

ART. V.—*Description of a Meteorite from Green County, Tennessee*; by WM. P. BLAKE.

THE meteoric iron, of which the following is a description, was found by a farmer ploughing his field, in Green County, Tennessee. It was completely buried in the earth and there is no knowledge of the time of its fall. In the year 1876 it was sent by General J. T. Wilder with the minerals of Tennessee to the International Exhibition at Philadelphia, and has since been in the writer's collection at New Haven. The weight of the mass is 290 pounds, equivalent to 639.36 kilograms. The original weight is said to have been 300 pounds. It has been lessened by small portions cut from the ends of the iron and by exfoliation.

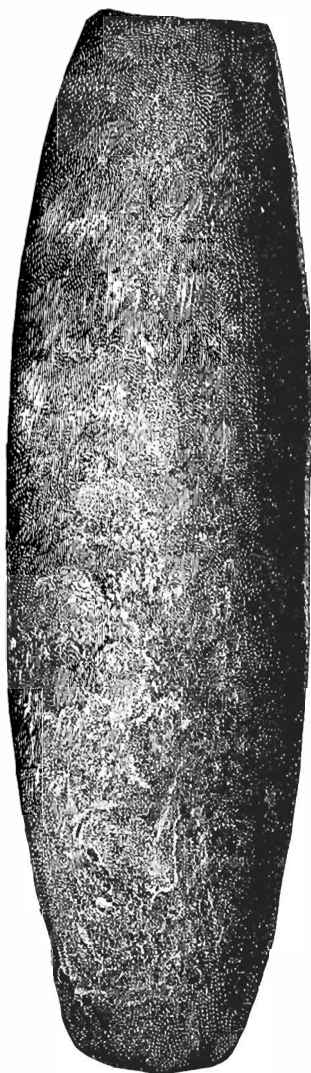
The form of this iron is its most striking visible peculiarity, being an extremely regular long ellipsoid, tapering at each end to a flattened point, but having throughout its length an ellipsoidal section. It has been compared in shape to a flattened cigar. The form and general appearance of the mass are, however, shown by the accompanying illustrations. Figure 1, a top view of the broadest surface, from a photograph, and figure 2 an outline of the side view.

The dimensions of this meteorite are:

* This Journal, Sept., 1880, pp. 197, 198.

	Inches.	Meter.
Length.....	36	·9144
Breadth	10	·2540
Thickness	6	·1524
Girth	24	·5991

The cutting off of small fragments from each end before it came into my possession has, apparently, reduced the original length three, or possibly as much as six, inches, assuming that the mass was prolonged in the direction of the remaining surfaces.



The surface is scaly and rusty, but is in general smooth and evenly curved, with the exception of several cup-shaped indentations or depressions, one of which, near one edge, gives the inward curvature in the elliptical outline seen in fig. 1. One of the depressions is nearly three inches broad and an inch in depth. So far as the examination of the mass has extended, the interior not having yet been laid open to view, these depressions do not appear to be due to the weathering out of more or less globular inclusions, such as troilite or schreibersite, but rather to the unequal exfoliation. The mass when struck by a hammer is remarkably sonorous and seems to be very compact and sound throughout.

This meteorite clearly belongs to the class of exfoliating deliquescent irons, several examples of which have been found in Tennessee and the adjacent States of Georgia and North Carolina. The oxidized crust is in some places very thin and a few strokes of a file develops the unchanged bright iron below, but in other parts of the mass the crust has been found to be much thicker, especially after the meteorite has stood unmoved for several years. Flakes

as broad as the hand, and nearly one-quarter of an inch in

thickness, have then been scaled off from the lower side. This scaling is the result of the gradual oxidation of the surface of the iron by the deliquescence of included



iron protochloride—lawrencite of Daubrée—as shown by the abundant reactions for chlorine and the constant accumulation of moisture, especially upon the under surface of the iron. This deliquescence has for years been sufficient to cause drops of perchloride of iron to form and fall off at times upon the support below. The heavier of the oxidized crusts exhibit thin successive layers with smooth mammillated surfaces like the surface of limonite. They consist of a mixture of hydrous sesquioxide of iron and magnetic oxide. They affect the magnetic needle and exhibit feeble polarity as some fragments of the bright iron also do, but this may be in consequence of the invisible presence of a scale of the magnetic oxide. The exudation of moisture appears to be greatest from small seams, which on cutting into the iron are found to extend for half an inch or more below the surface and are filled up with dark and hard magnetic oxide. Freshly cut surfaces of the iron, when laid upon a sheet of white paper, soon cause rusty spots, and moisture accumulates upon the surface, particularly in damp weather. We have perhaps in this constant exfoliation of the mass an explanation of its peculiar symmetrical form. It may be regarded as the kernel or residuary nodule of a much larger and probably a much more irregularly shaped mass, the gradual exfoliation having thrown off the irregular projections leaving, finally, the symmetrical core.

For the examination of the internal structure and chemical composition a slice a few ounces in weight was cut from one end. The iron is readily cut by a saw with oil and it works well under a file, giving a uniform dense surface without any signs of inclusions or of crystalline structure. If a fragment is sawn partly across and is then struck a strong sharp blow a fracture is obtained and exhibits a fine granular surface like some fine grades of cast steel, but no crystalline facets are visible. It is perfectly malleable. Thin, fin shaped projections may be bent back and forth repeatedly without cracking. A fragment heated to redness and quenched in cold water is not perceptibly hardened, and may be, as before, spread into thin sheets under the hammer. Its malleability is not impaired.

The metal takes a high mirror-like polish. The only imperfections seen are the occasional seams of magnetic oxide which probably will not be found in portions taken from the interior of the mass. The polished surface treated with nitric acid fails to show any structural markings, and the etching of a cuboidal mass with polished plane surfaces at various angles gives a like negative result. The iron dissolves equally on all sides leaving a delicate velvety or frosted surface indicating a very even and fine granular structure. In polishing, the use of a burnisher must be avoided for the lines of unequal condensation will appear in the etched surface. The dull soft surface left by etching has a silvery gray color and yields quickly to the burnisher and becomes mirror-like. The specific gravity of the iron at 60° F. taken upon a cuboidal mass dressed with a file to remove all scale was found to be 7·858, but subsequent solution showed that there was a very small amount of included scale.

A qualitative examination showed the presence of iron, nickel and chlorine. A special examination for phosphorus was not undertaken. No satisfactory reaction for cobalt could be obtained. Hydrogen is probably occluded, but no test for it was made. A more complete chemical examination is intended upon a portion taken from the midst of the mass. A quantitative determination of the iron and the nickel by the method recommended by Baumhauer gave me in per cents :

Iron	91·421
Nickel	7·955
	<hr/>
	99·376

The solution of the iron in pure cold nitric acid developed some hidden peculiarities. A gray heavy metallic powder is thrown off as the solution progresses and accumulates at the bottom of the beaker. This powder when separated by decantation and washing is found to be in distinct grains and resembles finely divided metallic nickel, which is its dominating constituent. It remains apparently unacted on by the nitric acid, while the solution of the parent source is progressing rapidly. Exposed to the air, even while moist, it does not appear to oxidize. It is very malleable, and when pressed in a smooth agate mortar with the polished end of the pestle it flattens and covers the surface as if with a sheet of silver. It dissolves quickly in hot nitric acid, and gives a green solution and the reactions for nickel and for iron also. The quantity varies with the temperature and strength of the nitric acid used. In one trial about five per cent. was obtained. In another the grains were in the form of spiculæ, the length being greater

than the breadth. In composition it is an alloy or mixture of nickel and iron with the nickel in larger quantity relatively to the iron than in the mass.

This deportment in acid indicates the diffusion of granules of a nickel alloy less soluble than the bulk of the iron. It is possible however that the separation of these grains may be the result of mechanical action attending rapid solution, and the evolution of gas disintegrating the iron, producing small grains, from the surface of which the iron is dissolved faster than the nickel. Either view of the origin of the granules sustains the conclusion that this meteoric iron has a granular structure, which is but another phase of the still unexplained phenomena of the aggregation, or structure, of meteoric irons, whether they are distinctly crystalline or are made up of layers differing in composition. The granular condition is more like that of electrolytic iron than the crystalline or banded forms and it may be regarded as lending additional support to the theory of electrical deposition.

Compared with some other meteoric irons with oxidized surfaces it is found to resemble the iron from Dalton, Whitfield County, Georgia, now in the collection of Professor Shepard. This meteorite has a brown and scaly coating but the iron has traces of geometrical structure. It is stated that when this Dalton meteorite was found, one mass of iron was sent off to Cleveland, Tennessee, and has since been lost sight of. Another meteorite from Green County, Tennessee, is described as having an oval flattened form with a coating of specular iron penetrating for half an inch or more the mass of iron. Specific gravity 7.43. No crystalline structure and no nickel was found, but three per cent of carbon, chromium, and tin.* Except in composition and gravity this iron compares closely with the subject of this paper.

According to Prof. Shepard, a meteorite from Green Co., Tenn., contains 14.7 per cent of nickel.† The Tazewell County, Tennessee, meteorite, in which the late Prof. J. Lawrence Smith found solid protochlorid of iron was oxidized in some places one quarter of an inch deep. It exhibits crystalline structure and contains 15 per cent of nickel. Gr. 7.88.‡

The iron of Campbell Co., Tennessee, also attracts moisture and exhibits regular crystalline figures. According to Willett§ an iron from Putnam Co., Georgia, was covered with a brown scaly crust, and freshly cut surfaces soon became moist with drops of a liquid supposed to be chlorid of iron. Structure became visible by etching.

* This Journal, xvii, 329.

† Ibid, xvii, p. 137.

‡ Ibid, vol. xvii, p. 327.

§ Ibid, xvii, 331.

Being unable at present to give further attention to the investigation of the internal structure and peculiarities of this meteorite, it has been transferred to Mr. Geo. F. Kunz, who will probably have it cut up for investigation and distribution.

Mill Rock. New Haven, Oct. 1, 1885.