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The Boxhole meteoritic iron, Central Australia.

(With Plates XX and XXI.)

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THE Boxhole meteorite crater has been described previously.[1] It is in Central Australia at latitude 22° 37′ 30″ S., longitude 135° 11′ 59″ E. During the single afternoon that was spent examining this great crater, nearly 200 yards across, most of the time was occupied with taking measurements and photographs, and only a few shale-balls were found in the way of meteoritic material. Mr. Joe Webb, who lives nearby, was instructed to continue the search, and in due course he sent down to Adelaide three pieces of iron weighing respectively 17 lb. 9 oz., 1 lb. 8 oz., and 5 oz., shown in figs. 1 and 3, together with six more shale-balls. This material was purchased by the South Australian Museum. Two other small pieces of iron have been obtained by the author from other sources.

Mr. Webb said he found all the iron 150 yards from the east side of the crater, and the other two pieces were also said to have come from the east side. The iron fragments and shale-balls are in appearance indistinguishable from the Henbury specimens as figured by Dr. Alderman.[2] The largest piece, shown in text-fig. 1, has the typical appearance of any small iron meteorite that has undergone considerable weathering,

[1] C. T. Madigan, The Boxhole crater and the Huckitta meteorite (Central Australia). Trans. Roy. Soc. South Australia, 1937, vol. 61, pp. 187–190. [M.A. 7–72.]

[2] A. R. Alderman, The Henbury (Central Australia) meteoric iron. Rec. South Australian Museum, 1932, vol. 4, pp. 555–563. [M.A. 5–159.]

with its thumb-marks, smaller pitting, and dark-brown colour. It may well have been a separate member of a shower. There is no evidence of great strain or shattering, even in the polished section. The smaller pieces lack both the thumb-marks and small pitting. One of them, on the left in pl. xx, fig. 3, is equidimensional with concave depressions, two others are flat and dish-shaped, while the last, weighing 1½ lb. and seen on the right in fig. 3, is definitely torn and twisted, just like some of the Henbury fragments. The same suggestion presents itself as in the case of Henbury and Canyon Diablo, that some of the pieces of iron found near the crater are fragments of the exploded mass that formed the crater, and others are separate bodies that accompanied the main mass and fell as a shower. As the fragments seem to predominate on the eastern side, it would appear that the meteorite came from the east, the smaller members of the shower lagging behind.

The specific gravity was determined on the 17½ lb. piece of iron, by weighing in air and water, and was found to be 7·80.

The outer skin on the iron was not specially studied. It is merely a thin coating of oxide. Weathering has been considerable, shale-balls four inches thick being oxidized right through.

The iron cut comparatively easily with a hacksaw. A piece was cut off one end of the large specimen, near where the beginning of a saw cut can be seen to the right in fig. 1. The polished and etched section shows the structure of a medium octahedrite (pl. xx, fig. 4). The direction of section was not favourable to producing symmetrical figures. What is seen at a glance is bands of kamacite of comparatively uniform width, the average being 0·9 mm., running in four directions, a few well-defined and irregular cracks, which follow the kamacite bands and exude drops of hydrated lawrencite, and some scattered brassy grains of troilite. It is notable that the kamacite bands occupy almost the whole of the area, without enclosing any obvious fields of plessite. The longest continuous kamacite band is 16 mm. long. Most of the bands are in parallel sets from 4 to 8 mm. long. The troilite grains are mostly rounded, but two long narrow grains, each about 4 mm. long, were seen on the section. Other troilite grains are of the order of ½ to 1 mm. across.

A study of the surface under magnification shows several interesting features about the kamacite bands, and also the presence and nature of interstitial areas between the kamacite. The kamacite bands themselves are seen to be of two kinds. One, far the more plentiful, is made up of featureless grains of polygonal outline, bordered by straight to slightly curved cracks. This can be seen in pl. xxi, figs. 7 and 9, particularly well. The other type of kamacite band, in some cases parallel and similar in dimensions to the common kind and in the same group with them, and in other cases more in the nature of interstitial areas between the normal kamacite bands, is made up of innumerable small laths of kamacite, with an infilling of taenite. In narrower bands of this type the laths are all parallel to each other and at right angles to the longer

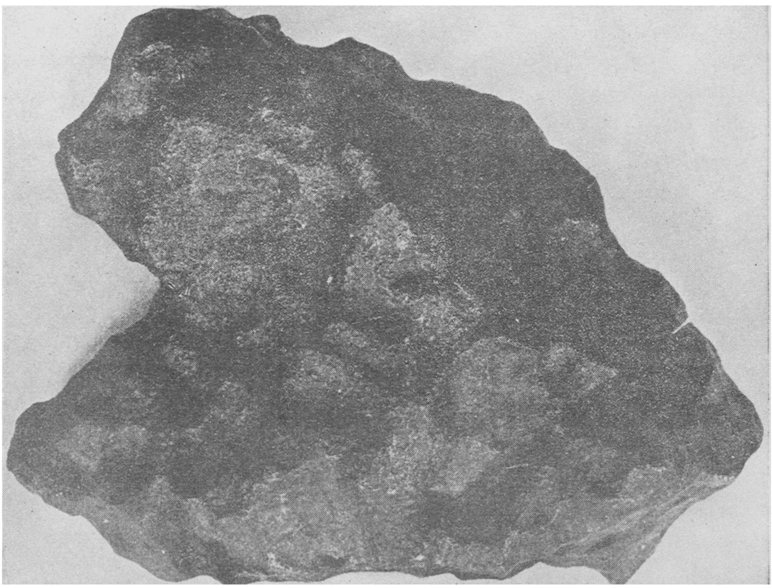

FIG. 1. Meteoritic iron from the Boxhole meteorite crater, Central Australia. Weight 17½ lb. × ½.

side of the band; in broader areas the laths are at right angles to the margins all round. This is shown in fig. 5, where the large central grain is made up of laths normal to all its sides; while to the left centre a smaller area shows kamacite laths in two directions embedded in the black taenite, with a similar structure in the upper left. Fig. 6 shows six of these composite bands, all vertical, between the normal kamacite bands.

The kamacite bands are separated by a very thin bright line of taenite, which may thin out and disappear, leaving only a dark line. In other places the dividing line opens out and the taenite line divides and surrounds a minute dark area of plessite. The greatest width of plessite is 0·2 mm. The bright taenite lines between kamacite bands are shown in figs. 8 and 10, with enclosed plessite. In some cases comparatively wide lines of taenite do not enclose plessite, as with the line appearing black at the top of fig. 5. Figs. 5 and 6 are microscope photographs in ordinary daylight. In them the black areas and lines are all composed of taenite. Figs. 7–10 were made with a metallography apparatus. In

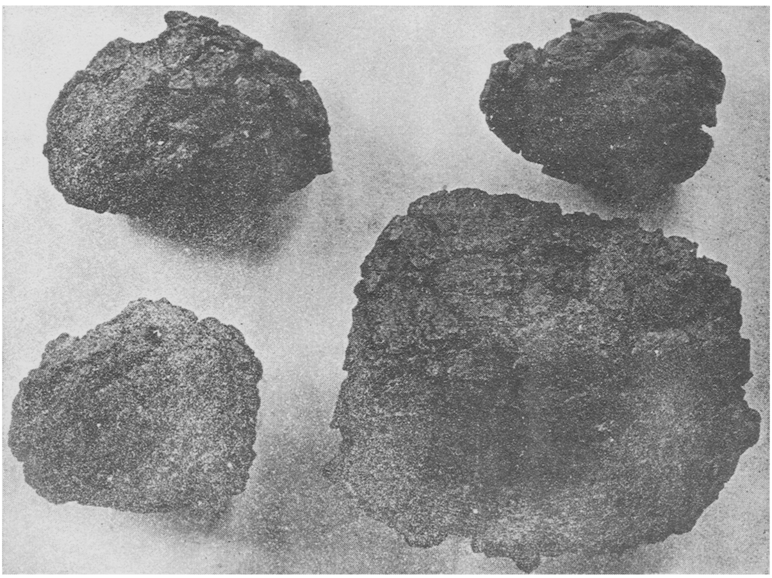

FIG. 2. Shale-balls from the Boxhole meteorite crater, Central Australia. ×½.

them the taenite appears a clear white; also the images are reversed, left and right. The positions of the photographs are marked by the lettered circles on pl. xx. The area shown in fig. 7 lies inside that of fig. 5, and the central 'fish-shaped' area in fig. 5 appears near the bottom of fig. 7. The comparison is interesting, remembering that the figures are reversed, so that the 'fish' points in opposite directions. The taenite is black in fig. 5 and white in fig. 7. Fig. 7 shows that all the dividing lines between kamacite grains are not made up of taenite. Fig. 9 shows the interstitial taenite as composite grains and also some enclosed plessite in association with the taenite. Little rectangular areas of plessite like those shown are not uncommon, but they tend to be triangular and grade into the common narrow triangles which end the lines of taenite between kamacite bands, as in figs. 8 and 10. The proportion of plessite is very low.

The shale-balls, of which some are shown in text-fig. 2, including the largest, do not call for special comment. They are quite similar to those from Henbury. They cannot be marked with a hacksaw, and seem somewhat siliceous, like the siliceous limonite form of gossan. The largest one was broken in two and was found to be oxidized completely through, with no core of iron. The shale is magnetic, crushes to a brown powder, and gives off water in a closed tube.

Dr. Alderman carried out an analysis of borings, taken from the surface left on the large piece from which the polished section was cut, with the following results (I):

	Fe.	Ni.	Co.	P.	S.	C.	SiO_2.	Total.
I.	91·77	7·80	0·44	0·08	0·03	0·049	0·01	100·18
II.	91·54	7·54	0·37	0·08	0·01	0·013	0·03	99·58

He says that, owing to the varying distribution of such minerals as troilite, the values given for sulphur, and probably phosphorus, may be taken as typical but not constant. The carbon was determined by Mr. T. W. Dalwood of the South Australian School of Mines assay department. The analysis is a normal one for iron meteorites of the medium octahedrite class, and shows no outstanding features. It compares very closely with Dr. Alderman's analysis (loc. cit.) of the Henbury iron, quoted under II.

It appears that all the large meteorite craters have been made by iron and not by stony meteorites, suggesting that the larger meteorites are all of iron, or perhaps that stony meteorites break up more readily in their passage through the earth's atmosphere.

In conclusion, it may be mentioned that a mass of 181 lb. (82 kg.) of the Boxhole iron was acquired in 1938 for the British Museum collection of meteorites [M.A. 7–73].

Description of Plates XX and XXI.

Meteoritic iron from the Boxhole meteorite crater, Central Australia.

(Photographs by H. E. E. Brock.)

Figs. 1 and 2 in the text.

Plate XX, Fig. 3. Two smaller pieces of Boxhole iron weighing 5 oz. (left) and 1 lb. 8 oz. (right). The right-hand piece is torn and twisted, indicating a fragment of the main disrupted mass. $\times \frac{1}{2}$.

Fig. 4. Polished and etched section of Boxhole iron. Kamacite bands running in four directions, cracks following the bands, and dark grains of troilite can be seen. Taenite does not show up, and plessite areas are too small to be distinguishable. The circles mark the areas of the enlargements in pl. xxi. $\times 2\frac{1}{2}$.

Plate XXI, Fig. 5. Composite grains or short bands of kamacite, consisting of short laths of kamacite at right angles to the sides of the grain, with a border of taenite (black) extending inwards between the laths. One such grain in the centre, one centre left, and one upper left. A wider streak of taenite is represented by the black line at the top. The remainder is kamacite as larger grains forming the normal bands. $\times 10$.

Fig. 6. Normal kamacite bands vertical and horizontal, with composite bands between. The latter are all vertical, three above, bordered by black lines of taenite, and three below, two of them much narrower. The black lines are taenite, the remainder kamacite. $\times 10$.

Fig. 7. A higher magnification of the central portion of fig. 5, with mirror image reversal. The borders of the kamacite bands and grains are clearly seen as dark lines, with a white line of taenite above, and the white interstitial taenite in the composite grains of kamacite. $\times 15$.

Fig. 8. A white line of taenite between kamacite bands, enclosing a triangle of plessite at one end. Composite grains are seen on the right. $\times 15$.

Fig. 9. Kamacite bands showing division into grains, and white taenite lines enclosing small dark plessite areas. $\times 15$.

Fig. 10. Taenite lines enclosing plessite between kamacite bands. $\times 15$.

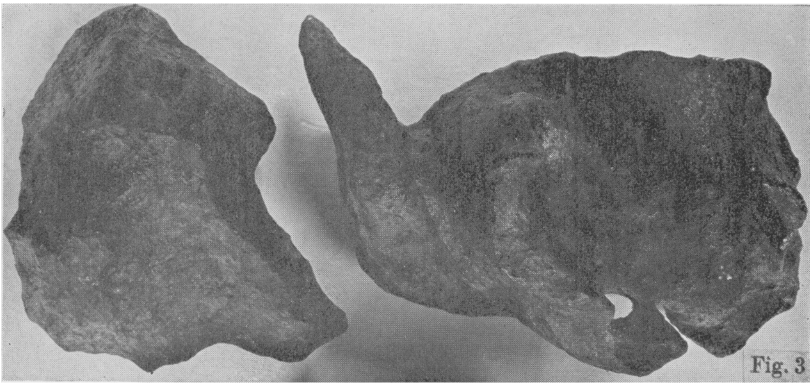

Fig. 3

Fig. 4

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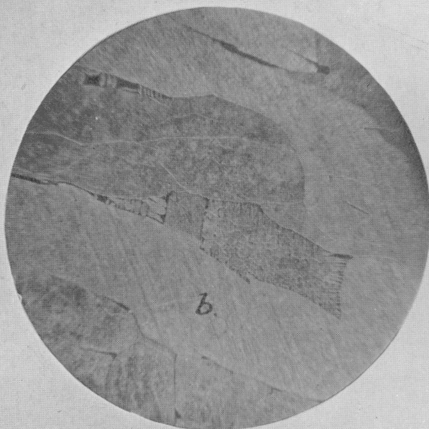

Fig. 5.

Fig. 6.

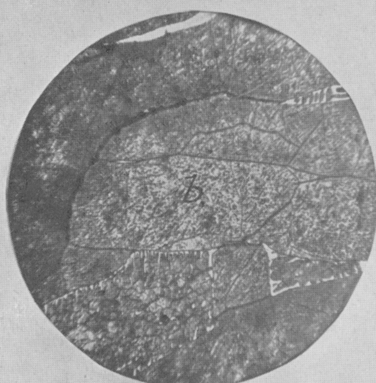

Fig. 7.

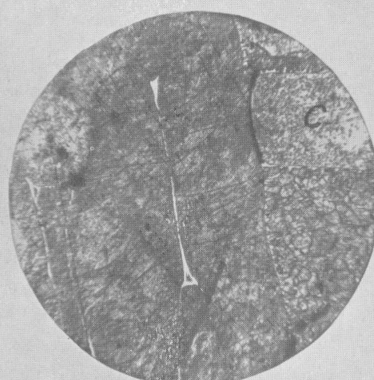

Fig. 8.

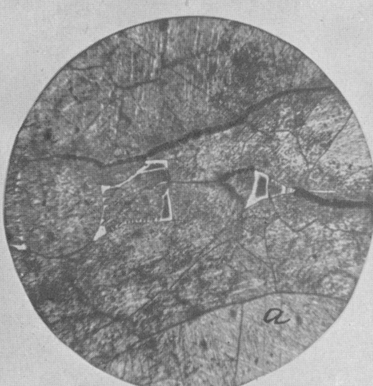

Fig. 9.

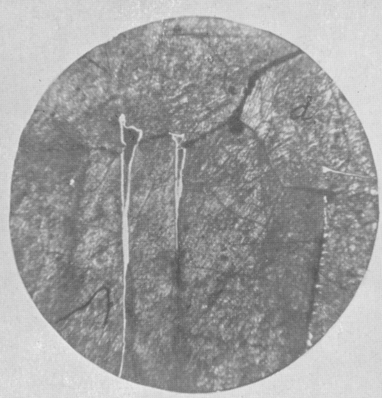

Fig. 10.

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