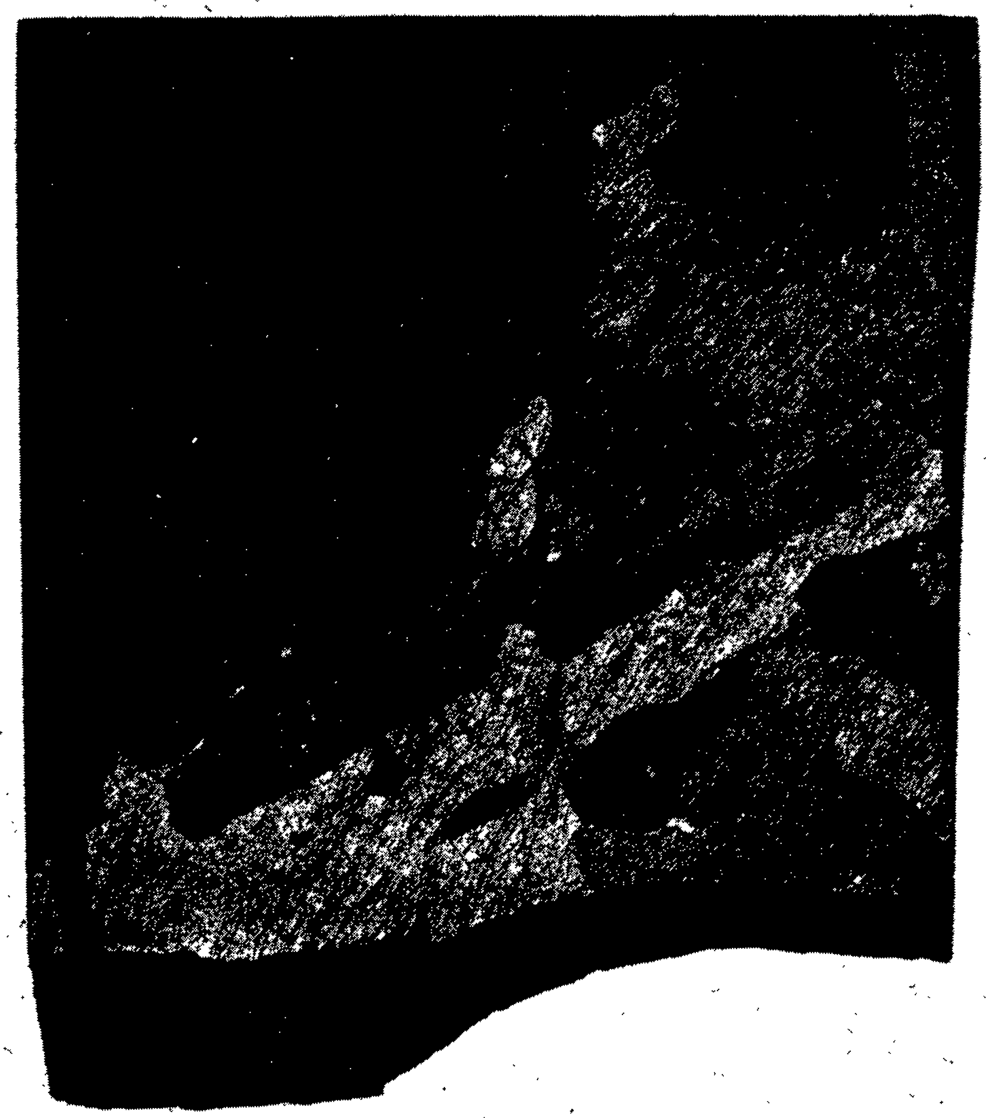

Fig. 5 **Polished and etched face of Mount Dooling meteorite**

CONCLUSIONS

The Gosnells iron is a fragment of the Mount Dooling meteorite. Simpson (1912) records that Mr. Brophy broke two fragments from Mount Dooling and sent them to the Mines Department in Perth for identification. Both of these and the main mass (31.3 kg) were later transferred to the Geological Survey of Western Australia, and are now in the Western Australian Museum. A 400 g piece was transferred to the Australian Museum,

Fig. 6. Cast of Gosnells meteorite fitted to Mount Dooling main mass

Sydney. There is no evidence of a 1.5 kg fragment having been lost, but details of the circumstances of the find are obscure.

The Gosnells meteorite was found 400 km from Mount Dooling, Fig. 7, and the evidence for both localities seems satisfactory. The Boguslavka iron (Krinov, 1960) is a comparable case of fragments of iron meteorite being found to fit, but the pieces were found only 0.5 km apart. Wasson (1968) examined the distribution of the Arizona octahedrites, which are separated by distances of up to 530 km, and concluded that human transport was involved. He pointed out that there is much evidence of iron meteorites having been transported by prehistoric peoples, pioneers, and prospectors. The largest well-documented meteorite shower is the Allende chondrite, which was scattered over an ellipse 50 km long and approximately 300 km^2 in area (Clarke *et al.*, 1970).

It is improbable that the Gosnells fragment was shed from the main Mount Dooling mass during flight. Wide separation on the ground would imply that the smaller fragment was detached at a very high altitude, and the original surfaces would have been destroyed by ablation so that the observed excellent fit would not exist.

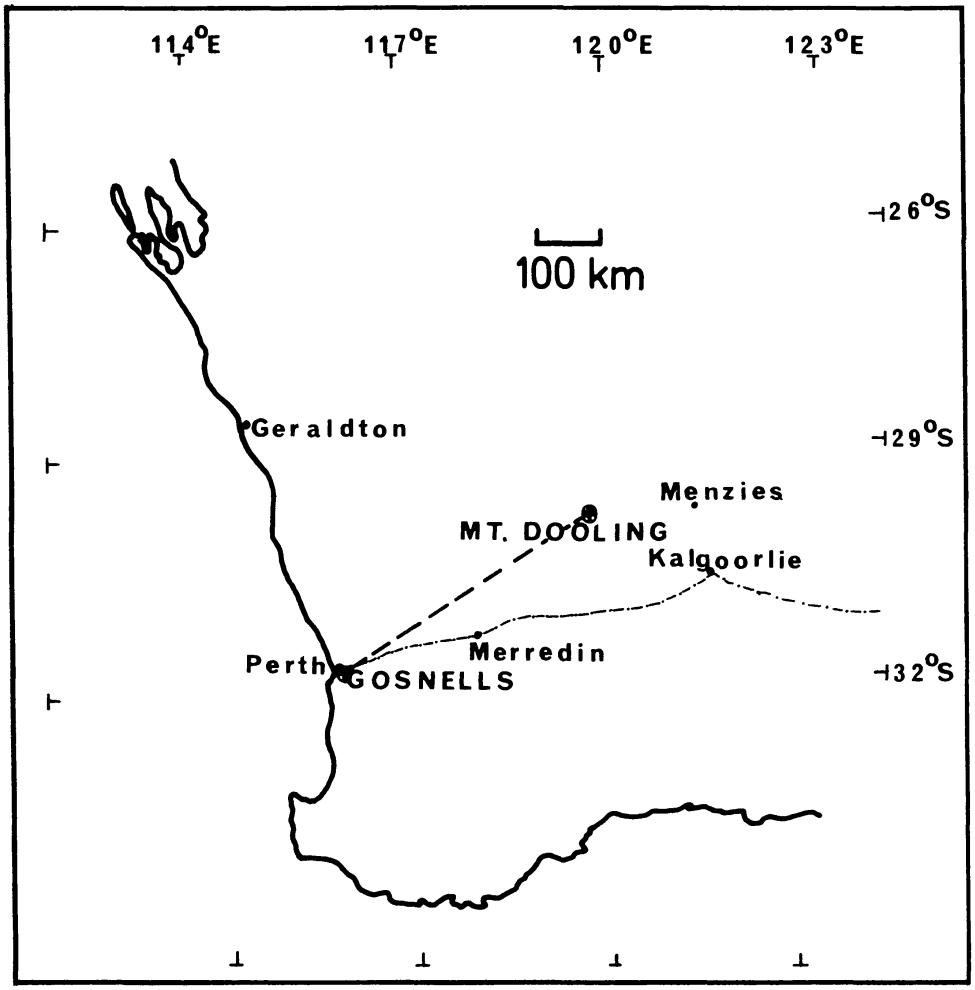

Fig. 7. Locations of Gosnells and Mount Dooling

Dooling Soak is in a comparatively inaccessible area and is visited by very few people, except perhaps aborigines, though the desert tribes rarely moved as far West as the Darling scarp and are not known to have collected iron meteorites. Nevertheless, human transport is the most likely explanation for the separation of the Gosnells fragment from the main mass.

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