The History of the Hoba Meteorite III: Known and loved by all ...

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In spite of its remote location in the then little-visited and almost unknown territory of South-West Africa (Namibia today), we saw previously (Spargo 2008b) that the second decade of the great meteorite's life opened with its existence being relatively widely known to the public in South Africa and the United States. This was as a result of articles in *Die Volksblad* (Bloemfontein), *The Cape Times* (Cape Town), *The Star* (Johannesburg) and *The New York Times*[1]. There were also brief notes in *Die Sterne* (R.H., 1930), the popular German astronomical magazine, which at least alerted German astronomers to its existence, and the *Zeitschrift für Praktische Geologie* (Schneiderhöhn, 1929) performing a similar function for German geologists.

However, apart from Luyten's very brief note in the Harvard College Observatory *Bulletin* (Luyten, 1929a, reproduced in facsimile in Fig. 8 in the second of this series of articles) and his short, largely descriptive articles in the *South African Journal of Science* (Luyten 1929b) and *Popular Astronomy* (Luyten, 1930), nothing of serious scientific import had been published.

It will be recalled, however, that on 5 September 1929 the meteorite had been visited by a small party of geologists who were on an excursion to Southwest Africa following the International Geological Congress, which had held its XV Session in South Africa in July and August of that year. The most eminent of the visitors was unquestionably L.J. Spencer[2] (Fig. 4)

[1] Astonishingly, in spite of this newspaper publicity, and particularly the two 1929 articles in *The New York Times*, *The Times* of London made no mention of the meteorite in either 1929 or 1930.

[2] Leonard James Spencer (1870-1959) was a British mineralogist of great eminence. A distinguished undergraduate career at Cambridge was followed by immediate appointment to the Mineral Department of the British Museum (Natural History) in London. He worked nowhere else, serving the British Museum for forty years as well as remaining closely associated with it until the time of his death twenty-four years later – a total of sixty-four years. His work on the very extensive mineral collection at the Museum resulted in it being ranked as the best documented and indexed in the world. On succeeding G.T. Prior (Spargo, 2008b, p.166, n. 1.) as Keeper of Minerals in 1927 he continued the latter's work on meteorites, being greatly stimulated by his investigations of the Hoba and Gibeon meteorites during his visit to South-West Africa in 1929. Not one to look back after having once set his hand to the plough, he edited the *Mineralogical Magazine* with meticulous care and great technical competence from 1900 until his death in 1959.

of the Mineral Department of the British Museum (Natural History) in London. An expert on meteorites and a scientist of international repute, his first impressions of the meteorite were published not long afterwards – but only as a relatively brief footnote in an article on the meteorite at Piedade do Bagre, Brazil:

> Here the mass is surrounded by a thick layer of scale, which has obviously been formed by the weathering of the iron. This 'iron shale' is well exposed in the sides of the pit that has been partly dug round the mass. It has a thickness of one foot and shows a lamination parallel to the adjacent surface of the unaltered iron from which it is sharply separated. The scale is dark-brown to black with a dark-brown streak and is slightly magnetic. It shows green nickel stains and is seamed with calcium carbonate from the surrounding surface limestone (Kalahari Kalk) in which the mass is embedded. The meteorite has the form of a roughly rectangular block with its large upper surface level with the surrounding ground. A dozen people can walk about on the level surface of the meteorite. Measurements taken by me in September 1929, are 295 x 284 cm. (about 10 x 9 feet) on the large flat surface with a thickness at one end of 111-122 cm. And at the other end of 55-75 cm. From these measurements I calculated the weight of the mass to be about 60 metric tons (Spencer, 1930a, p. 272, n.2).

Fig. 1 Samuel George Gordon (1897-1952)
Source: http://www.minrec.org

This description, with its accurate measurements of the dimensions of the meteorite, its estimate of the mass, as well as its detailed description of the 'iron shale' surrounding it, thus ranks as the first account of the meteorite that might be termed scientific.

It is also worth noting that, as was the case with so many of the early scientists who visited the meteorite, covetousness – that insidious and widespread sin prohibited so firmly and in such detail in the Ten Commandments – was also lurking in Spencer's mind, for in a popular 1930 article describing the 'Meteoric Irons from South-West Africa' he confesses to his readers that on his visit to the meteorite the previous September "I much regretted that I was quite unable to collect it for the British Museum." (Spencer, 1930b, p. 245).

The visit to the meteorite by a second scientist conversant with meteorites was not long delayed, for in December 1929 Samuel G. Gordon[3] (Fig. 1), a member of the Fourth Academy-Vaux Mineralogical Expedition of the Philadelphia Academy of Sciences, visited the site (Gordon, 1931a). After examining the meteorite and the surrounding ground with care, (Fig. 2) he estimated that 'The weight of the "iron shale" formed by the oxidation of the meteorite was probably fifty tons, which would indicate the weight of the meteorite at the time of fall to have been about one hundred tons."[4] After noting with sharp disapproval that "The meteorite has been damaged in the past by the use of an oxy-acetylene blowpipe in endeavors to get specimens.", he proceeded without blinking an eye to continue the process of destruction by removing for his own use 'a clean sawed piece of 15.5014 grams'!

On his return to Philadelphia Gordon determined the specific gravity of the meteorite as 7.971, while two surfaces of his own sample – "of about 80 square cm. and 30 square cm." – were tested for hardness and then polished, etched and examined microscopically. The surfaces showed eight "elongated patches of troilite",[5] some graphite and an oriented sheen when viewed at an angle. "More remarkable are veins and areas of intersecting lines,

Fig. 2 Samuel Gordon, the second ever scientist to visit the meteorite (3 months after the L.J. Spencer party), photographed during his December 1929 expedition.

[3] Samuel George Gordon (1897-1952), a pioneer American mineralogist, received no formal university education but had the great privilege in 1926-27 of spending six months in Heidelberg working with the great German mineralogist Victor Goldschmidt. Early in his life he became Assistant Curator of Minerals at the Academy of Natural Sciences of Philadelphia. Gordon made five major mineralogical expeditions under the auspices of the Academy to collect specimens for the Vaux Collection at the Academy.
It is most curious that in his account of his visit to South-West Africa (Gordon, 1931b) although he includes a photograph of the Hoba meteorite – as well as mentioning that the most striking objects in the South African Museum in Cape Town are "the huge iron meteorites from Southwest Africa, Griqualand, and Cape Province" – the text of the article contains no mention of his visit to the Hoba meteorite.

[4] As we will see below, in his 1932 paper (p. 8) Spencer estimated that "perhaps… an original weight of 88 tons would be indicated." Seventy years later Ursula Marvin, of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, claimed that 'Before oxidation, the meteorite would have weighed about 88 metric tons' (Marvin, 2000, p. 51). We shall return to this particularly interesting topic in the final article in this series.

[5] Troilite: a mineral, native ferrous sulphide, FeS, that occurs in many metallic meteorites.

resembling Neumann lines,[6] …" He also noted that Widmanstätten lines[6], characteristic of so many metallic meteorites throughout the world, were absent.

Gordon then undertook the first accurate analysis of both the meteorite and the 'iron shale'. His results, expressed as percentages by mass, are given in the table below. From the analysis of the meteorite it is clear why would-be collectors, whether vandals or scientists, have always found it far more difficult than expected to remove a piece of the meteorite, as by any metallurgical standards a nickel-iron mass with just a touch of cobalt will result in an alloy of unexpected toughness, even if deceptively ductile! The results of Gordon's analysis of the iron shale leave one in no doubt that this material is nothing other than the oxidation product of the original meteorite, with the surrounding soil playing little or no part in its origin.

METEORITE	'IRON SHALE'[7]
Fe …….. 82.40	Fe_2O_3 …. 65.48
Ni …….. 16.76	FeO …… 5.60
Co ……. 0.74	NiO …… 8.88
S ……... 0.02	CoO ….. 0.59
P ……... Trace	H_2O …… 8.47

We now come closer to home for it was at this point that, for the first time, officialdom entered the scene. On 28 April 1931 Dr H.E. Wood, the Union Astronomer, and hence head of the Union Observatory in Johannesburg, wrote to the Secretary for the Interior, 'Union Buildings, Pretoria', concerning the meteorite. It is interesting to note that once again the question of moving the meteorite, this time not to New York or London but once again to South Africa, arises!

> I wish to draw your attention to the attached newspaper cutting from the Johannesburg "Star"[8]. If the report is correct, it would suggest that considerable damage is being done to a unique natural object of world-wide interest. The meteorite at Grootfontein is the largest known meteorite in existence, being considerably larger than the Greenland meteorite which is now in the Natural History Museum in New York. Its mass is estimated at not less than 50 tons and, on account of this, it has probably been considered not feasible to transport the meteorite to a

[6] The structure of iron meteorites may be revealed by etching a smooth cross-section with dilute acid. They then frequently reveal an unusual pattern, or set of figures, called a 'Widmanstätten pattern", named after their discoverer the Austrian mineralogist Aloys B. Widmanstätten. They are important in revealing the crystalline structure of an iron meteorite. Neumann lines are very narrow lines running in different directions on a smooth cross-section of a meteorite. The angles of the lines and the cleavage of the meteorites which possess them indicate a cubic structure.

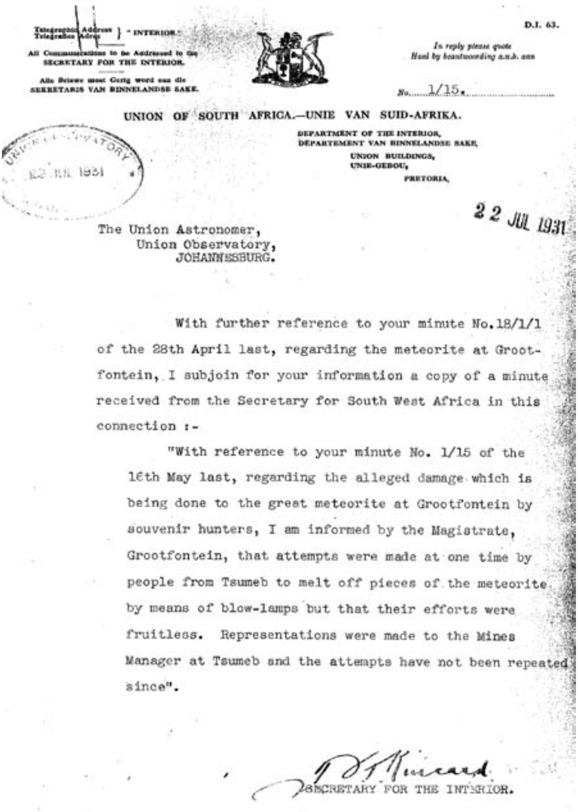
[7] The analysis of the 'iron shale' was repeated by Golden, *et al.*. (Golden, 1995), who showed that although the Co has remained in the oxide layer, small percentages of Ni have migrated into the adjacent limestone.

[8] This article has not been located.

> South African Museum. The meteorite should however be protected against vandalism, just as Bushmen paintings etc are protected. I wish to suggest that steps might be taken to ascertain from the local authorities at Grootfontein whether the report is true and, if so, that the question of the protection of the meteorite should be considered (Wood, 1931).

Almost three months elapsed before Wood received a very formal but nevertheless reasonably re-assuring reply from one Kincard, acting on behalf of the Department of the Interior (see Fig. 3). There the correspondence ends and one must assume that Wood was satisfied by the response he had received to his expression of concern.

We return now to that stout meteorophilic[9], L.J. Spencer (Fig. 4), who, as we have described above, had visited the meteorite in September 1929, and in 1930 had published two relatively brief accounts of the meteorite (Spencer, 1930a and 1930b). However, in June the following year, Spencer made amends for his footnote of 1930 by reading a substantial paper on the meteorite at a General Meeting of the Mineralogical Society in London[10]. Published in March 1932 in the Society's *Magazine and Journal*, this paper (Fig. 5) is still, seventy five years later, the essential starting point for any modern researcher seeking reliable, accurate general information on



Telegraphic Address / Telegrafies Adres } "INTERIOR."
All Communications to be Addressed to the SECRETARY FOR THE INTERIOR.
Alle Briewe moet Gerig word aan die SEKRETARIS VAN BINNELANDSE SAKE.

D.I. 63.
In reply please quote / Haal by beantwoording a.u.b. aan
No. 1/15.

UNION OF SOUTH AFRICA.—UNIE VAN SUID-AFRIKA.

DEPARTMENT OF THE INTERIOR,
DEPARTEMENT VAN BINNELANDSE SAKE,
UNION BUILDINGS,
UNIE-GEBOU,
PRETORIA,

UNION OBSERVATORY 22 JUL 1931

22 JUL 1931

The Union Astronomer,
Union Observatory,
JOHANNESBURG.

With further reference to your minute No.18/1/1 of the 28th April last, regarding the meteorite at Grootfontein, I subjoin for your information a copy of a minute received from the Secretary for South West Africa in this connection :-

"With reference to your minute No. 1/15 of the 16th May last, regarding the alleged damage which is being done to the great meteorite at Grootfontein by souvenir hunters, I am informed by the Magistrate, Grootfontein, that attempts were made at one time by people from Tsumeb to melt off pieces of the meteorite by means of blow-lamps but that their efforts were fruitless. Representations were made to the Mines Manager at Tsumeb and the attempts have not been repeated since".

SECRETARY FOR THE INTERIOR.

Fig. 3 Reply from the Department of the Interrior to H.E.Wood, Union Astronomer, Johannesburg.

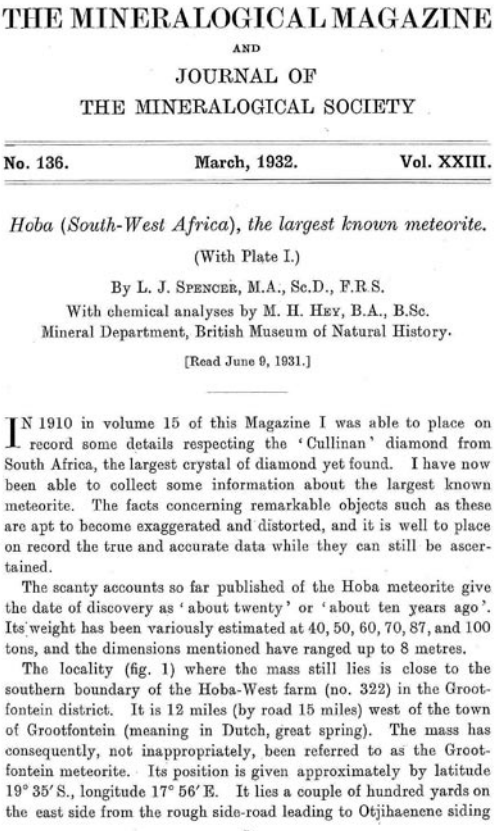
[9] This is the first known use of this word, which has been brought into being for the occasion.
[10] "Held in the Apartments of the Geological Society, Burlington House, London, W., June 9, 1931, at 5.30 p.m. Sir JOHN S. FLEET, F.R.S., President, in the Chair. Twenty-eight members and five visitors were present."

the history and nature of the meteorite (Spencer, 1932). The paper reflects his philosophy concerning both the largest meteorite and the largest diamond in the world, 'The facts concerning remarkable objects such these are apt to become exaggerated and distorted, and it is well to place on record the true and accurate data while they can still be ascertained' (Spencer, 1932, pp. 7-8).

In this paper Spencer, ever the scrupulously meticulous scholar, first outlined with care the history of the meteorite since its discovery in 1920, providing a map of the area in which the meteorite was located (Fig. 6), before describing his visit to the meteorite. Expressing his profound, and perfectly understandable, regret that as there was insufficient time for him to remove a piece of the meteorite itself, he had to be content with a sample of the 'iron-shale' surrounding it. The meteorite was measured 'with a steel tape' and both its surface and the nature of the iron-shale examined with care:

> The block shows a complex of broad and shallow concave surfaces. There are no large and prominent pits and no

Fig. 4 Leonard James Spencer (1870-1959)



THE MINERALOGICAL MAGAZINE
AND
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THE MINERALOGICAL SOCIETY

No. 136. March, 1932. Vol. XXIII.

Hoba (South-West Africa), the largest known meteorite.

(With Plate I.)

By L. J. Spencer, M.A., Sc.D., F.R.S.
With chemical analyses by M. H. Hey, B.A., B.Sc.
Mineral Department, British Museum of Natural History.

[Read June 9, 1931.]

IN 1910 in volume 15 of this Magazine I was able to place on record some details respecting the 'Cullinan' diamond from South Africa, the largest crystal of diamond yet found. I have now been able to collect some information about the largest known meteorite. The facts concerning remarkable objects such as these are apt to become exaggerated and distorted, and it is well to place on record the true and accurate data while they can still be ascertained.

The scanty accounts so far published of the Hoba meteorite give the date of discovery as 'about twenty' or 'about ten years ago'. Its weight has been variously estimated at 40, 50, 60, 70, 87, and 100 tons, and the dimensions mentioned have ranged up to 8 metres.

The locality (fig. 1) where the mass still lies is close to the southern boundary of the Hoba-West farm (no. 322) in the Grootfontein district. It is 12 miles (by road 15 miles) west of the town of Grootfontein (meaning in Dutch, great spring). The mass has consequently, not inappropriately, been referred to as the Grootfontein meteorite. Its position is given approximately by latitude 19° 35′ S., longitude 17° 56′ E. It lies a couple of hundred yards on the east side from the rough side-road leading to Otjihaenene siding

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Fig. 5 The front page of what is still one of the most authoritative papers on the meteorite.

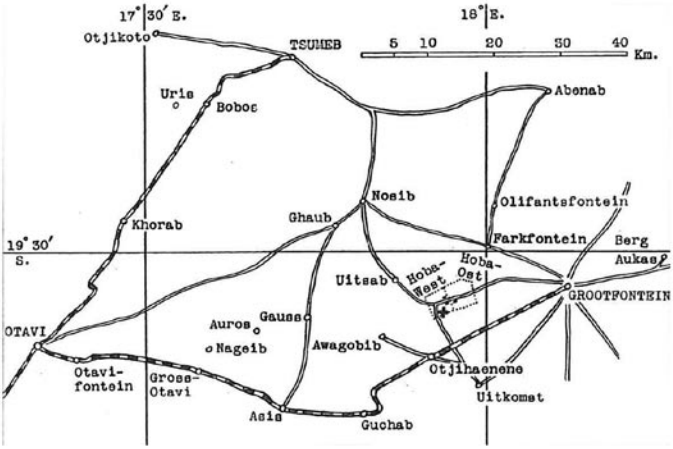

Fig. 6 Spencer's 1932 map showing the location of the meteorite.

angular corners. It is just a huge block from which it is difficult to detach any portion. I have previously suggested [Spencer, 1930a, p.272] that the characteristic surface of iron meteorites is the result of slow atmospheric weathering, rather than the result of rapid burning during the brief flight through the earth's atmosphere. The foot of 'iron-shale' seen in situ represents the amount of weathering that the mass has undergone since it has lain in the ground. This perhaps indicates the original size of the mass: adding 30 cm. all round, an original weight of 88 tons would be indicated (Spencer, 1932, pp. 7-8).

Fortunately, Spencer's distress at having no time to collect a specimen of the meteorite was short-lived, for in 1930 Mr W.R. Feldtmann, General Manager of the South West Africa Company, presented a piece of the meteorite to the British Museum on behalf of the Company 'after obtaining official permission from the Administrator of South-West Africa and from the Department of Mines, the piece being sawn off under his personal supervision.':

This was done by two natives working for two days and with a considerable consumption of hack-saw blades. The specimen obtained is a wedge-shaped piece weighing 2489 grams (5½ lb.) with a triangular cut surface measuring 22 x 9 cm. (about 15 square inches). It shows two earlier cuts that had been made surreptitiously by unauthorized persons, and also the wilful damage done with an oxy-acetylene blowpipe. The meteorite has unfortunately been disfigured all along one top edge by some stupid person with an oxy-acetylene blowpipe. … Mr Feldtmann also sent 83 grams of the sawdust, which is still available for any further investigation. … The metal is comparatively soft and quite malleable, and is more easily worked than some other meteoric irons. It takes a brilliant steel-grey polish (Spencer, 1932, p. 8).

Analyses of the Hoba Meteoric Iron.

	Fe.	Ni.	Co.	Cu.	S.	P.	C.	Total.	Sp. gr.	Fe/Ni.
I.	83·44	16·24	0·76	0·03	trace	trace	0·02	100·49	7·96	5·1
II.	82·40	16·76	0·74	—	0·02	trace	—	99·92	7·971	4·9

I. Analysis by M. H. Hey. Carbon as insoluble residue after distillation of iron in chlorine. Sulphur and phosphorus present, but less than 0·01 %.
II. Analysis by S. G. Gordon, loc. cit., 1931, p. 254.

Fig. 7 Spencer's and Gordon's analyses compared.

A portion of the specimen was cut, polished and examined microscopically. Like Gordon, Spencer found no Widmanstätten lines but, unlike Gordon, found no evidence of lines resembling Neumann lines. He also found troilite[5] and another mineral, schreibersite, a phosphide of iron and nickel found in meteorites. The specimen was then analysed chemically by Spencer's colleague at the British Museum, M.H. Hey, and its specific gravity determined. Hey's results only differed slightly from those of Gordon (Fig. 7). However, the results of his analysis of the 'iron shale' differed substantially from those of Gordon, but as one would expect this material to vary in composition this is not surprising. Unfortunately Spencer did not suggest possible reasons for the uniquely rectangular shape of the meteorite. It is also sad to note that he published nothing further on the meteorite.

Although the meteorite was now comparatively well known, and hence visited by a fair number of people, the records indicate very few of these were scientists. However, in the early 1950s it was visited by the Brian Mason, later Curator of Mineralogy at the American Museum of Natural History (AMNH) in New York. It will of course come as no surprise at all to learn that his visit to the meteorite evoked in him the same feeling of covetousness that had arisen in the breasts of so many scientists on visiting the site!

> In Africa I made a pilgrimage to the Hoba iron (estimated weight 60 tons) in Namibia, sitting in the veldt about 20 km from Tsumeb. I had a vague idea of collecting it for the AMNH, to add to the other large irons Cape York and Willamette[11]. The Tsumeb Corporation had the heavy equipment that could have moved the Hoba to the railhead at Tsumeb; however, at that time the railroad gauge was 2 feet, with an axle loading of 4 tons, which made

[11] The Willamette Meteor was found in Oregon, USA, in 1902. At 14.2 tons it is the fourth heaviest meteorite in the world after the Hoba, the Cape York and the Bacubirito irons (Spargo, 2008a, p. 85).

[12] It is curious that in Marvin's retelling of this story (Marvin, 2000, p. 51), the following, has been added to Mason's own account, "Dr Brian Mason … visited the Hoba farm and discussed with the owner the possibility of purchasing the mass … The owner was agreeable to a sale". This addition simply does not ring true as it is extremely difficult to believe that the owner of the farm really believed that, the year before the meteorite was declared a National Monument (and when the farm owner would surely have been aware of the impending declaration), he actually had the right to sell off the whole meteorite to a foreigner. One can only wonder where Marvin obtained this additional, historically important, information regarding the farmer's willingness to enter into a sale. One can find no reference to it anywhere else.

> moving it further by rail impractical (Mason, 1996, p. 10).[12]

To which one can only record one's fervent gratefulness for the narrowness of the gauge of the adjoining railway!

In 1966, J.D. Fernie, a Canadian astronomer based at the David Dunlap Observatory in Ontario but who had been a lecturer in astronomy and physics at the University of Cape Town during the mid-1950s, visited the meteorite (Fernie, 1967). Commenting that "Among the major meteorites known on earth, few can have received less attention than the Hoba meteorite …", he and a companion decided to motor to Grootfontein from Cape Town. Their long journey by (non-4-wheel-drive) car was not without incident and recalls vividly some of the vicissitudes of such undertakings in remote areas of Southern Africa some forty years ago.

After observing that "there is no surviving evidence of any crater associated with the meteorite", he noted that

> Excavation has been carried out around one side of the meteorite so that one can gain some impression of the depth of the object and the underlying rock. It has been declared a national monument and a wire fence (partly broken down, however) surrounds it (Fernie, 1967, p. 139).

It is particularly interesting to note that Fernie's measurements of the dimensions of the meteorite differ substantially from those of Spencer in 1929, with two of the three being larger than those of Spencer. As a result he decided that "we might conclude that the minimum mass is of the order of 75 tons". It is also worth noting the Fernie's article is illustrated by what is almost certainly the first colour photograph of the meteorite to appear in the scientific literature. (To our astonishment Fernie expresses no wish to take the meteorite back to Canada with him!)

And thus, with perhaps just a touch of sadness, we bring to a close our account of the history of this, the greatest captive meteorite in the world. Of course no history ever really ends, and while the meteorite would continue to be the subject of ongoing scientific investigation (and perhaps the occasional illegal removal of small pieces[13]), what we may call its pioneer days were now over. We have seen in Part I of this series that in 1955 it had been declared a National Monument while in 1985 the National Monuments Council of Namibia and the Rössing Foundation had surrounded it with a stone amphitheatre and transformed it into a tourist site. Some sixty-five years after its discovery Hoba had finally become respectable.

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13 Given the history of vandalism of the meteorite, it is of particular interest to note that fragments are still on sale today from American dealers. Thus an Internet search in May 2008 revealed advertisements for four pieces of the meteorite: 7.45 g ('Sold'); 4.71 g ($470); 2,58 g ('Sold') and 1.77 g ($85). One cannot help but wonder when they were removed from the meteorite – or whether they were even originally part of the meteorite at all! Readers are reminded that it is illegal to trade or privately own meteorites in South Africa.

Acknowledgments

I acknowledge with thanks the kind assistance that I have received from the following people in the preparation of this paper: Mr C. Inskip, Vredehoek, Cape Town; Mr J.C. Loock, Department of Geology, University of the Free State, Bloemfontein, South Africa; Ms Annette Joubert, of the Library, Council for Scientific and Industrial Research, Pretoria; Ms. Shireen Davids, South African Astronomical Observatory, Cape Town and the Inter-Library Loan staff, Chancellor Oppenheimer Library, University of Cape Town. Finally, to four little boys who encouraged – and of course also distracted – me greatly by frequently enquiring, "What you doing, Grandad? … Why?" [To which one can only answer, "Yes, why indeed!"] ☆

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