Two new meteoric stones from South Australia— Lake Labyrinth and Kappakoola.

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THE recovery of these two meteoric stones is due to the energy and resource of Mr. R. Bedford of the Kyancutta Museum, South Australia. They have been sent by him for description and placing on record, and he has very kindly allowed portions to be retained for the British Museum collection of meteorites. I also owe my thanks to him for the detailed information he has supplied respecting the finding of the specimens.

The Lake Labyrinth meteorite.

This stone was collected by Mr. R. Bedford in October 1934 'about twenty miles north' of Lake Labyrinth. He gives the locality more precisely as about eight miles north of Peela rock-hole and well on the Wilgena sheep station, and the latitude and longitude as approximately 30° 20′ S., 134° 45′ E. At his request it is described as the Lake Labyrinth meteorite. Peela Well I have not been able to find on any map available. Plotting the latitude and longitude as stated, I find that the spot lies between Teatree Well and Sextabyng Wells,[1] 27 miles NNW. of the western end of Lake Labyrinth, and about the same distance north of the Trans-Australian railway line. It lies north of the Warburton Range.

The following graphic account of the finding of the meteorite is quoted from Mr. Bedford's letter of November 20, 1934:

> I heard a rumour that a half-caste Australian aboriginal working at shearing round that district knew of a meteorite up there, and the rumour seemed sufficiently definite to justify our making the trip, a total distance of about 600 miles by motor-truck. We were successful in finding the aboriginal, who proved to be

[1] Surveyor-General's map, scale 16 miles to one inch, dated 1920. Also Surveyor-General's map, scale 8 miles to one inch, dated '190–' (received at the Royal Geographical Society in 1913).

a most intelligent and observing man, his name Billy Austin. He had just been shearing at Kukatha station, and was on his way to North Well, a section of the great Wilgena station of 2000 square miles area. He readily agreed to come with us and show us the meteorite, from which we were then some 65 miles distant by the station tracks. Billy informed us that a light and a rumbling noise had been heard in the district on the night of about February 5, 1924, this date being as near as he could remember. About a fortnight later, whilst travelling on the station, he found, in the remote spot above mentioned, a hole in the ground with dirt freshly scattered around; bushes about were freshly burnt and scorched, and at a little distance lay the meteorite, which was already commencing to break up, one lump lying between the hole and the meteorite. Some time afterwards he brought a piece to Mr. McBride, the owner of the station, who, he thinks, took it to Adelaide; and he showed the spot to a visitor from Mt. Gambier, who took a piece. For the last six or seven years Billy had not revisited the spot, and apparently no one else would be able to locate it without his assistance; and for these six or seven years no further attention was given to the find.

When we visited the spot we found the small crater to be at the foot of a red, sandy rise; the vegetation was mulga scrub, sufficiently dense to make it impossible to have located the spot without Billy's assistance, though he himself walked onto it with perfect accuracy. Mr. Ben Peters, my assistant, who was driving our truck, and is himself no mean bushman, was greatly impressed by the way in which Billy guided us over the long, deviating route, often without a track visible, without a moment's hesitation. The crater, when we saw it, was a shallow, saucer-shaped depression 12 feet across, having been largely filled up by washed and blown sand. We dug it out; it must have been originally about 4 feet deep in the centre; we confirmed Billy's assurance that no meteorite material was present in it. The meteorite lay 30 yards west of the crater, up the slope of the sand-rise. Billy, from his original observation, was of the opinion that the meteorite had struck a glancing blow and then rolled on to the point where it lay; otherwise I should have thought that it had been blown out of the crater by a back-fire.

Billy says that the surface [of the meteorite] was originally shiny, though it is now dull, and that inside it was green. The less weathered fragments are still greenish-grey, but weathered fragments are brown. The specimen is now so fragmentary that it is impossible to reconstruct it entirely; but it is clear that it was originally a spheroid with diameters of 9½, 8½, and 7½ inches. Part of the surface was rugged, with smaller and deeper 'thumb-marks', while the rest was more regularly spherical in curvature with wide and shallow markings. Allowing for pieces that had been previously removed, the original weight of the meteorite is estimated as about 75 lb. The actual total amount of the fragments recovered is 57 lb.

The material received for the British Museum collection includes the following pieces:

B.M. 1935,38.—A partly crusted piece weighing 3750 grams (8¼ lb.) and measuring 18 × 15 × 8 cm. This is the best of the larger fragments that were recovered. It shows prominent 'thumb-marks' on two surfaces, while a third is flatter (fig. 1). The crust is preserved, but is stained with a film of limonite. There are three large broken

and iron-stained surfaces, one of which is in part slickensided and black (fig. 1). Another of the broken surfaces has a thin encrustation of calcium carbonate, evidently due to seepage from the soil in an arid climate.

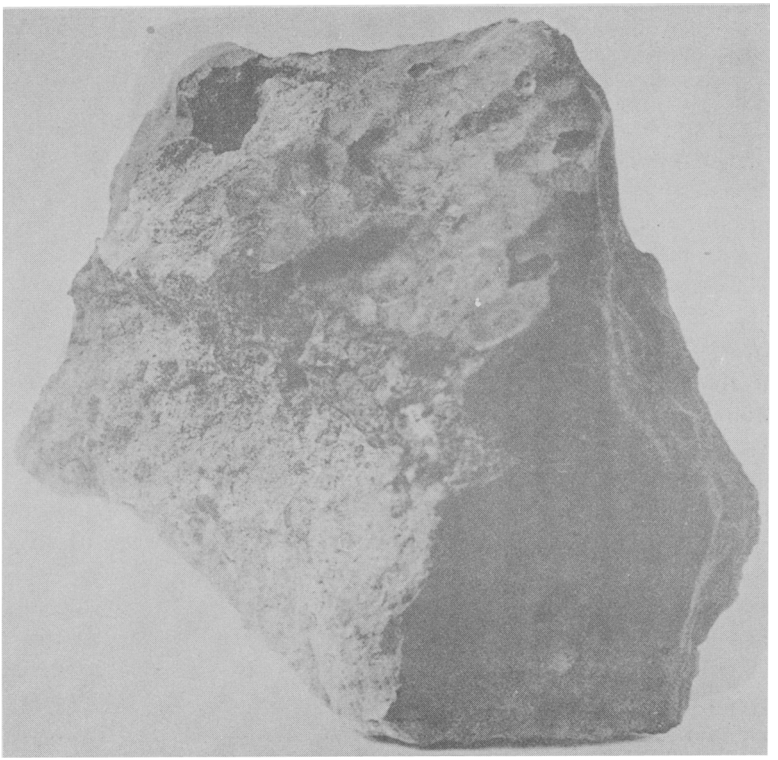

FIG. 1. The Lake Labyrinth meteoric stone. $\times \frac{2}{3}$.

B.M. 1935,39a.—An internal fragment weighing 81 grams, and showing a darker patch due to limonite staining.

B.M. 1935,39b.—An internal fragment weighing 56·5 grams, showing black slickensides, and pierced by a hole due to oxidation.

B.M. 1935,39c.—A crusted fragment weighing 52 grams, showing a flat surface with oxidized crust.

B.M. 1935,39d.—Eleven fragments (93·5 grams) of the least oxidized material. The fractured surfaces are of a light grey colour with a slight greenish tinge.

A polished surface of the least altered material (B.M. 1935,39d) shows grey and white chondrules up to 5 mm. in diameter, one with a sharp outline and the others with indefinite outlines. Metallic nickel-iron is present in small patches, and there are smaller speckles of troilite. The specific gravity of one of these smaller pieces is 3·45.

Micro-sections show the material to be very finely fragmented with small broken crystals of olivine and broken chondrules of radiating enstatite. One enstatite chondrule, oval in outline (5 × 4 mm.), is penetrated by a thin vein of nickel-iron which extends beyond into the matrix of olivine fragments. The stone may be classed as a light grey olivine-enstatite-chondrite with very little nickel-iron and troilite.

Mr. Bedford has himself suggested that this Lake Labyrinth meteorite may possibly be identical with the Kingoonya meteorite. The only available information about the latter is that given in Dr. G. T. Prior's catalogue of meteorites,[1] which is based on letters of March 17 and 31, 1927, from Mr. G. W. Card, formerly of the Mining Museum at Sydney. When on a visit to Kalgoorlie, Western Australia, 'a few months ago' Mr. Card saw this meteorite in the collection of Mr. Spencer F. C. Cook, manager of the Palace Hotel. The three pieces with a total weight of $5\frac{1}{2}$ lb. had been sent to Mr. Cook, who stated that they had been found near the 204-mile post on the Trans-Australian railway line, this being near to the Kingoonya railway station, which is 209 miles from Port Augusta. The date of the find is not stated. The original weight was considered to be about six lb., and Mr. Card describes the stone as 'a fresh chondrite containing little nickel-iron and troilite' (which so far agrees with the description of the Lake Labyrinth stone). He secured a small piece which he handed to the Australian Museum at Sydney,[2] and it was to have been described by Mr. T. Hodge-Smith.

Now, as stated by Mr. Bedford, two pieces of the Lake Labyrinth meteorite had been taken away between 1924 and about 1927, and these would naturally get to the railway line. Kingoonya railway station is about 25 miles SE. of Lake Labyrinth and about 50 miles from the spot where the Lake Labyrinth meteorite was found. There is

[1] G. T. Prior, Appendix to the catalogue of meteorites, British Museum, 1927, p. 25.

[2] Annual Report of the Australian Museum for the year ended 30 June, 1927, p. 9, has the entry: 'A portion weighing 25·6 grams of the "Kingooya" [*sic*] meteorite, South Australia, has been presented by Mr. Cook.'

thus a possibility that the 'Kingoonya meteorite' may be one or other of these pieces. Still, the statement that it was found near the 204-mile post seems to be quite definite; and, if the estimate of 6 lb. was for a complete stone, the weights do not correspond, unless there was a shower of stones.

The Kappakoola meteorite.

This was found in September 1929 on Section 11, Hundred of Kappakoola, County Le Hunte, in the Eyre Peninsula. The spot is about eight miles south of Kyancutta, and Mr. Bedford gives the latitude and longitude as approximately 33° 20′ S., 135° 30′ E. It was found on the top of a sand-hill by Mr. F. W. Daniel, the farmer and owner of Section 11. He had picked it up to throw at a parrot, and thinking it an unusual kind of stone he took it home. It lay about in his shed and was lost sight of. Some time afterwards he mentioned the matter to Mr. R. Bedford, who suggested it might be a meteorite. At that time Mr. Daniel could not find the stone; but later, when dismantling the shed, he made another search and found it in wet dirt and buried under old straw. It was then cracked and dull. Mr. Daniel states that when the stone was first found it was black and glossy, and not cracked. He used it for some time as a paper-weight, and finally took it to Mr. Bedford in October 1935; and it is now the property of the Kyancutta Museum.

Mr. Bedford has suggested that this meteorite might be called the 'Kyancutta stone'. But this name is preoccupied in the nomenclature of meteorites, having been given to a meteoric iron[1] found in 1932 at a spot 28 miles ESE. of Kyancutta. This iron was brought to notice by Mr. Bedford, and is also the property of the Kyancutta Museum, and he was anxious that it should be known as the 'Kyancutta meteorite'. To give the same name to two meteorites, obviously belonging to different falls, found near the same place, or at different places of the same name,[2] can only give rise to confusion. If, however, they are of the same type they may be presumed to belong to the same fall as part of a shower, and then the same name may be applied. It is best to name a meteorite after the nearest place of fall, even though this be a small and obscure place not to be found

[1] L. J. Spencer, a new meteoric iron found near Kyancutta, South Australia. Min. Mag., 1933, vol. 23, pp. 329–333.

[2] For example, Lafayette, Colorado, a siderite; Lafayette, Indiana, a stone [Min. Abstr., vol. 6, p. 207].

on the maps of an ordinary atlas. A statement of the latitude and longitude should always be given, and this fixes the locality. Such general terms as 'Antarctic', 'Australia', 'Central Missouri', 'Kansas', 'Portugal', 'Queensland', &c., that have been applied to

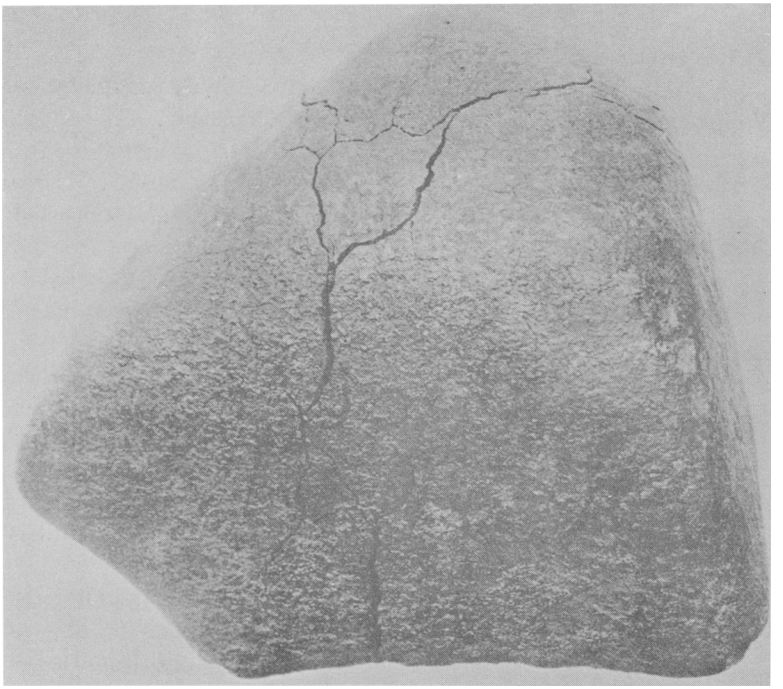

FIG. 2. Photograph of the Kappakoola meteoric stone. $\times \frac{1}{3}$.

some meteorites are useless. For these reasons it is proposed to adopt the name *Kappakoola* for the meteorite now described.

The stone is a complete individual crusted all over. Before being cut it weighed 392·5 grams; and coloured casts were made. The pointed end has been cut off, leaving the main mass weighing 331 grams, and giving an end-piece of 45 grams for the British Museum collection, two small pieces of 2·2 and 1·4 grams, and two micro-sections. The shape of the stone is peculiar and quite unusual. It has the form of a right triangular prism with flat base and domed top. The base is very slightly concave, while the prism faces are plane except where they curve off into the domed top and at the

rounded edges. The prism faces and two of the edges are approximately perpendicular to the base, while the third edge is undercut. The surface is even and smooth, without any 'thumb-marks'. The photograph (fig. 2) gives an inadequate idea of the shape of the stone,

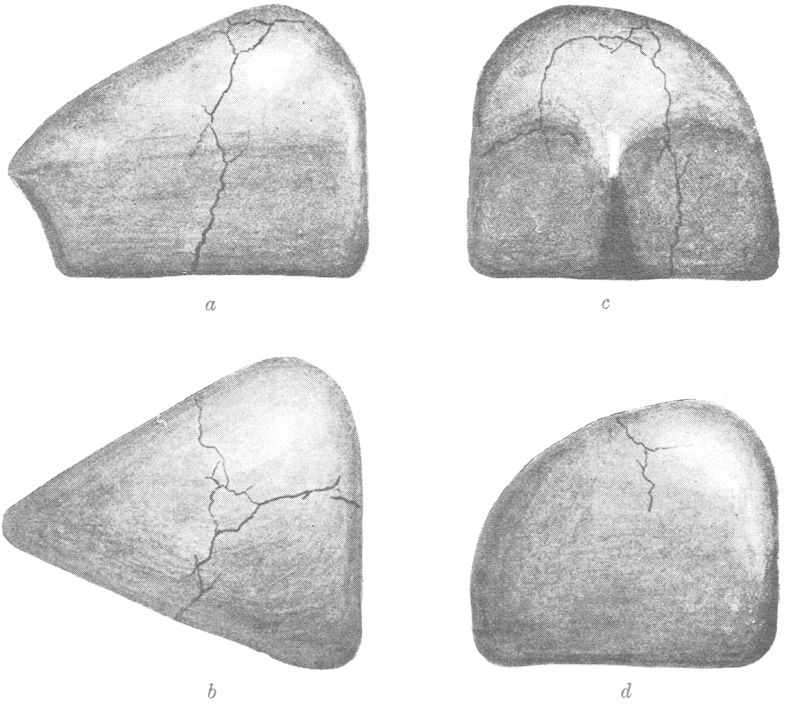

FIG. 3. Sketches of the Kappakoola meteoric stone. $\times \frac{2}{3}$. (*a*) elevation, (*b*) plan, (*c*) and (*d*) end views.

which is better represented by the shaded sketches (fig. 3 *a–d*). The extreme dimensions in two directions at right angles are 7·1 × 5·3 cm., in fig. 2*a*, and 7·1 × 5·5 cm., in fig. 2*b*. The dome was no doubt the front of the stone during its flight through the earth's atmosphere.

The original fusion crust of the stone has been mostly altered to a dark brown skin of limonite with a minutely warty surface, in which a few grains of sand have become cemented. There are deep and prominent cracks in the stone. When found the stone was said to be black and glossy, and not cracked; and it had evidently changed after being kept for six years in a damp shed. This may be taken

as an example of the rapid disintegration to which meteoric stones are liable.

The cut and burnished section of the stone shows a rather thick sprinkling of bright metallic grains of nickel-iron. These are evenly distributed, and are ½ mm. or less across. Fewer grains of bronze-coloured troilite are seen. The ground is a granular aggregate of crystalline stony matter speckled with limonite. Chondrules are few and inconspicuous, and do not exceed 1 mm. in diameter. The specific gravity is 3·59, as determined by Mr. S. E. Ellis in the Mineral Department of the British Museum by hydrostatic weighing of the piece of 45·108 grams.

A thin micro-section shows large numbers of broken angular fragments up to 1½ mm. across of clear colourless olivine surrounded by limonite. Only a few chondrules up to 1 mm. in diameter are shown. One consists of lath-shaped crystals of olivine, another of finely granular olivine, and a third of fibrous enstatite. The stone may be described as a dark grey, minutely brecciated olivine-chondrite with a medium amount of nickel-iron.

Unfortunately there is still difficulty in obtaining information about South Australian meteorites, some of which remain undescribed. Their positions given on the sketch-map in this Magazine[1] are not in all cases correct. Kingoonya, in particular, being placed to the west on the Nullarbor Plains, is quite out of place; and Murnpeowie is also out of place. Rather than drawing another sketch-map from still insufficient data, the following list is given of South Australian meteorites (apart from those of Central Australia and North Australia) with the approximate latitude and longitude of each so far as can be determined.

[1] L. J. Spencer, Min. Mag., 1932, vol. 23, p. 41.

South Australian meteorites.[1]

Accalana,[2] undescribed, found before 1917. 29° 14′ S., 139° 57′ E.

Cadell, stone ?, found 1910. 34° 2′ S., 138° 40′ E.

Carraweena,[2] undescribed, found before 1917. 29° 10′ S., 139° 59′ E.

Glen Osborne, undescribed.

Kappakoola, stone, found 1929. 33° 20′ S., 135° 30′ E. (p. 357 above).

Karoonda, stone, fell Nov. 25, 1930. 35° 6′ S., 139° 51′ E. (Min. Abstr. **5**–15, **6**–16).

Kingoonya, stone, found before 1927. 30° 56′ S., 135° 24′ E. (p. 356 above).

Kyancutta, iron, found 1932. 33° 19′ S., 136° 2′ E. (Min. Mag. **23**–329).

Lake Labyrinth, stone, found 1924 (? fell Feb. 5, 1924). 30° 20′ S., 134° 45′ E. (p. 353 above).

Murnpeowie, iron, found 1909. 29° 35′ S., 139° 54′ E. (Min. Mag. **24**–13).

Rhine Villa, iron, found 1900. 34° 38′ S., 139° 17′ E.

Weekeroo, iron, found 1924. 32° 16′ S., 139° 52′ E. (Min. Abstr. **5**–159).

Yardea, iron, found 1875. 32° 22′ S., 135° 31′ E.

[1] C. Anderson, A catalogue and bibliography of Australian meteorites. Rec. Austr. Mus., 1913, vol. 10, pp. 53–76; G. T. Prior, Catalogue of meteorites, British Museum, 1923, 1927.

[2] Accalana and Carraweena may possibly belong to the same fall, the localities being only five miles apart (see Min. Mag., 1935, vol. 24, p. 14, footnote). Along the same line and four miles farther north is Artracoona. This may perhaps be the locality of the 'Artracoona meteorite', also undescribed, which has been listed under Central Australia but not further localized.