TWO SUPPOSED EAST MIDLANDS METEORITES

I. THE YADDLETHORPE (LINCOLNSHIRE) STONE

by

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Summary

An examination of the so called Yaddlethorpe "meteorite" of 1963 is reported. The presence of goethite, graphite, gehlenite, and glass gives a combination unrecorded in meteorites to date; absence of a fusion crust, of sulphur or sulphide minerals and of magnesium bearing minerals are noteworthy. For these reasons, the Yaddlethorpe stone cannot be accepted as being of meteoritic character.

Introduction

On 8th June, 1963, the fall of a stone outside No. 7 Cresta Drive, Yaddlethorpe, near Scunthorpe, Lincs. (National Grid Reference SE 88430761), was witnessed by the tenant, Mr. P. Wood, and by Mr. D. Wood. The stone was collected by Mr. P. Wood, who made an immediate note of his observations of its fall: it was subsequently presented to Scunthorpe Borough Museum. The Museum's then geologist, Mr. P.S. Doughty (now Assistant Keeper of the Ulster Museum, Belfast), sent the stone to one of the authors (W.A.S.S.) for examination, later agreeing to its sectioning for study.

The occurrence attracted some attention in the local and national press and the stone, though never added to the official list of British meteorites, has come to be known as "the Yaddlethorpe meteorite". This report describes its characteristics and explains why its meteoritic character must be viewed with extreme doubt.

The author's study of the stone was made in 1966-67 but, in view of its negative results, publication of the report of the investigation has been delayed for some years. It is now embarked upon because of the persistence of the story of the "Yaddlethorpe meteorite".

Circumstances of the Fall

The stone was observed to fall at an angle of 70^{o} to 80^{o}; a faint swishing sound was heard during its flight. It fell into soft, moist earth and formed a small impact crater 12 mm. in diameter and approximately 8.5 mm. in depth. A sulphurous smell was noticeable in the air near to the stone. When picked up, it was still quite warm and was found to have broken into three fragments, the frontal portion thus becoming detached.

Description of the Stone

1. External Morphology As is illustrated in Plate 3, the complete stone is roughly ovoid in shape (length, 27 mm.; maximum diameter, 20 mm.; minimum diameter, 17 mm.). The external colour is black to dark brown and the dull, finely porous surface is extensively cracked. No striations or ribs are present on the surface.

The interior broken surface is mottled dark grey and dark brown; it has a fine grained texture. Under a low power microscope, numerous irregular rounded bodies and graphite plates are seen, set in the finer matrix.

2. Density and Magnetic Properties In order to preserve the stone, the density was measured using an air-comparison pycnometer to obtain the volume. The calculated density at 20°C was 2.73 gm/cc. The stone proved to be weakly magnetic.

3. Mineralogy and Texture A polished thin section was prepared from one of the smaller fragments; this is illustrated in Plate 4 and interpreted in Text-fig. 1. The section was examined in reflected and transmitted light.

The ground mass is opaque and appears as a dull brown/black fine-grained mass in reflected light. Occasional minute graphite flakes can be detected, and in a few places a black glass can be seen. An X-ray powder diffraction pattern of this material shows the crystalline components of the groundmass to be graphite and goethite.

Some larger graphite flakes, up to 1 mm. in diameter, occur within the groundmass (also confirmed by their X-ray powder diffraction pattern).

Also occurring scattered throughout the matrix of glass, graphite and goethite are abundant irregular blebs of transparent colourless glass. In certain instances, this glass is partly replaced by a crystalline mineral. In thin section this mineral is colourless, yellow or pale brown, non-pleochroic, and occurs as euhedral short (0.1 - 0.2 mm.), square prismatic crystals. The crystals are often filled with rod-like inclusions. Their refractive index was estimated to be 1.65 to 1.70; they exhibited straight extinction and a low birefringence. As this optical information did not permit identification of this phase, an X-ray powder diffraction pattern was produced. This proved the mineral crystallising within the glass to be a melilite close to the gehlenite ($Ca_2\ Al_2\ SiO_7$) end member.

The possibility of potassium-argon dating was discussed by the authors with Dr. Alan Mills: in view of his comments (*in litt.* to W.A.S.S.) that it would involve fusion of most of the specimen and might not give a definitive result, this was not attempted.

Conclusions

The peculiar characteristics of this stone, namely the colour, low density, the presence of graphite and the apparent absence of free nickel-iron, originally caused the authors to wonder whether it might be a carbonaceous chondrite. (Its weakly magnetic character and density of 2.73 suggested a comparison with the Type II carbonaceous chondrite of Wiik, 1956).

However, there were a number of disturbing compositional differences from any meteorite previously recorded. First of all, instead of containing serpentine (as would be anticipated in such a chondrite, this stone is composed of goethite, graphite, glass and gehlenite. Although a sulphurous smell had been reported in connexion with the stone's arrival, treatment with conc. HNO_3 and HC1 revealed that free sulphur or a sulphide phase were alike absent. The lack of a nickel-iron phase might be explained by oxidation and hydration, during and subsequent to its atmospheric traverse: the small dimensions might have produced an unusually high degree of oxidation and vitrification during flight through the atmosphere, possibly accounting also for the loss of sulphur. The lack of magnesium - bearing minerals, however, is also noteworthy and difficult to account for on similar bases.

These points - the presence of minerals unexpected in a meteorite, the absence of minerals that would be expected to be present - are all sufficiently disturbing. An even greater difficulty is the absence of the fusion crust typical of meteorites: the crust visible on Plate 4 is extremely thin and does not correspond to a true meteoritic fusion crust. Equally disturbing is the very deep cracking, suggesting a period of weathering longer than the interval between the arrival of the stone and its examination by the authors.

The comment of Dr. M.H. Hey (*in litt.* to W.A.S.S.) was: "In our opinion, it is a small fragment, originally of graphite-rich cast iron with glassy inclusions of slag, which has undergone a long period of terrestial weathering in which the iron has been completely oxidised. Melilite is not uncommon in glassy blast-furnace slags". Dr. M.H. Hey suggested that Mr. Wood might have collected the wrong object: but Mr. Wood (*in litt.*) discounted this possibility.

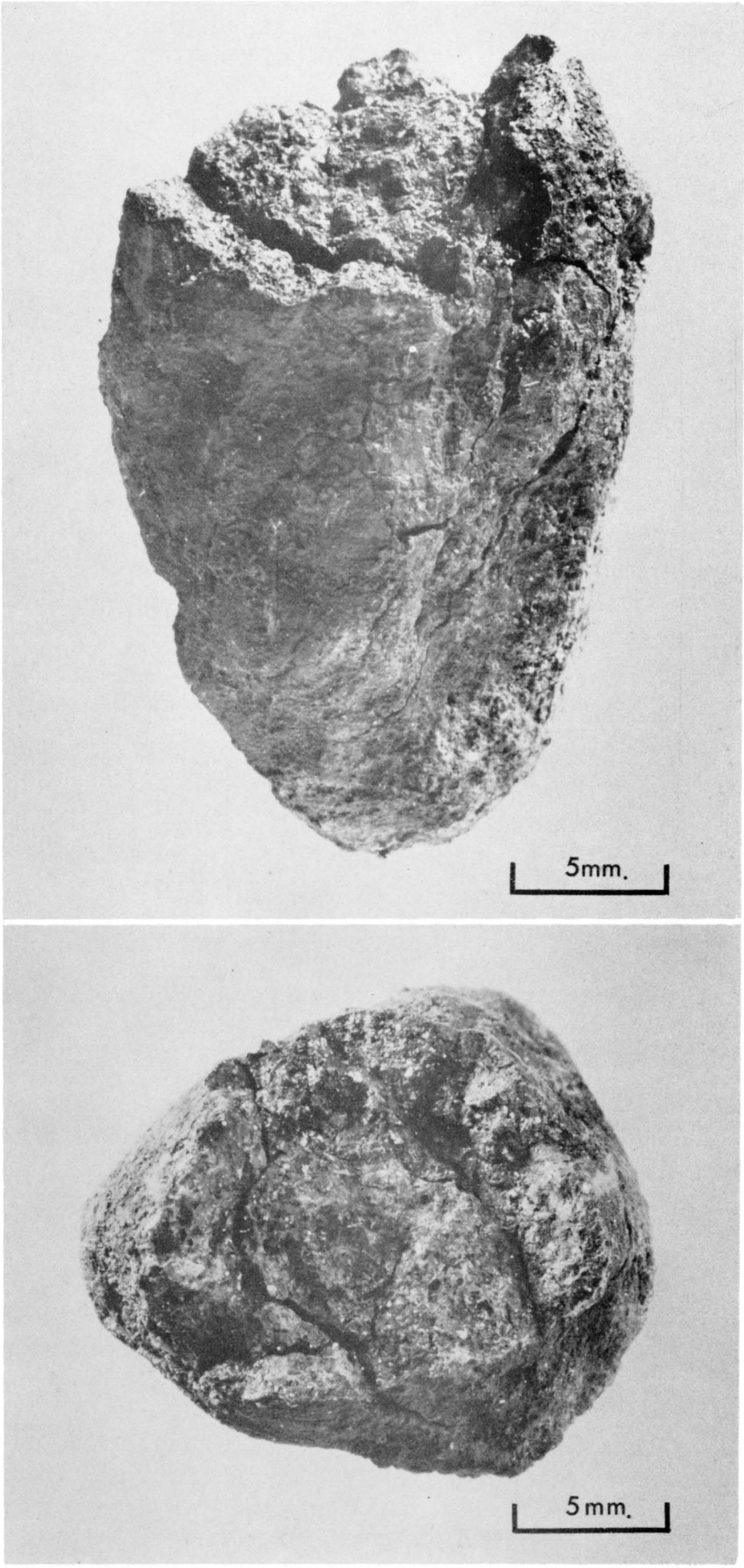

Plate 3. Side and front views of the Yaddlethorpe stone.

Whilst it is recognised that to assume any meteorite must necessarily possess characters in common with previously accepted meteorites has its inherent dangers as a circular argument, mineralogical evidence is certainly heavily against the Yaddlethorpe stone being a meteorite. The observed circumstances of its arrival, so exactly correct for a meteorite, remain to be explained.

Acknowledgements

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They are also indebted to the following scientists who patiently read the original draft of this manuscript and commented upon it at length: Dr. M.H. Hey, of the Department of Mineralogy, British Museum (Natural History), Dr. H.B. Ridley of the British Astronomical Association, Dr. A.J. Meadows of the Department of Astronomy, Leicester University and Dr. Alan A. Mills of the Analytical Chemistry Group, Atomic Energy Research Establishment, Harwell. All concurred in viewing the meteorite character of the Yaddlethorpe stone as being in the highest degree suspect.

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Reference

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Text Fig.1. Diagram illustrating the principal features of the polished section (Plate 4). The dotted portion in the lower part of the diagram represents a thin crust, predominantly of quartz, on one surface. The unshaded area is the matrix of fine graphite and goethite + glass. The shaded patches are glass with occasional gehlenite crystals. The solid black represents graphite.

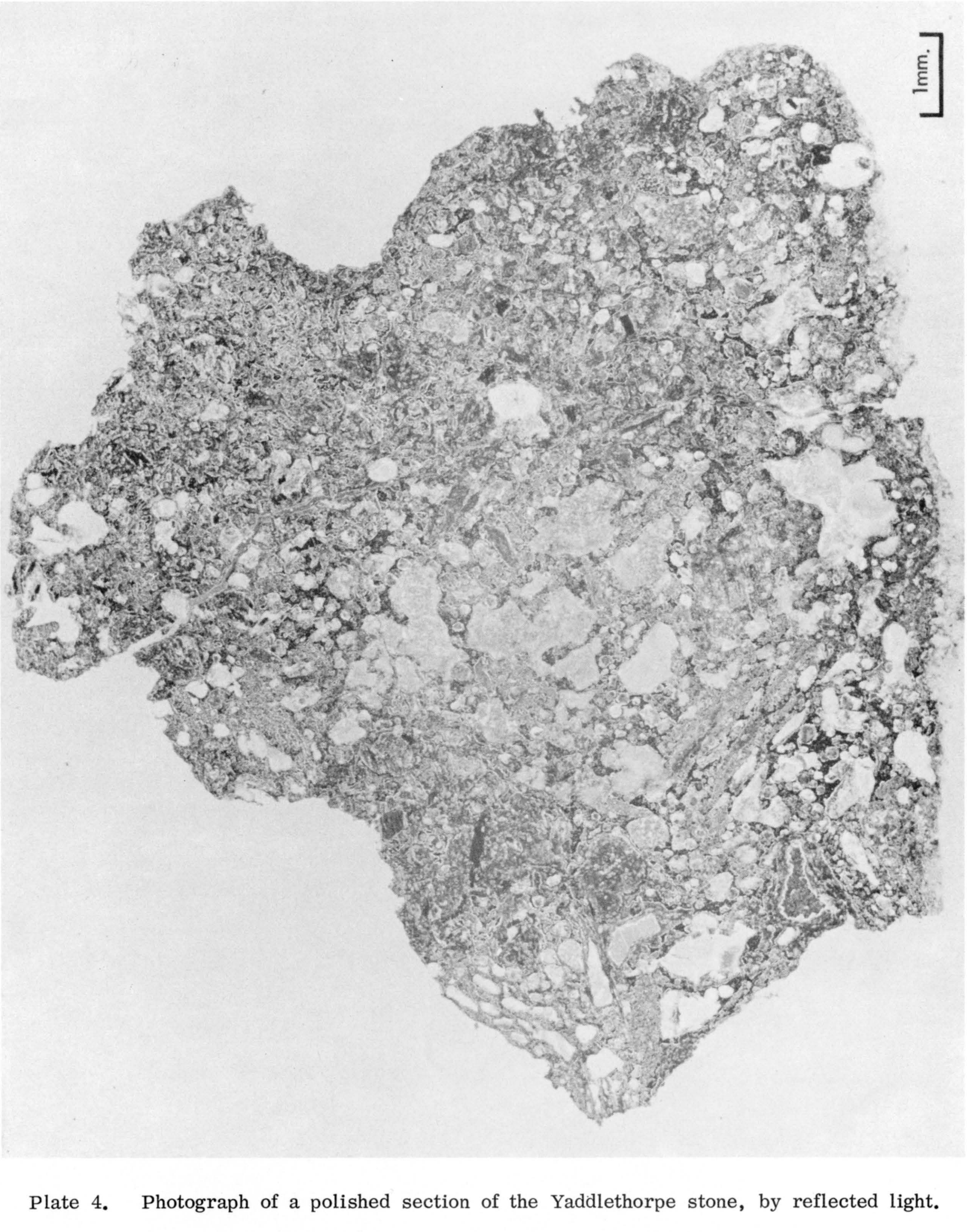

Plate 4. Photograph of a polished section of the Yaddlethorpe stone, by reflected light.