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Vanessa Fell

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Introduction

A multi-period site at Laleham, near Staines, Surrey (OS grid reference TQ 0451 6950), the site of the former Fairyland Caravan Park, was excavated in 1997 by Pre-Construct Archaeology (Taylor-Wilson 1998). The site yielded evidence for middle to later Iron Age occupation, probably commencing after 300 BC.

The iron block examined here (sf 7) was recovered from pit 272, assigned to Period I of the site (c.300–1BC) and interpreted as a refuse pit. The block is from the upper part of the primary fill (context 274), found together with pottery sherds, briquettes, part of a triangular loom-weight, and animal bone (Taylor-Wilson 1998).

There are a number of similar hooked iron blocks known from central and southern England, for example one from Phase 1 occupation (4th & 3rd centuries BC) at Gussage All Saints, Dorset (Wainwright 1979, 351, fig. 7.17, no. 2.276) and two of later Iron Age date from Meare Village West, Somerset (Gray and Bulleid 1953, 244, I.28 and I.32). These blocks were very probably billets — a preliminary form of smithed iron (Crew 1995a; 1995b). Other, or perhaps secondary uses for these hooked blocks have been proposed and these include earth anvils (Gray and Bulleid 1953, 244), weights (Wainwright 1979, 351) and possible metalworkers anvils (Ehrenreich 1985, 33; Fell 1990, 96–7).

The iron which was produced during the pre-Roman Iron Age was made by the bloomery or direct smelting process. The raw bloom produced in the furnace comprised a spongy mass of slag and particles of metallic iron, sometimes containing steely portions. This was hammered hot in order to expel the bulk of the slag and to consolidate the metal. Thus, products of the early stages in smithing, including billets and some bar iron, can be expected to be heterogeneous in composition and to contain large quantities of slag.

Methods of examination

The block had been X-rayed and partly cleaned (on one narrow side) prior to its submission for metallographic examination. The radiographs showed that the block was poorly welded towards the flat broad face (referred to here as the 'end-face'). The block weighed 1579g prior to removal of surface deposits. Additional partial cleaning revealed the length to be 158mm (i.e. with bent hook) and the end-face to measure 67 x 30 mm maximum. Several welds are visible on the metal surface on the sides near the end-face. The corrosion products, where visible, form a smooth brownish-black continuous layer except where interrupted by the weld seams.

Samples for metallography (Fig. 1) were removed from the hook and end-face using a low speed cut-off wheel, with a thin (0.15mm) diamond edged blade. The samples were mounted in epoxy resin, ground and polished to ¼ micron fineness according to standard metallographic techniques, and examined in the unetched condition and after etching with 1% nital. Microhardness readings are averaged Vickers Pyramidal values obtained using loads of 0.2kg applied for 30s. Grain size was measured with an eyepiece graticule at x100 magnification. The specimens have not been analysed for elemental composition. The voids from sampling were filled with epoxy resin (Araldite Rapid) coloured with natural powder pigments.

Samples

Hook [specimen F157]. Transverse section through one corner on the inner side of the hook, c.30mm from the hook tip, producing a triangular specimen of area 7.5 x 5.0 mm

End-face [specimen F158]. Longitudinal section though one edge of the end-face, on the side away from the hook and c. 25mm from one corner, producing a triangular specimen of area 12.5 x 4.5 mm [F158].

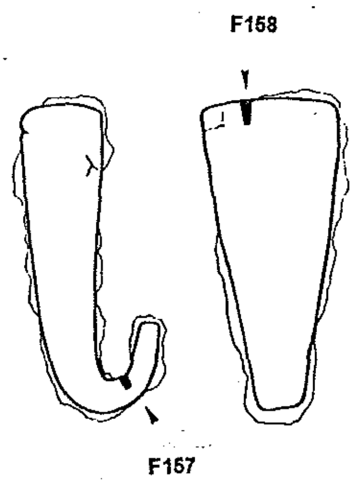

Figure 1. Location of samples for metallography. Scale 1:4

Results of metallographic examination

Examination: unetched

The specimen from the end-face revealed abundant, small, dual-phase non-metallic inclusions (Plate 1). These were non-uniformly distributed, and together they accounted for c. 2% or less of the specimen surface area. The majority of these inclusions were orientated transversely to the length of the block, although some formed longitudinal stringers. There were fewer inclusions visible in the specimen from the hook, although the inclusion density was c. 5% or more. These comprised small glassy single-phased particles, as well as larger dual-phased inclusions with associated corrosion at one side of the specimen. Both specimens showed extensive corrosion at the edges and within the metal, which made estimation of inclusion density difficult.

Examination: etched

Etching with 1% nital revealed large grains of equiaxed ferrite in both specimens, grain size 2 ASTM in the end-face, 1–3 ASTM in the hook. There were traces of grain-boundary cementite (spheroidised iron carbide) in the end-face (Plate 2), and this specimen etched rapidly and its appearance was dull and unclear. Hardness in the ferrite was 94 HV(0.2). The specimen from the hook revealed ferrite, hardness 207 HV(0.2), some of which showed evidence of 'ghosting' (Plate 3) suggesting the presence of phosphorus. There were abundant intragranular particles and acicular needles of nitrides, or conceivably carbides or nitride/carbide compounds, located towards the centre of the specimen (Plate 4).

Table 1. Summary of metallographic results

Specimen	Microstructure	Carbon %	Hardness HV(0.2)	Grain size ASTM	Inclusion density	Comment
End face	Ferrite	~ 0	94	2	low	Cementite traces
Hook	Ferrite	0	207	1–3	high	?Phosphoric iron

Interpretation

The block was forged from impure iron containing much smelting slag which had not been expelled during preliminary smithing. Phosphorus in the iron would have derived from the ore, whereas the acicular nitrides needles probably result from diffusion of nitrogen from the furnace draught (cf. Scott 1990, 19). There was almost no carbon in the areas examined, which is not uncommon for iron made by the direct reduction process in Iron Age bloomery furnaces, although regions of well-carburised metal may also be found (cf. Scott 1990, 16–17). In the final heating cycle, the block was worked hot, or at least annealed, leading to large equiaxed grains and spheroidisation of the cementite, before it was finally air cooled.

Discussion

The composition and condition of the samples from the Laleham block are similar to two other hooked blocks which have been examined metallographically. One from Houghton Down, Hampshire revealed ferrite and abundant slag inclusions (Fell forthcoming). Another, from Hunsbury, Northamptonshire comprised ferrite and slag and also had small amounts of grain-boundary cementite distributed non-uniformly (Ehrenreich 1985, HNY69a; Fell 1990, 483, S63, pl. B49, a-b).

Crew (1995b) suggests that hooked blocks such as the one from Laleham are products of the early stages in the refining of iron, and so shaped as a result of their use as trade iron. By drawing down one end of the block of iron and bending it round to form a hook, the smith was able to demonstrate the quality of the iron (Crew 1995b, 277). Furthermore, Crew suggests that these billets were used to make products which were relatively short and thick, such as adzes, hammers and picks, in contrast to currency bars which were more likely to have been forged into blades and light implements (Crew 1995b, 281-2).

The metallographic results from the Laleham block suggest partial refining of the iron, with smithing at elevated temperatures. The relatively small size of the specimens makes estimation of the overall slag content difficult, but the iron itself seems to be impure although reasonably well homogenised compared with the porous, unconsolidated structure of raw blooms. Experimental evidence suggests that the final yield of iron from a single bloom was very low owing to the large volume of slag which had to be expelled (e.g. Salter and Ehrenreich 1984), and so the Laleham block may well be the sole product of one, or more, smelting operations.

In general, artefacts from the Iron Age have been found to be made of low quality iron (Ehrenreich 1985). The Laleham block had probably been refined adequately for many purposes, perhaps for example for structural uses, various fittings and implements, and some types of tools such as anvils and picks. However, it would have been unsuitable for manufacturing many of the more specialized products, such as many blades and certain types of tools including hammers — which were often well carburised, or products which would have required well-refined and malleable iron, such as pins and brooches.

Acknowledgement

I would like to thank Chris Doherty, Research Laboratory for Archaeology and the History of Art, University of Oxford, for assistance with photographic images. David Starley provided useful comments on an earlier draft of this report.

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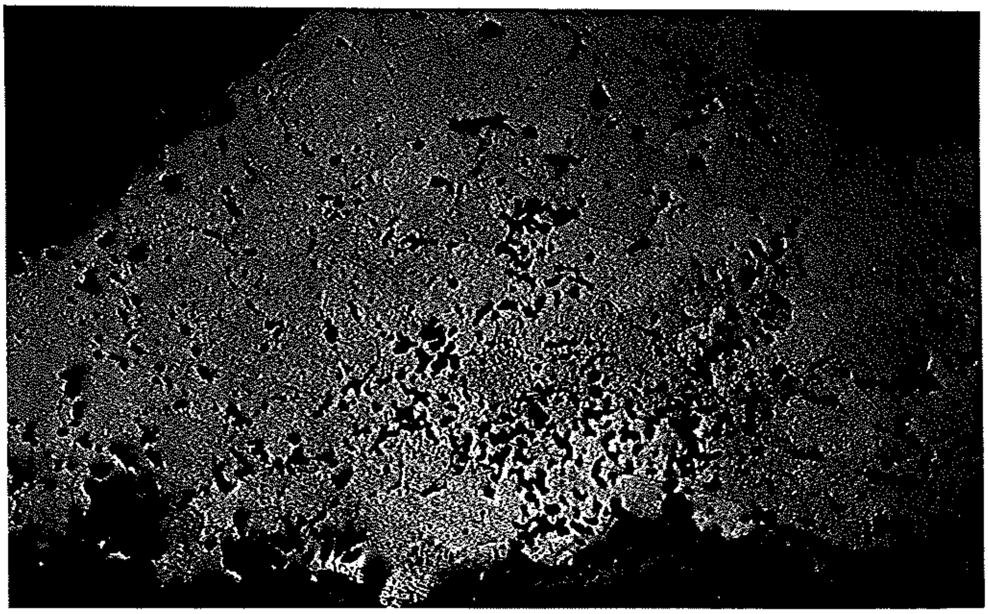

500μm

Plate 1. Corroded edge of sample from the end-face showing abundant slag inclusions with associated corrosion (dark) and ferrite grains (pale). Nital etch.

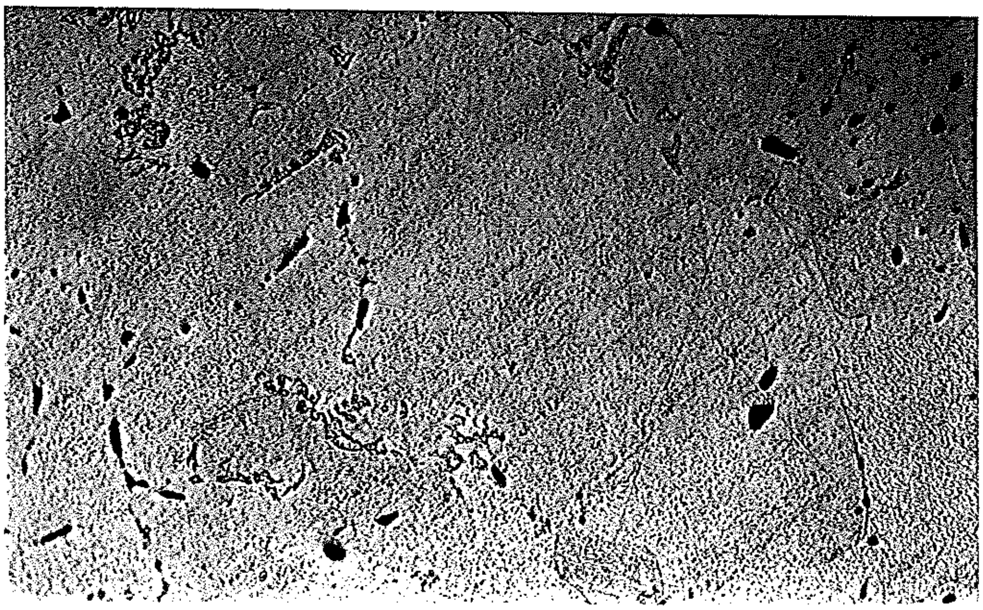

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Plate 2. Detail of end-face showing ferrite (pale) with traces of grain boundary spheroidised cementite (grey) and non-metallic inclusions (black). Nital etch.

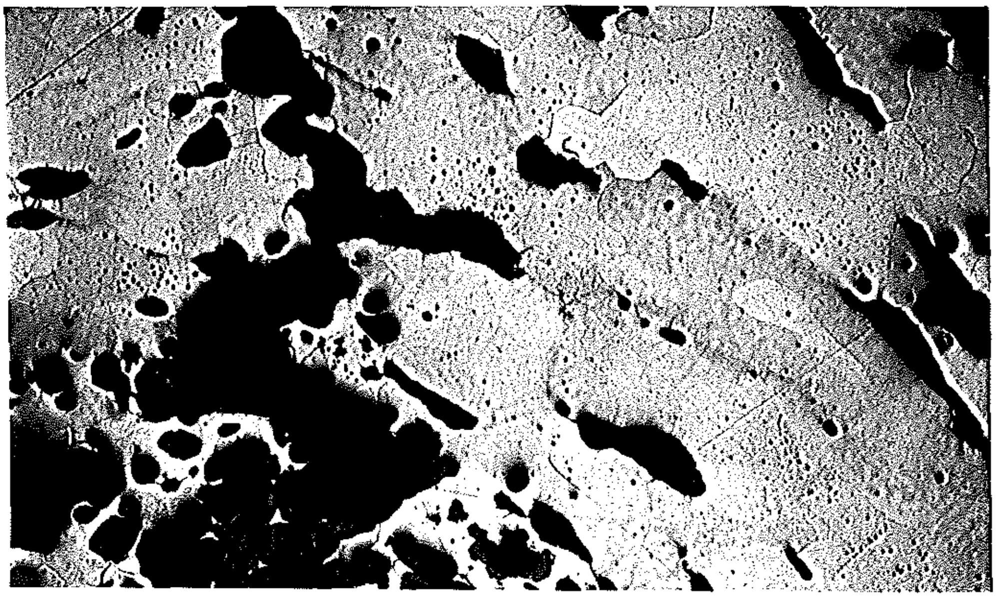

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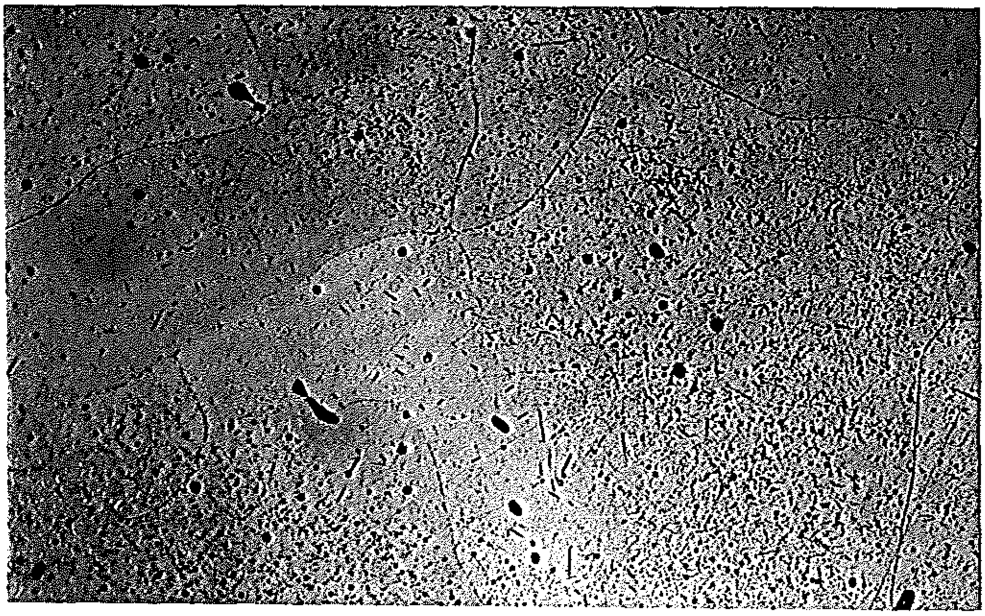
Plate 3. Sample from hook showing large grains of ferrite with mottling (pale), and abundant slag inclusions and corrosion islands (dark). Nital etch.



100μm

Plate 4. Detail of sample from hook showing ferrite grains with acicular needles and particles (dark), probably nitrides or carbides. Nital etch.