Minepit excavations at Rosemead Farm, Horam, East Sussex 2019
photo: Simon Stevens



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# WEALDEN IRON

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# FIELD NOTES

*Robert Turgoose*

## A bloomery site in Udimore, East Sussex

A recent foray has discovered a bloomery at the southern edge of Spout's Wood in Udimore at TQ 867 193. Small pieces of tap slag, ore and roasted ore are scattered over an area of about 50 square metres. The geology is Ashdown Beds. The site lies about 25 metres below the crest of the Udimore ridge and adjacent to a ploughed field, and hill wash may have partly buried the slag heap. There is a spring about 100 metres to the west of the slag scatter. The woodland is chestnut coppice with oak standards.

This site has similarities in respect of extent, type of slag, and woodland edge position to the site at Stock's Wood, TQ 870 191, which is about 300 metres distant.

## A bloomery site in Brede, East Sussex

Recent coppicing work and associated removal of undergrowth has enabled a bloomery site at TQ 846 195 in the east of Brede parish to be examined. Tap slag extends for about 40 metres from east to west and can be seen in deep wheel furrows and in a tree throw.

The site is about 100 metres north of the B2089 in an area of woodland named on early OS maps as Long Sowden.

The site lies on the north facing slope of the Udimore ridge on the Ashdown Beds. There are ore pits nearby in South Sowden Wood at TQ 8454 1924. The woodland is predominantly chestnut coppice.

This site is recorded without a name by Cleere and Crossley.[1] There is no record of this site being previously visited by WIRG. Cleere and Crossley give Straker page 344 as their source. On this page bloomeries at Pickdick in Brede (TQ 8445 1850) and Ellenwhorne in Ewhurst (TQ 7980 2140) are

1. H. Cleere and D. Crossley, *The Iron Industry of the Weald* (Leicester University Press, 1985), 288.

mentioned.

From a copy of the typescript list of bloomeries submitted for inclusion in the gazetteer of Cleere and Crossley's book (ex inf. J. Hodgkinson) it is evident that the inclusion of the grid reference TQ 846 195 was a typographical error and that TQ 846 183, the location of Pickdick, was intended.[2] The grid reference of the next site on the list ends with '195'; its simple transposition may explain the error.

It is therefore a remarkable coincidence that the incorrect grid reference relates to an actual site.

2. [List of sites recorded by Ernest Straker with their modern grid references], *Wealden Iron*, 1st ser., **1** (1969), 15.

# A MIDDLE IRON AGE BLOOMERY AT BIRCHEN LANE, HAYWARDS HEATH, WEST SUSSEX

*Garrett Sheehan*

*with contributions by* Stacey Adams and Luke Barber

## INTRODUCTION

This article presents the results of an archaeological trial trench evaluation, excavation and watching brief carried out by Archaeology South-East (ASE, UCL Institute of Archaeology) on land north of Birchen Lane, Haywards Heath, West Sussex (Fig. 1). The fieldwork was undertaken from 12-30 September 2016 and 18-21 September 2017 and was commissioned by CgMs Consulting Ltd in advance of residential development.

The archaeological excavation area totalled 0.24ha with additional trenching and watching brief areas (Fig. 2).

Fieldwork at Birchen Lane was situated in a miniature east-west aligned valley, on the northern outskirts of the town of Haywards Heath and to the west of the village of Lindfield. The West Sussex Historic Landscape Characterisation (HLC) Survey identifies that, of the site area of 6.38ha, 4.51ha can be characterised as originating as late medieval assart (fields formed from woodland clearance). Residual flint flakes recovered from colluvium deposits were indicative of low-level pre-Iron Age activity in the valley, from the Late Mesolithic/Early Neolithic to the Middle Bronze Age (Period 1).

Significant evidence of Middle Iron Age metallurgical activity was discovered, comprising evidence for the excavation of iron ore from an exposed seam in the northern bank of a west-east running watercourse, at the bottom of the small valley, and the smelting of this ore in a bowl furnace. Limited on-site primary smithing also occurred, as evidenced by small quantities of smithing slag and hammerscale retrieved from ash deposits

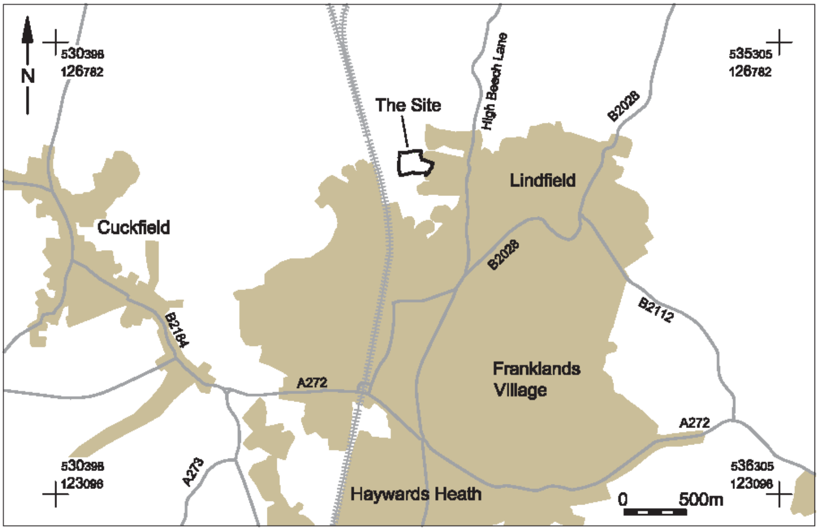


*Figure 1: Site location*

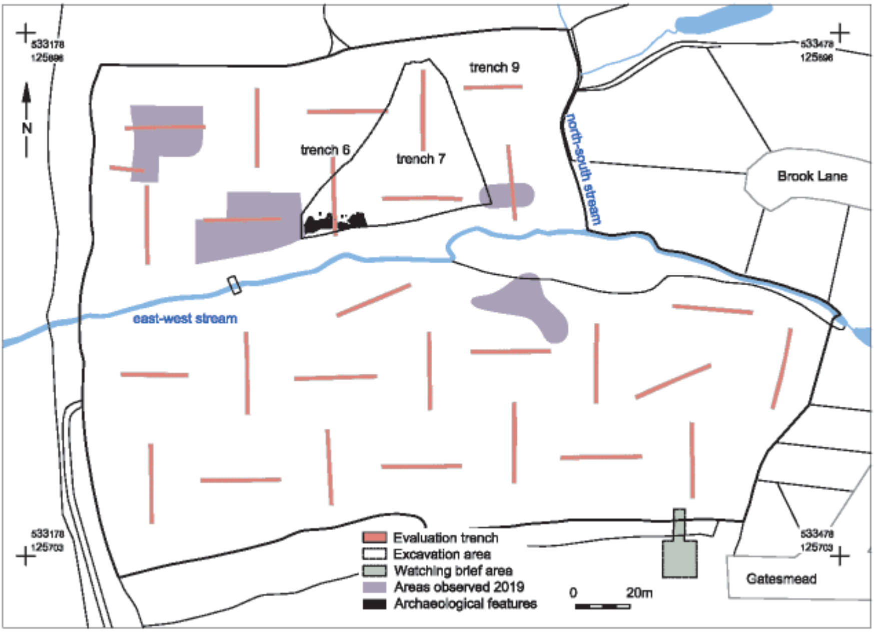


*Figure 2: Site plan showing areas of archaeological intervention*

*Figure 3: Photograph across the site, looking northeast*

*Figure 4: Photograph of the site, stripped to geological substrate, looking north*

from the backfilled quarry and the fill of a small pit. The features and deposits associated with the bloomery were sealed by a layer of colluvium, which had probably formed by the transitional Middle/Late Iron Age period. This was likely followed by a period of re-forestation. The pottery assemblage recovered from the subsoil overlying the colluvium indicates that assarting and subsequent agricultural activity had occurred by the 13th century, although the small number of recovered sherds suggests that this activity was likely to have been of low intensity. The post-excavation assessment should be referred to for discussion of the results from the pre- (Period 1) and post-Iron Age (Period 4) periods (Sheehan 2017).

## THE GEOLOGICAL AND TOPOGRAPHIC SETTING

The site comprised two broadly rectangular east-west orientated fields divided by a west-east flowing stream. A north-south flowing stream was present at the north-east boundary of the site (Fig. 2).

The valley falls from c.55m AOD on the north to approximately 49m AOD at the small west-east flowing stream, before rising again to c.61m AOD to the south.

The site was underlain by a complex sequence of geology deposits. To the north of the west-east stream, on higher ground, was an outcrop of Ardingly Sandstone. South of this, as ground level fell, are successive deposits of Lower Tunbridge Wells Sand, Wadhurst Clay and Upper Tunbridge Wells Sand. The latter extends across the southern part of the site (BGS 2017).

To the immediate north and south of the west–east orientated stream the superficial geology (G22) consisted of pale yellow and grey alluvial clay, with varying amounts of ironstone and manganese inclusions; at the extreme north and north-west it trended into light orange brown clay, which became increasingly oxidised towards the slow-moving stream at the site's north-eastern corner (Figs. 3–4).

The evaluation established that the topsoil at the eastern end of the valley is underlain by a water-logged peaty soil containing fragments of brushwood (Trench 9; Fig. 2). This peaty deposit, as well as the oxidised nature of the geological substrate, indicated that the current north–south stream was wider in the past and that the surrounding area was prone to flooding.

The evaluation also identified a broadly northeast-southwest aligned palaeochannel in this part of the site (Trench 7; Fig. 2), which had truncated the orange clay and was filled with a stiff grey-blue alluvial clay, devoid of any obvious inclusions (G22). An indurated dark brown – black layer overlaid this alluvial clay along the channel's northeast edge, at the same level as the Wadhurst Clay (Fig. 4). This channel presumably once flowed into the base of the valley towards the southeast corner of the northern field.

A number of likely naturally-formed hollows were recorded in the northern part of the site along the northern side of the extant west-east running stream. These features were infilled by colluvially-derived deposits, generally composed of fine-grained orange brown sandy clay silts.

## RESULTS OF EXCAVATION

### Period 2, OA2: Middle Iron Age

The earliest cut-features identified on-site were associated with the extraction and smelting of iron ore during the earlier Middle Iron Age (Figs. 5-11). This activity was centred on the northern bank of the west-east running stream. Analysis of associated environmental evidence suggests the extraction and smelting would have been undertaken in a clearing within a wooded valley dominated by oak.

### Period 2.1

The earliest feature associated with this activity was a hollow (G1), measuring at least 9m east-west by over 3m north-south, which was cut into alluvial deposits on the northern bank of the west-east running stream (Fig. 7, sections 1-2; Fig. 8). This feature was identified during the evaluation in Trench 6 and was thought to be of natural origin, representing the slope of an of an earlier stream bank, which had been in-filled by later alluvium and colluvium. However, during the excavation charcoal-stained layers were observed below these later alluvial deposits, which appear to have been truncated by the later quarry (G3; see below).

This possibly implies that the earlier deposits within the G1 hollow were of anthropogenic origin, and that the hollow itself may have been a man-made feature. It is possible that this was a quarry pit, dug to extract iron ore from the river bank. The thin deposits of charcoal-stained material within the cut may represent the dumping of raked-out furnace waste. Only one furnace

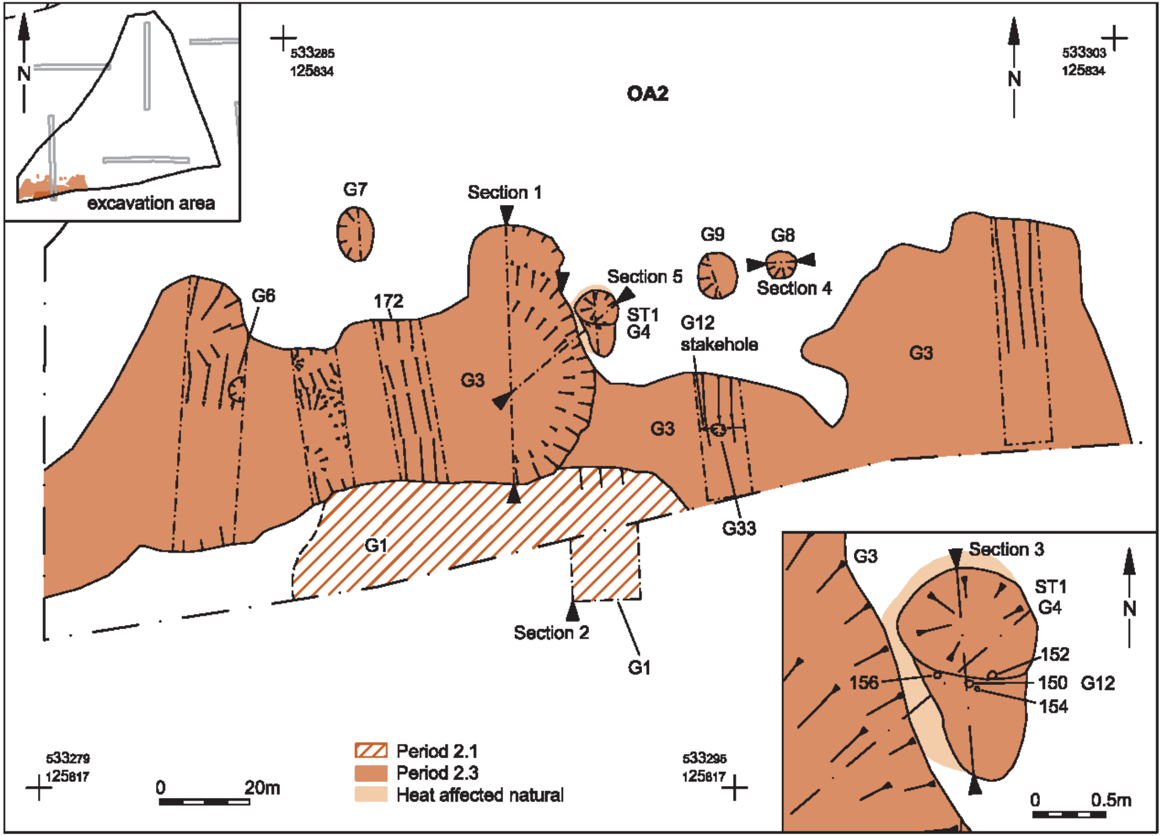


*Figure 5: Plan of Middle Iron Age features*

*Figure 6: Photograph of east-facing section through Period 2 features during recording*

was recorded on-site, which was contemporary with the later phase of ore-extraction (Fig. 7; sections 3-4). It is possible that that earlier ironworking activity associated with this potential phase of ore-extraction could have been truncated by the Period 2.3 quarry.

A small pit (G6), which was truncated by the second G3 quarry cut, may have been associated with this potential initial phase of metalworking activity.

## Period 2.2

The G1 ore quarry was subsequently infilled through colluvial and alluvial processes (G2). This possibly occurred quite rapidly (Fig. 7; sections 1-2) prior to later truncation by the second phase of quarrying activity (see G3 below).

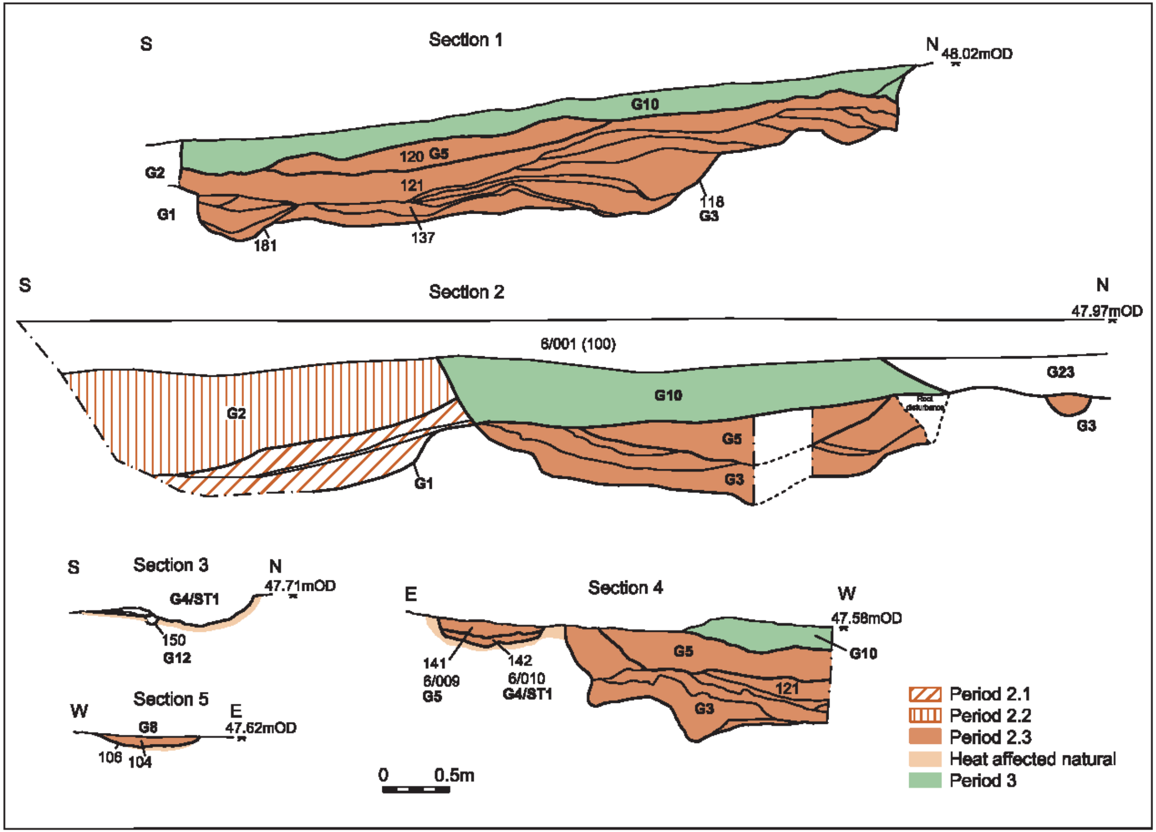


*Figure 7: Period 2 section drawings*

*Figure 8: Photograph of east-facing section through G1 quarry in evaluation Trench 6*

*Figure 9: Photograph of west-facing section through G3 quarry, showing alternating quarrying up-cast and rake-out deposits*

*Figure 10: Photograph of northwest-facing section through G4 furnace and G3 quarry*

*Figure 11: Post-excavation photograph of G4 furnace*

### Period 2.3

The second phase of iron working activity was represented by the remains of a furnace (G4; ST1), sited immediately adjacent to a second quarry cut (G3) and three small, probably associated, pits (G7-9; Fig. 5; Figs. 9-11).

The G3 quarry comprised a broadly east-west oriented irregular hollow, which measured over 24m in overall length by 6.4m in width and between 0.46m and 1m in depth (Fig. 7, sections 1-4). The quarry was deepest at the point adjacent to the G4 furnace, where it appeared to have been modified in order to accommodate rake-out deposits. This second quarry was cut further upslope into the stream bank than G1, the northern edge of which it truncated. The later quarry was presumably positioned in order to continue to follow the same seam of ore utilised by the earlier cut.

The G3 quarry was actually composed of a series of separate quarrying events; it was filled by a sequence of alternating furnace-rake-out deposits and 'cleaner' clay layers. This indicates that a quantity of ore would be extracted and processed, with the up-cast clay and the waste from the ore-smelting furnace thrown back into the extraction cut, followed by further extension of the cut as the extraction process was repeated.

Possible evidence of structural features associated with the metal-working is represented by a posthole (G33) and an adjacent stake-hole (G12), cut into the slope of the eastern end of the G3 quarry (Fig. 5). Both features were filled with grey brown clay silt and sealed by the Period 3 colluvium.

The remains of the G4 furnace itself were located at the western edge of the ore-quarry and comprised a sub-circular pit measuring over 0.80m in diameter by 0.21m in depth, with steep sides, which broke abruptly to a broad, somewhat concave base (Fig. 5; Fig. 7, sections 3-4). A shallow north-south oriented depression on the southern side of this pit likely marked the position of the stoke-hole or rake-out opening in the furnace superstructure. The geological substrate at the sides and base of the furnace was fire-reddened to a thickness of 0.06m, with scorching also evident on the side of the nearest part of the quarry/ rake-out pit.

A group of four charcoal-filled stake-holes ([150], [152], [154], [156]), positioned on the outer southern edge of the furnace pit, were likely elements of the furnace superstructure, anchoring a wattle frame over which daub would have been applied (Fig. 5; Fig. 11). Wattle impressions were visible on a number of fired clay fragments, which were clearly part of this superstructure, and one large broken fragment had vitrified close-set parallel 0.05m diameter wattle imprints. Analysis of these fired-clay fragments suggests that the wall of this superstructure measured between 0.05m-0.10m in thickness, presumably being thickest towards the base; the lower wall fragments were also subject to greater heat, as evidenced by higher levels of vitrification.

The lower fill within this furnace was a charcoal-stained ashy deposit containing small fragments of ore, slag and burnt clay. This deposit related to the primary function of the furnace and represented the remains of the final firing.

That there were multiple firings of this furnace, albeit probably all within a single smelting season, was evidenced by the numerous deposits of rake-out material, interspersed with quarrying up-cast, recorded in the adjacent quarry cut. This is also confirmed by the large amount of furnace superstructure fragments recovered from throughout these rake-out deposits and reworked pieces in the overlying colluvium. It appears that the furnace superstructure was also periodically repaired between uses, as opposed to being demolished entirely, as analysis of the fired clay fragments revealed that one fragment had had a new layer of clay applied to one of its vitrified faces.

While the majority of the rake-out deposits from the back-filled quarry pit and the fills from the furnace produced either undiagnostic or smelting slag, the final rake-out deposit also produced pieces of probable smithing slag and hammerscale indicating that at least some primary smithing was occurring on site. The fact that hammerscale was only recovered from this latest rake-out layer suggest that this smithing may have only occurred during the final use of the furnace.

The presence of smithing slag within a small pit (G8), situated to the east of the furnace, suggests that this feature may have been associated with this short-lived phase of primary smithing. This pit was broadly circular in shape and very shallow, measuring 0.09m in depth (Fig. 5; Fig. 7, section 5). The geological substrate at its base differed from the surrounding clay, being lighter in colour and harder and more brittle in compaction. This alteration was presumably the result of some process occurring within the pit; perhaps low-level heat-exposure or compression from an anvil. This pit was filled with clay silt, containing moderate amounts of charcoal, which, in addition to the smithing slag, produced fragments of ore and smelting slag as well as a residual flint flake.

Two other sub-circular pits (G7 and G9) were located to the north of the quarry (Fig. 5). Neither pit contained any artefactual material, although their proximity to the furnace and quarry, and the lack of evidence for any other activity prior to the post-medieval period in this part of the site, suggests that they were probably also associated with the Middle Iron Age metal-working activity.

The primary fill of the furnace itself (G4) was overlain by a layer of fired clay, containing both small amorphous pieces and larger fragments with flattened faces and varying levels of vitrification ([141]; Fig. 7; sections 3-4). A compositionally similar, and probably contemporary layer (G5), overlay the final rake-out deposit in the back-filled quarry pit (Fig.7; sections 1, 2 and 4). These deposits clearly consisted of the remnants of furnace superstructure fragments and represent the demolition of the furnace after its final use.

### Period 3, OA3: Post-bloomery colluvium

A thick (up to 0.65m) layer of colluvium (G10; Fig.7; sections 1 and 2) directly sealed the furnace demolition deposits within the furnace (G4) and G3 quarry pit. This colluvium contained residual fragments of furnace lining and superstructure, slag, roasted ore and other metal-working waste. Two conjoining sherds of a vessel of transitional Middle/Late Iron Age date were also recovered from this colluvial layer.

## PERIOD 2 CHARCOAL ANALYSIS

### By Stacey Adams

Charcoal from five of the ten sampled features at Birchen Lane were selected for analysis from Early/Middle Iron Age Furnace Pits to inform on the local environment and fuel selection and use.

Preservation of the charcoal from Birchen Lane was moderate to good with the majority of the fragments identifiable to genus and occasionally species level. Over one fifth of the fragments displayed evidence of vitrification, indicative of high burning temperatures. Radial cracks were a common feature amongst the fragments and have been associated with the burning of fresh wood (Keepax 1988, 32).

Oak (*Quercus*) was the most common taxon within the furnace pits and dominated over 78% of the total assemblage. Quarry pit [172] (G3) consisted of an almost pure oak assemblage, broken only by a single fragment of alder (*Alnus* sp.). The charcoal of poplar (*Populus*) often cannot be distinguished from that of willow (*Salix*). However, the well-preserved nature of the assemblage allowed for the distinction between the homogenous rays of poplar and the heterogeneous rays of willow indicating the presence of willow within the assemblage. Birch family (*Betulaceae*) charcoal was present in all samples, represented by hazel (*Corylus avellana*), alder, birch (*Betula* sp.) and hornbeam (*Carpinus betulus*). Coniferous trees were represented by a single fragment of yew (*Taxus baccata*) charcoal in layer [120] (G5). Elm (*Ulmus* sp.), field maple (*Acer campestre*), hazel (*Corylus avellana*), ash (*Fraxinus excelsior*), viburnum (*Viburnum* sp.) and charcoal of the apple sub-family (*Maloideae*) were also recorded in quarry pit [118] (G3).

The dominance of oak at Haywards Heath implies that it was abundant within the local area, enough to be exploited for fuel rather than reserved for use as timber as Taylor (1981) suggests. Fragments of round wood were rare, this suggests that larger branch or trunk wood was coppiced or pollarded to provide fuel wood. This would ensure a secure and regular supply of fuel for the furnaces. The ash of oak and birch is rich in lime, potash and magnesia and both are known to have been selected in the Iron Age for use in the smelting process (Paynter, 2006, 272). The wood from these taxa may have been deliberately burnt to ash for this purpose at Birchen Lane.

The range of taxa identified at Haywards Heath indicates the presence of a mixed oak woodland in the vicinity. Ash wood may not have been immediately available on the local silty sandstone soils and may have derived from the chalk soils of the South Downs due to its preference for calcareous soils (Rodwell 1991, Polunin and Walters, 1985). Alder and willow are ecological indicators for damp and wet environments, such as river valleys. Yew is poorly represented from archaeological sites in Sussex despite the fact that it would have been widely available within the local area. Mooney (2015, 262-71) identified a similar pattern within the Iron Age charcoal assemblage at Peacehaven and suggests it may have been intentionally avoided as a fuel source due to its associations with death and burial in the past.

| Phase 2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Sample Number** | 101 | 102/107 | 106 | 108 | 109 | |
| | **Context** | 121 | 137 | 120 | 181 | 183 | |
| | **Parent Context** | 118 | | | | 172 | |
| | **Feature** | Furnace Pit | | | | Furnace Pit | |
| | **Sample Volume (L)** | 40 | 30 | 20 | 10 | 40 | |
| **Taxonomic Identifications** | **English Name** | | | | | | |
| ***Taxus baccata*** | Yew | | | 1 | | | **1** |
| ***Ulmus* sp.** | Elm | | 1 | | | | **1** |
| ***Quercus* sp.** | Oak | 77 | 76 | 75 | 67 | 97 | **392** |
| **cf. *Quercus*** | cf. Oak | 6 | 1 | 2 | 1 | 1 | **11** |
| ***Quercus/ Corylus*** | Oak/ Hazel | 3 | 2 | | 1 | | **6** |
| ***Quercus/ Castanea*** | Oak/ Sweet Chestnut | | 1 | | 1 | | **2** |
| **Betulaceae** | Birch Family | | 2 | | 1 | | **3** |
| ***Betula* sp.** | Birch | | | 1 | | | **1** |
| ***Alnus* sp.** | Alder | | 2 | | 4 | 1 | **7** |
| ***Carpinus betula*** | Hornbeam | | | 1 | | | **1** |
| ***Corylus avellana*** | Hazel | 1 | 1 | 3 | 5 | | **10** |
| ***Populus/ Salix*** | Poplar/ Willow | | 1 | 3 | 2 | | **6** |
| ***Salix* sp.** | Willow | | | 1 | | | **1** |
| ***Fraxinus excelsior*** | Ash | 1 | 6 | 4 | 1 | | **12** |
| **Rosaceae** | Rose Family | | 1 | | | | **1** |
| **Maloideae** | Apple Sub-Family | 1 | 5 | 2 | 12 | | **20** |
| **Prunoideae** | Plum Sub-Family | | | 1 | | | **1** |
| ***Acer campestre*** | Field Maple | | | 1 | | | **1** |
| ***Viburnum* sp.** | Viburnum | | | | 2 | | **2** |
| **Indet.** | Indeterminate | 11 | 2 | 6 | 3 | 1 | **23** |
| | | | | | | | |
| | **Vitfrified** | 28 | 29 | 15 | 15 | 24 | **111** |
| | **Radial Cracks** | 10 | 11 | 6 | 9 | 16 | **52** |
| | **Post-depositional Sediment** | 9 | 4 | 4 | 4 | 5 | **26** |
| | **Distorted** | 19 | 7 | 15 | 10 | 16 | **67** |
| | **Round wood** | | 3 | 4 | | | **7** |
| | **Knot wood** | 3 | | | 1 | | **4** |

***Table 1: Charcoal identification***

## METALLURGICAL ANALYSIS

### By Luke Barber

The excavations recovered 33,784g of material initially classified as slag/industrial waste from one of 18 individually numbered contexts. This includes 7417g from the evaluation work, with 26,367g coming from the Stage 2 excavation. These totals consist of 27,144g (357 individual pieces) of hand-collected material with the remainder being derived from one of 14 environmental residues. It should be noted that quantification by count was only undertaken for hand-collected material – that from the residues was too small and numerous to make this a realistic or worthwhile exercise. As such, in the current report the medium of weight is the standard quantification cited.

The current report represents an overview of the slag based on visual inspection of general surface and internal morphology of the pieces. The material was sorted into a number of morphologically different slag types for recording, with samples of each being retained for long-term curation for potential future scientific analysis. In addition, the largest or most diagnostic pieces were retained after recording to also be kept with the archive. The retained material is indicated in the archive recording – the remainder of the assemblage was discarded. No scientific analysis or detailed research on comparable waste products was undertaken for the current report but the material was discussed with Sarah Paynter, metallurgist with Historic England. The assemblage has been fully listed by context and type on metallurgical pro forma sheets, which are housed with the archive. The information from these has been used to create an Excel spreadsheet for the digital archive.

Although the assemblage contains a number of different morphological types it all appears to relate to one fairly short-lived period of Middle Iron Age iron working. This theory is confirmed by comparison of the different types of material in the different context/groupings: essentially similar types, whether ore, furnace structure or slag, appear in different functional groupings, including the sealing colluvium. As such the material from different associated deposits, whether directly within the furnace or in the associated rake-outs, has been grouped together and tabulated in Table 2.

| Type | Description | Process | Weight (g) | Comments |
|---|---|---|---|---|
| 1a | Orange to grey silt clay with surface vitrification | Undiagnostic | 14,816 | Parts of furnace super-structure |
| 1b | Orange to grey silt clay with adhering matt grey undiagnostic iron slag | Undiagnostic | 1620 | Parts of furnace |
| 1c | as 1b but no/very little slag | Undiagnostic | 3990 | Burnt clay from furnace |
| 2a | Grey, dense slag with some aeration. Some flow/solidified droplet on surface | Smelting | 3224 | Often very irregular with small runnels |
| 2b | As 2a but more aerated (lightweight) and with some vitrification | Undiagnostic/ Smelting? | 1000 | Often very irregular with small runnels |
| 2c | Grey, aerated (lightweight) in ir-regular runnel/droplet/spherical form. Some pieces a little glassy | Undiagnostic/ Smelting? | 523 | |
| 2d | Matt grey slag seams/patches (amorphous) within burnt clay. Close to 1b | Undiagnostic | 1494 | Close to 1b. Seepage of slag into ground/ furnace |
| 2e | Dark grey/black, well aerated but quite dense | Undiagnostic | 3914 | Merges with 2f |
| 2f | Grey, aerated but with orange/ brown outer margin/surface and occasional charcoal inclusions | Undiagnostic/ Smithing? | 1690 | Possibly smithing waste |
| 3a | Fuel ash slag. Lightweight/aer-ated and vitrified | Undiagnostic | 2 | |
| 4a | Magnetic fines | Undiagnostic/ Ore? | 292 | Granules of 4b and 4c iron concretions/ siltstone too small to classify |
| 4b | Brown/black irregular silty fer-ruginous concretions | Undiagnostic/ Ore? | 496 | Occur naturally in clay but some burnt |
| 4c | Dull red irregular silty ferrugi-nous concretions | Undiagnostic/ Ore? | 256 | Occur naturally in clay but some burnt |
| 5a | Dense Wealden clay ironstone | Ore? | 175 | None burnt |
| 5b | Ferruginous nodules (burnt) with orange-brown outer skin | Ore? | 288 | Roasted ore? |
| 6a | Flake hammerscale | Smithing | 2 | |
| 7a | Clinker (lightweight, matt black and aerated) | Coal-burning waste | 2 | Late post-medieval intrusive material |

***Table 2: Summary of industrial waste***

The type 1 material all appears to relate to badly fragmented pieces of furnace superstructure. These include, those that have been protected from the main heat (Type 1c) as well as pieces with notable burning/vitrification (Type 1a). Most consist of small pieces, often with just one flattened face, but colluvium [102] (G10) produced a notably quantity (14,816g, 1620g and 3990g respectively for T1a, T1b and T1c) including the single largest fragment (3626g). This has heavy vitrification on both its somewhat irregular faces with further burnt clay overlaying the vitrification in one area suggesting a repair or re-use. Two other large pieces were recovered from furnace demolition [6/009] (G5: 1152g and 1754g). The larger has a vitrified concave inner face but has broken mid-point thus losing the original exterior surface, but in so doing, exposing close-set parallel 5mm diameter wattle imprints (some of which are also vitrified). The distance from the inner surface to the wattle marks is some 50mm, suggesting a full wall thickness in the region of 100mm. The smaller piece appears to have the full thickness of the wall, albeit it only measures 50mm wide and presumably from higher on the structure. However, this has a gently convex outer face with no vitrification and a notably vitrified inner concave face. These Type 1a fragments of furnace structure are spread throughout nine different contexts suggesting they either relate to more than one furnace superstructure, have been reworked, or both.

There is a notable variety in morphology within the Type 2 iron slags. The most distinctive is the denser Type 2a material, which is almost certainly from smelting. Although no classic tap slag was recovered this may well be due to the early date of the furnace. At this time molten runnels and protrusions have been noted on dense smelting slags, often in the absence of the classic flow structure of true tap slag (S. Paynter pers comm.). This may be the result of early furnaces not achieving a high enough temperature to allow the slag to flow properly. Although not present in large quantities this slag type is present in 11 different contexts, including rake out material, furnace demolition and colluvium. It was also found in association with all other slag types. The Type 2b and 2c slags are almost certainly related to the Type 2a material, as their morphology is so similar, even if their density is not. However, in isolation they could only be classified as undiagnostic of process even though a notable quantity of Type 2c was recovered from the furnace primary fills (e.g. contexts [6/010] and [142] G4).

The Type 2e and 2f material is slightly different in morphology and could as easily derive from smithing or smelting. Of the two the Type 2f is most like smithing slag with its rusty brown colouration, good aeration and charcoal inclusions, but such morphology can occur in the upper levels of a smelting furnace. This material was only recovered from pit [106], fill [104] (G8), quarry fill [121] (G3) and colluvium [159] (G10) but was always in association with the T2a smelting slag within these deposits. The only definite evidence of smithing was recovered from fill [121] (G3) that produced some 50-100 (2g) fresh hammerscale flakes to 4mm across (again in association with a range of slag types, including T2a smelting). The presence of this material demonstrates at least some primary smithing was occurring on site but, considering hammerscale was only recovered from [121], this must have been very short-lived. Certainly had any significant smithing occurred hammerscale would have been expected in a number of the residues.

The Type 5 material appears to be of ore quality and may represent crushed (T5a) and roasted (T5b) ore accordingly. However, if this Wealden ferruginous siltstone had been the only ore one may have expected to see more of it, though this may be in part a bias caused by on-site collecting. The significant quantities of Type 4 may indicate the use of naturally occurring ferruginous concreted deposits (including bog-iron) on or within the natural clay. The fact that some are notably magnetic and have clearly been subjected to significant heating would support this suggestion but more detailed scientific work would be needed to establish the use and exact source of this material beyond doubt.

Overall it would appear that the remains relate to a badly damaged iron smelting furnace that may have seen a relatively short period of use and utilised more than one source of potential ore. Some primary smithing did occur but this may only been a single episode associated with one particular smelting campaign.

## DISCUSSION

### PERIOD 2

The location of the ore-quarry and furnace at Birchen Lane is typical of the earliest evidence for ore-extraction in the Weald; the earliest ironworkers derived their ore from natural exposures of the mineral in stream banks, digging back into the ground and removing the layers of nodules as required (Hodgkinson 2008, 12).

Analysis of the recovered environmental material indicates the presence of a mixed oak woodland in the vicinity, which would have served as the source of fuel for the furnace. Charcoal recovered from samples of the raked-out deposits within the back-filled quarry indicates that oak was the dominant species selected for fuel, with wood charcoal of the apple sub-family, as well as lesser amounts of hazel and ash, indicating that these species were also intentionally selected.

C14 dates achieved from samples of the furnace demolition layer, recovered during the evaluation excavation, produced calibrated date ranges of 380-200 BC and 370-180 BC for the final use of the bloomery. Two dates were subsequently achieved from furnace rake-out material, excavated during the mitigation excavation, deposited as back-fill within the secondary ore-quarrying cut. These stratigraphically earlier deposits produced calibrated date ranges of 375-203 BC and 360-116 BC, the overlapping dates appear to confirm the short lifespan of the bloomery activity at the site. While furnaces of this date are rare in the archaeological record, a number of broadly contemporary sites have been identified in the wider area. A charcoal sample from a smelting hearth excavated at Tablehurst Farm, Forest Row, *c*.10km northeast of the site, yielded a date between 370 BC and AD 30, which, at a less confident level, could be narrowed down to between the late 3rd to mid-1st century BC (Hodgkinson 2008, 28) and radiocarbon dates from a furnace at Rathlin Road, Crawley, *c*.13km to the northwest, gave a date of 372 BC to 42 BC (Pine 2013). In the wider Weald an increasing number of bloomery sites of similar date have been identified; a recently excavated bloomery furnace at Brokes Wood, Southborough has produced a C14 date of *c*.340 BC (Stapple 2016).

Previous studies have suggested that the earliest furnaces in Britain were of simple non-slag tapping 'bowl furnace' types, which have a westerly distribution and date from *c*.400-100 BC but that the earliest furnaces in the Weald were of the slag-tapping type, with non-slag tapping furnaces absent in the region until the mid-Saxon period (Cleere and Crossley 1995, 39, 52-53). The inspiration for these Wealden slag-tapping types was assumed to have had a Rhineland origin dating from the 1st century BC/AD. However, the smelting slag recovered from the furnace and rake-out deposits at Birchen

Lane indicates that this furnace was of a non-slag-tapping bloomery type, as were the other Early/ Middle Iron Age examples cited above and below.

Recent archaeological work has shown that the earliest evidence for iron working in the southeast, and from Britain in general, is from the Thames Valley region; large quantities of hammerscale and other iron working debris were found in association with two round-house structures dated to the 10th century BC on a site at Hartshill Copse, on the north side of the Kennet Valley, in West Berkshire (Lambrick, Robinson and Dood 2009, 215-218). The iron working evidence from this site is exceptionally early for northwest Europe in general, let alone Britain, and it does not appear to signal the beginning of a continuous, fully fledged, British iron working tradition. Evidence for iron working in the earliest Iron Age is, however, represented in the region by a site at Coopers Farm, Dunston Park, not far from Hartshill Copse, where smithing slag was also recovered from a 7th century BC pit (*ibid.*).

Closer to the site, early iron working is evidenced, to the northwest of the Weald, by the iron working settlement at Brooklands, Weybridge, which is dated to the 6th or 5th century BC (Hodgkinson 2004). An Early to Middle Iron Age settlement with associated metal-working debris, but no *in situ* structural remains of furnaces or hearths, has been excavated at St. Ann's Heath School, Virginia Water (Lambert *et al* 2013) and a number of Middle Iron Age iron working sites have been recorded in the Surrey and Hampshire region. To the northeast of the Weald, on the chalk downlands of Kent, at Canterbury Road, Hawkinge, metal-working waste associated with both bronze-working and iron-smelting was found in association with the remains of probable furnaces, which have been dated on pottery evidence to *c.* 550-350 BC (Paynter 2000; Dawkes, in prep.). A potentially Early Iron Age smelting-site has recently been investigated within the Weald itself; trial investigations into the slag heap of a bloomery site in Cullinghurst Wood, Hartfield, *c.*16km northeast of the site, produced a calibrated date range of 750-350 BC (Hodgkinson 2008, 28).

In addition, possible evidence for western British influence on Wealden metallurgical processes may be supported by an unusual structure, excavated at Wickhurst Green, Broadbridge Heath *c.*15km west of the site (Margetts 2018, 55-8); this structure comprised a spiral-shaped gulley, enclosing a small post-built structure, which contained quantities of fired-clay and fuel ash slag. This feature was dated to 400-200 cal BC. The strongest parallels for this structure were with the so called 'snail-shaped' smithy buildings of North Wales, particularly that at Bryn y Castell, Gwynedd, the earliest phase of which returned an initial date of 230 ± 100 BC, which was later revised to 320 ± 110 BC (*ibid.*).

The metalworking processes identified at Birchen Lane consisted, for the most part, of the extraction of iron ore from the stream bank and the smelting of that ore into bloom. Metallurgical waste recovered from the latest rake-out in-fill deposit from the G3 quarry and from the fill of the G8 pit, indicates that some primary smithing was taking place on-site towards the end of this phase of activity. It seems clear that for the majority of the bloomery's period of use the blooms were taken elsewhere for further processing or that it was stored prior to smithing at the end of the smelting season(s). Evidence of further metal-working activity in the vicinity of the site has been identified at Gravelye Lane, *c.*2km to the southwest, where evaluation excavations identified a number of broad, shallow pit features, displaying evidence of *in-situ* burning. One of these produced a piece of probable smithing slag (Nicholls 2014). These pits were morphologically similar to the G8 pit and samples of hazel/ alder and oak charcoal, recovered from the fill of one pit, returned date ranges of 340-50 BC and 390-205 BC respectively. This indicates broad contemporaneity with the bloomery at Birchen Lane.

### PERIOD 3

The Middle/Late Iron Age sherds recovered from the colluvium layer, which sealed the furnace demolition deposits, represent the latest artefactual material recovered from this colluvial layer and suggest that it had started to form by the later 2nd century BC. This indicates that metal-working had ceased on-site by that date. No evidence of Later Iron Age, Romano-British or Saxon/early medieval activity was identified during the evaluation or mitigation excavations, suggesting that the site was not settled or exploited for agricultural purposes until the later medieval period.

## CONCLUSION

The metal working site at Birchen Lane appears to have had a short lifespan, perhaps two seasons and was in use somewhere between the earlier 4th to end of the 3rd centuries BC. The site was chosen to exploit riverine iron ore seams and the surrounding oak woodland for fuel. Aside from the exposed ore seam in the river bank the metal workers may have utilised other ore sources from naturally reworked deposits on/very near the site; the presence of a buried peat horizon in the eastern part of the valley could indicate the presence of bog iron deposits. Limited on-site primary smithing also occurred, but this activity appears to have been associated only with the final use of the furnace.

This site adds to the growing evidence that the natural resources of the weald were being exploited as part of Middle Iron Age metalworking industry, which preceded the continentally inspired Late Iron Age/ Early Roman slag-tapping furnaces in the region. Furthermore; evidence from other sites in the region, such as Wickhurst Green, suggests that this Wealden Iron Age industry was part of a broader multi-regional British Iron Age metalworking tradition with its origins in the Thames Valley

## ACKNOWLEDGEMENTS

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# EXCAVATIONS AT HUGGETT'S FARM, BUXTED, EAST SUSSEX 1978-90

*Shiela Broomfield*

In some ways this is the story of the wrong way to excavate and record. The technology of today would have been such a help but I have had to make do with what I have for writing a report so the following attempt has many imperfections for which I apologise. Hindsight is a wonderful concept but not very useful in this instance.

The site lies near to the boundary of Huggett's Farm and Greenhurst Farm in an area known as the Rough at TQ 503251 at a height of approximately 60m and lies close to the boundary of a number of different geological formations. These are Ardingly Sandstone, Tunbridge Well Sand, Grinstead Clay, Wadhurst Clay and Ashdown Beds. The excavation was undertaken after ploughing had revealed large quantities of medieval and post-medieval pottery, and iron slag. In view of its proximity to Greenhurst Farm (where there are no discernible medieval remains) it had been suggested that this site may be that of the lost *vill* or *villata* of Greenhurst for which there are various 13th century documentary references.[1]

The excavation was undertaken on behalf of the Wealden Iron Research Group and was initially directed by Andrew Webster and Dr Anthony Streeten, under the auspices of the Garden Hill Excavation Group, from approximately 1978. Unfortunately the early excavation records are fairly rudimentary with no site plans. This proved even more unsatisfactory when both Mr Webster and Dr Streeten moved away from the area in around 1980 and the Garden Hill Excavation Group decided that, as it had no other volunteers willing to further the project, it would withdraw any further assistance. The excavation was then jointly directed by Mrs Dot Meades (who with her husband owned the farm and the site at the time of the excavation)

1. M. Holgate, 'Manors of the Archbishops in Sussex', *Sussex Archaeological Collections* (*SxAC*), **68** (1927), 271; B.C Redwood and A. E. Wilson (eds.), *Custumals of Sussex Manors of the Archbishop of Canterbury, 1285-1330* (Lewes, Sussex Record Society **57**, 1958); A. E. Wilson, 'Farming in Sussex in the Middle Ages', *SxAC*, **97** (1959), 101, 107, 116.

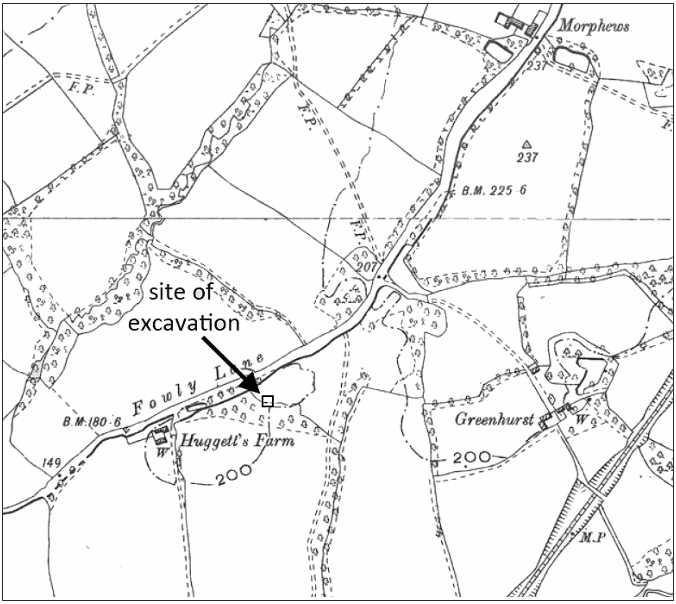


***Figure 1: Location of Huggett's excavation***
***(detail of Ordnance Survey 6 in. map: Sussex XXVIII.NW, 1899)***

and myself, with invaluable help from the late Fred and Margaret Tebbutt, many members of WIRG, the Tonbridge Historical Society and others.

These early excavations had revealed under a slag path obvious evidence of some sort of dwelling that had, in all probability, been burnt as there was a great deal of burnt daub and clay as well as many small sherds of pottery. Some stones indicating a wall had been found with no evidence of foundations – typical for a 13/14th century building. An area which had been interpreted as a ditch or very large pit needed more investigation as pottery, slag, burnt stone, small pieces of glass and iron nails had been found. The majority of this was in squares 21, 22, 31 and 30 which is why we concentrated most of the subsequent excavation in this area.

After the Garden Hill Excavation Group had left, excavation still took place on a monthly basis. This was found to be unsatisfactory as the condition of the site deteriorated in the intervening weeks meaning that most of the time was spent clearing back the vegetation to ascertain what had already been done. More squares were opened up with the intention of finding the extent

***Figure 2: Excavating at Huggett's***

of various features such as the supposed walls, ditch and other soil changes.

We then decided that it would be more satisfactory for the site and the band of dedicated diggers to excavate during two to three planned continuous weeks in the summer. This started in 1985 but was much hampered by torrential rain which fell for ten out of the fourteen days. In spite of this some progress was made by roofing one square with a plastic sheet held up by yacht masts, and constructed mostly by Tony Meades, so that some work could be done in quite challenging conditions.

## Excavations in 1985

By the end of the excavations in 1985 three 5-metre squares (21, 30 and 31) had been re-opened, revealing pottery, slag, burnt stone, small pieces of glass and iron nails as previously found but included what appeared to be the base of a wall with an adjacent burnt area, possibly the remains of a hearth or oven. The wall ran in the direction of a large pit whose full extent was not found. At this stage the pit appeared to be linear and at some time had been filled and then recut at a higher level.

Turf was removed from this square by Manpower Service Commission helpers working for East Sussex County Council. The square was then trowelled revealing pottery sherds of a possible medieval date, iron nails, tile, brick, chalk and quantities of charcoal and burnt daub/baked clay, flint pebbles, slag and iron in the plough soil and upper layers.

Work then began on the cross section across the possible ditch area. The rough section between two of the squares revealed clay with stones and intrusions of darker soil. Between each stone were smaller stones, possibly the remains of degraded sandstone and areas of grey plastic clay.

Initially, part of the filling of the recut pit was removed. This consisted of a mixture of yellow and whitish clay in which there were stones and small inclusions of silt but no finds. At the bottom and to the sides of this clay filling were some large flat stones, nails and a scattering of pottery and glass fragments. An unidentified iron object was found in the east side of the pit. Finally the wet weather forced an early finish and the open excavation was covered with black plastic with the hope of stopping too much weed growth.

## Excavations in 1986

The 1986 season proved kinder and better progress was made. The excavation was uncovered, cleaned and trowelled so that we could try to ascertain what had been revealed previously. Work continued on the cross-section, revealing more flat stones on the silt at the bottom of the clay filling and signs of a gradual rise in level towards the surface. A large animal hole also appeared in the cross-section. After planning we were unable to confirm the definite plan of a building as the supposed foundation trenches proved almost impossible to verify from excavation although I have included them.

Pottery sherds excavated in 1985 and 1986 were examined by Anthony Streeten who, referencing his work at Bayham Abbey,[2] reported that they covered a period from the 13th to 17th centuries with lesser quantities of 18th century wares.

## Excavations in 1989 and 1990

Owing to a change in circumstance for both Dot Meades and myself that precluded either of us having the time to supervise the work adequately nothing was done until a small group did some further work in 1989 as it had been thought that there were some possible postholes associated with a

2. A. Streeten, *Bayham Abbey: Recent Research, including a report on excavations (1973-76) directed by Helen Sutermeister* (Lewes, Sussex Archaeological Society Monograph **2**, 1983).

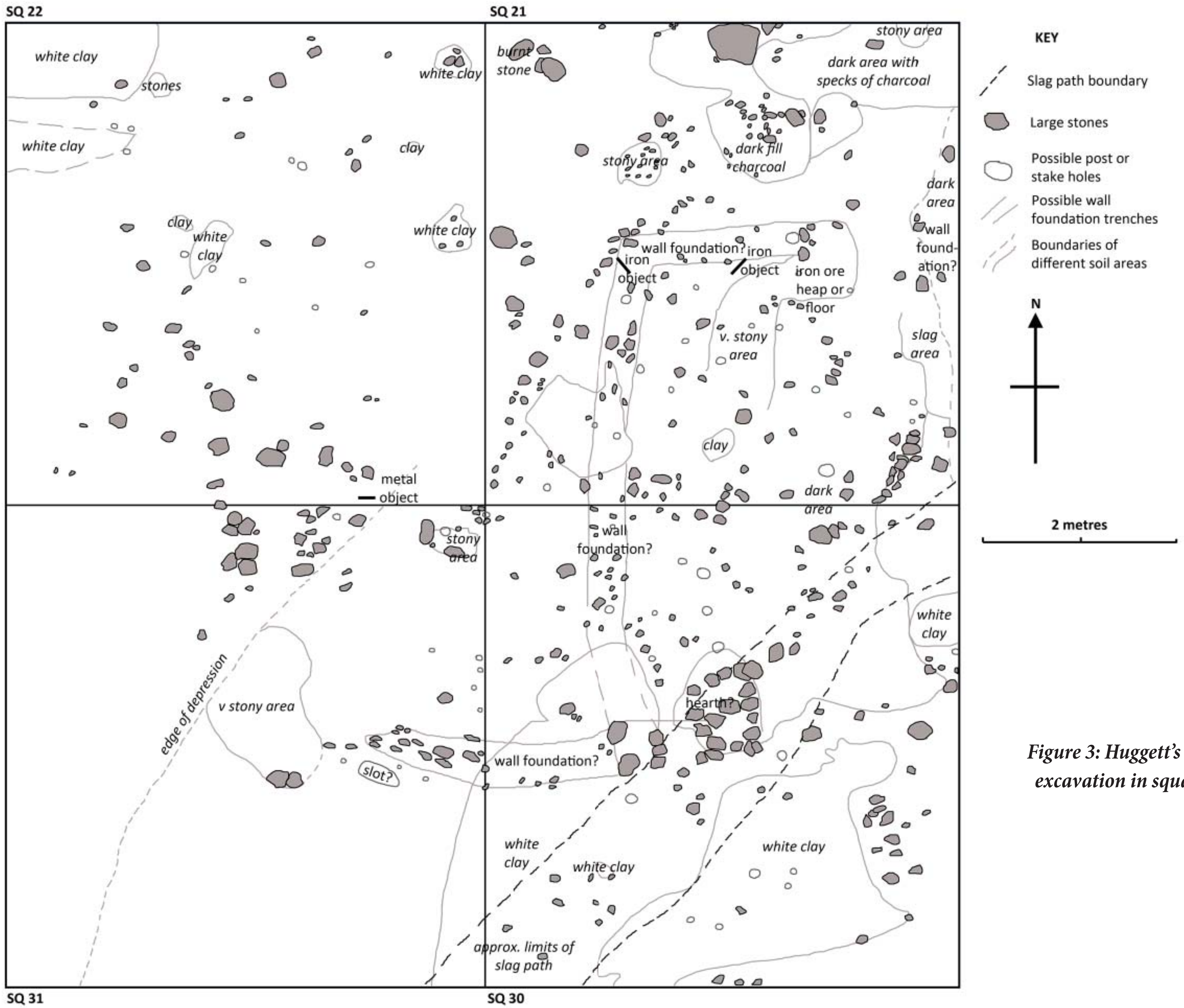


*Figure 3: Huggett's Farm, Buxted; plan of excavation in squares 21, 22, 30 and 31*

scattering of iron nails. This was impossible to confirm because of so much disturbance. A trench was dug which did confirm that once the plough soil had been removed we were down on clay subsoil.

We returned in 1990, when it was decided to try to finish the excavation and a small band of diggers met to do so. This meant that much time was spent in clearing vegetation before any real excavation could be started. Once this had been done and no further conclusions had been reached we decided to open another trench (13, adjacent to 21) in the hope that this would help. In fact after removal of the top soil to the clay subsoil with various unstratified finds of slag, pottery, glass and brick no further features were revealed A further trench was opened which did reveal the continuation of the slag path and more stones. The many stone scatters appeared to be random.

This was the final phase of any excavation on the site as the farm and land was sold and the new owners did not want any further investigations to be undertaken.

## Discussion

In conclusion the site was very enigmatic – obviously it had been a dwelling of some sort confirmed by the finds from a fairly wide date span from the 13th to 17th centuries with some from the 18th century. No firm interpretation or plan could be arrived at and no definite reference to any aspects of the iron industry was found although a bloomery had been noted by Fred Tebbutt close by at TQ 504251, a possible source for the slag.[3] A fairly large amount of slag was found but this was mainly from the slag path so was probably taken from various locations to enable this path to be constructed for ease of access. This did include a very small number of pieces of tap slag although the source was not recorded. The large amount of burnt clay and daub pointed to the possible dwelling being destroyed by fire at some point. Extensive searches have found nothing to date the existing farmhouse – I assumed that it was constructed when the site at the Rough had been abandoned possibly because of a fire as much burnt material such as daub was found on site.

## Acknowledgements

I am very grateful to the late Dot Meades (obit. *WIRG Newsletter 65*, Spring 2017) and the loyal band of diggers – many of whom are also no longer

3. C. F. Tebbutt, 'Wealden bloomery smelting furnaces', *SxAC*, **119** (1981), 60.

with us. I am not going to name them as I am sure I would miss some out inadvertently. I am also grateful for the Margary Grant given to us by the Sussex Archaeological Society which enabled us to have the very useful and comprehensive report on the pottery and other small finds which follows.

## THE FINDS

(For full reports with details of fabrics and tabular analysis see www.wealdeniron.org.uk/wp-content/uploads/2020/05/Huggetts-finds.pdf)

### POTTERY by Luke Barber

The assemblage is dominated by medieval material which accounts for 81.5% by number of sherds though most is represented by small sherds (average sherd size is 6.2g). The earliest appears to be of probable late 11th or 12th century date though these are never present in large quantities. Unfortunately the lack of diagnostic rims make closer dating impossible. Shell tempered wares are known from Bayham Abbey though only in small quantities (Streeten 1983). Of interest is the absence of flint tempered wares at Bayham but their presence at the present site. Although this may reflect the current site's more southerly position it may simply be the first occupation at Huggett's Farm was considerably earlier than that at Bayham This early material is confined to a plain unglazed cooking pot.

The bulk of the medieval pottery relates to occupation spanning the late 12th/early 13th to 14th centuries. During this period there were a number of fabrics. The late 12th to 13th century coarsewares are probably dominated by the sandy wares with some flint or shell inclusions, with the medium sand tempered wares gaining dominance toward the end of the 13th and into the 14th centuries. The finer sand tempered sherds, which predominantly relate to fineware jugs, could span the 13th to 14th centuries. The source of most of this material is probably from local, as yet undiscovered, kilns in the Weald. However, jugs possible from Streat, Rye and Ringmer appear to be represented and some very similar to 'Winchelsea Black' (Barton 1979, 118-20). This fabric was well represented at the aisled hall at Salehurst (Gardiner, Jones and Martin 1991, 92). A typical range of vessels appears to be represented: the assemblage is dominated by cooking pots, though glazed jugs are also quite well represented. With the exception of a skillet no other forms were recognised. Only two imported French 'Saintonge' sherds were present though they appear to be from two different jugs. This lack of imports is not a reflection of the site's status but the limited trade networks of the central Weald in the medieval period. Similar low quantities of imported medieval material were noted at Bayham and other sites (Streeten 1983, 99).

There is a notable decrease in the quantity of pottery of the late 14th to early 16th centuries (8.7% of the overall assemblage) though the site was obviously still occupied during this period. The decrease may in part be due to the effects of the plague and/or the increase in the use of metal, rather than ceramic, vessels. The range of fabrics and forms is typical of the somewhat utilitarian assemblages of this period. Likely sources of pottery are the kilns at Lower Parrock and Boreham Street though some Rye material may also be present. Larger less abraded sherds would be needed to be more certain of source.

The true post-medieval assemblage accounts for 9.8% of the overall assemblage though by far the majority of this material predated the 18th century. The site was obviously still occupied during the 16th to 17th centuries: by now the lesser amounts of pottery are certainly the result of an increase in metal vessels. Though the assemblage is small and somewhat spread between contexts, the majority coming from topsoil or subsoil layers, it demonstrates the increase in trade contacts for the Weald during this period. As well as Wealden and regional wares a notable amount of imported material is present from both France, but more notably from the Rhineland. A similar opening up of trade was also noted at Bayham (Streeten 1983). The post 1700 material is only represented by very few sherds which could be interpreted as simply a background scatter. As such, domestic occupation at the site probably ceased at some time in the mid to late 17th century.

## CLAY PIPES by Luke Barber

The excavations produced 13 pieces of clay pipe (60g) from nine different contexts. With the exception of three bowl fragments, all are from plain stems. The material appears to be predominantly of the second half of the 17th century although some of the stems could be of 18th century date. With the exception of one probably intrusive piece (Square 30, Context 4) all are from the topsoil/subsoil.

## CERAMIC BUILDING MATERIAL by Luke Barber

Some 167 abraded pieces of brick and tile, weighing a little under 4.9kg were recovered from 15 individually labelled contexts. The whole assemblage has been listed for archive on post-Roman tile record forms.

The majority of the assemblage is composed of fragments of early post-medieval peg tiles though some brick, mainly of late post-medieval date, is also present. Virtually all the material is in unstratified deposits and no definite medieval material is present. As a result it appears that tile was probably not used at the site until the 16th century with thatch being used during the medieval period.

## BURNT CLAY by Luke Barber

The excavations produced 289 pieces of burnt clay, weighing just over 2.1kg, from 27 individually labelled contexts. All material has been listed in the archive. Although virtually all of the material consists of amorphous lumps it is quite probable that much of it represents daub from a building or oven structure. This suspicion is strengthened by the presence of a number of pieces with flattened faces from Feature 2 (Square 21).

## METALWORK by Luke Barber

The excavations yielded 135 pieces of metalwork from 23 individually recorded contexts. Of these 129 consist of iron, five are of copper alloy and one is of lead. Although items in the latter two metals are in good condition all the ironwork was in very poor condition with heavy mineralisation and concretion. As a result most was discarded after recording on metalwork record sheets. Virtually all the metalwork is from unsealed/unstratified contexts: only 28 items are from contexts which could be considered 'stratified' and of these, excluding nails, only one is diagnostic of function.

The ironwork is dominated by general purpose nails which total 97 examples. The remainder of the ironwork can be divided between unidentified objects/fragments (totalling 20 pieces including binding strips) and recognisable objects: 12 examples. The latter group is dominated by bolts etc, often of late post-medieval date. One horse-shoe fragment is present along with a possible medieval tanged triangular arrowhead (Topsoil in Square 29). The closest parallel is a 13th-century example from Dyserth Castle, Flint (London Museum 1940, Type 17). The Huggetts Farm example presumably represents woodland hunting. The only other ironwork of interest are two tapering hinge pivots to secure doors or window shutters to wooden frames (Square 29, Context 1 and Square 30, Context 4). These are well known from medieval and early post-medieval sites (Margeson 1993, Nos 1149-1159). The diagnostic non-ferrous material is all from unsealed contexts. Copper alloy items include a 17th-century tinned spoon bowl (u/s) and a 19th-century pin-fire shotgun cartridge (Square 22, Layer 2). The single piece of lead is a cylindrical 44mm-high, 500g centrally-pierced weight, possibly for a loom (Square 21, Layer 2).

## GLASS by Luke Barber

The glass assemblage consists of 189 pieces (310g) from 17 different contexts. Most of the material is in good condition, though highly fragmentary: the average weight per sherd is only 1.6g. The glass is of two periods. The first, and by far the larger, relates to the mid 16th to mid/late 17th centuries. This assemblage consists of pale blue and blue-green window and beaker glass but is dominated by fine bottles of square, cylindrical or octagonal form typical of the period. Fragments of a moulded beaker were located in three different contexts showing the degree of mixing and re-working at the site. The second period, represented by only a few pieces, spans the late 17th/ early 18th to early/mid 19th centuries. This group is dominated by green wine bottles, and later brown beer bottles, although a little clear window glass is also present. Unfortunately the glass is usually always in 'unstratified' contexts, or probably intrusive into medieval ones, however, its presence does complement that of the ceramics in showing the domestic items in use in the early post-medieval period. A full list of the glass is housed with the archive.

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**Streeten, A., 1983**, *Bayham Abbey : Recent Research, including a report on excavations (1973-76) directed by Helen Sutermeister* (Lewes, Sussex Archaeological Society Monograph **2)**.

# FOR 'DARFOLD' READ PASHLEY

*J. S. Hodgkinson*

Ernest Straker identified a furnace that lay next to the River Lymden near Burgham Farm in Etchingham, naming it 'Darfold', or 'Echingham Furnace'.[1] Darfold is an earlier spelling of Darvel or Darwell, and Phyllis White and subsequently Cleere and Crossley have convincingly argued that he had mistakenly attributed to this furnace early records which should have been associated with Darwell Furnace in Mountfield.[2] While Etchingham Furnace would be an appropriate name for the Burgham site, Darfold clearly is not, but 'Etchingham Furnace' has apparently left no documentary record. So what should the Burgham site be called, and can any of its operating history be described?

The sixteenth-century evidence in the State Papers for these sites in Etchingham and Mountfield consists of six lists of ironworks and their owners and occupiers drawn up in 1574 following Ralph Hogge's complaint. These have been the subject of several studies, the most recent being that of Teesdale.[3] The first list has entries as follows:

> *Sr Robt Tirwight, one forge and one furnace in Echingham in the hands of Glede*
>
> *Thos Maye, one forge in Echingham*
>
> *Tho: Glyde, a furnace called Darfolde and Echingham forge*[4]

Sir Robert Tyrwhitt's works and Thomas Glidd's are a repetition, one of the other, Tyrwhitt being the owner and Glidd the operator, but the implication is that their works were in Etchingham. The same entries appear in a different hand in the second list, except that Thomas May is accorded a furnace not

1. TQ 7018 2804; E. Straker, *Wealden Iron* (London, Bell, 1931), 297.

2. W. P. White, 'Darvel Furnace - a note', *Wealden Iron*, 1st ser., **9** (1976), 18; H. Cleere and D. Crossley, *The Iron Industry of the Weald* (Cardiff, Merton Priory Press, 1995), 327-328.

3. E. Teesdale, 'The 1574 lists of ironworks in the Weald: a re-examination', *Wealden Iron*, 2nd ser., **6** (1986), 7-41.

4. The National Archives (hereafter TNA), SP 12/95/20 ff.49, 49v and 50v.

a forge in Etchingham.[5] A third list repeats the same information but omits mention of Sir Robert Tyrwhitt's ownership of Glidd's works.[6] A fourth list gives rather fuller information on the same people and clarifies the locations of Glidd's furnace and forge: [7]

> *Thomªs Glidd the yonger of Burwash… farmeth one forge and a furniss the forge being in Echingham and the furniss in Mondfeld of Sir Robt Terwitt knight. More the said Thomªs occupieth one furniss of my Ld Dacre being in the pishe of Hersemonser called Clipperham furnisse*
>
> *Thomªs May of Winchelsey hath one furness in Echingham*

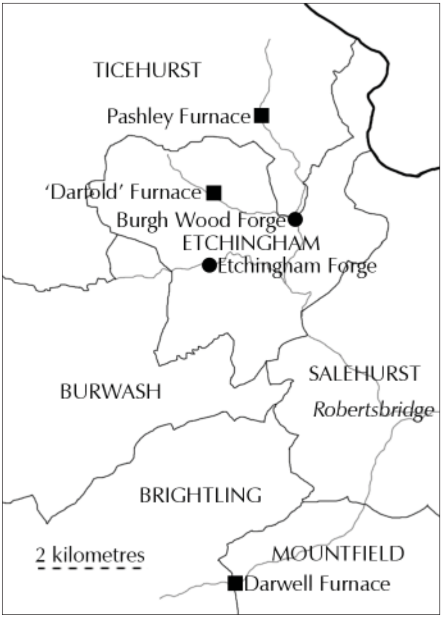



***Figure 1: Map showing ironworks mentioned in the text.***

The fifth list is a copy of the first list.[8] The sixth list has 'Thomas Glidd a furnace called Darfold and Itchingham forge' but omits Thomas May's works entirely.[9] Duplicates of the first three lists are also to be found in the Stowe manuscripts at the British Library.[10] Because some of the 1574 lists misleadingly refer to both of the works of Tyrwhitt/Glidd as being in Etchingham it is easy to see why Straker assigned the furnace he called Darfold to the Burgham Farm site.

From these lists two ironmasters stand out: Thomas Glidd, who was working Darwell Furnace in Mountfield and Etchingham Forge, both owned by Sir Robert

5. TNA, SP 12/95/21 f.51.
6. TNA, SP 12/95/61 ff.131v and 132.
7. TNA, SP 12/95/79 ff.176 and 177v.
8. TNA, SP 12/96 ff.112-113.
9. TNA, SP 12/96 f.113v.
10. British Library, Stowe MS, 570 f.103.

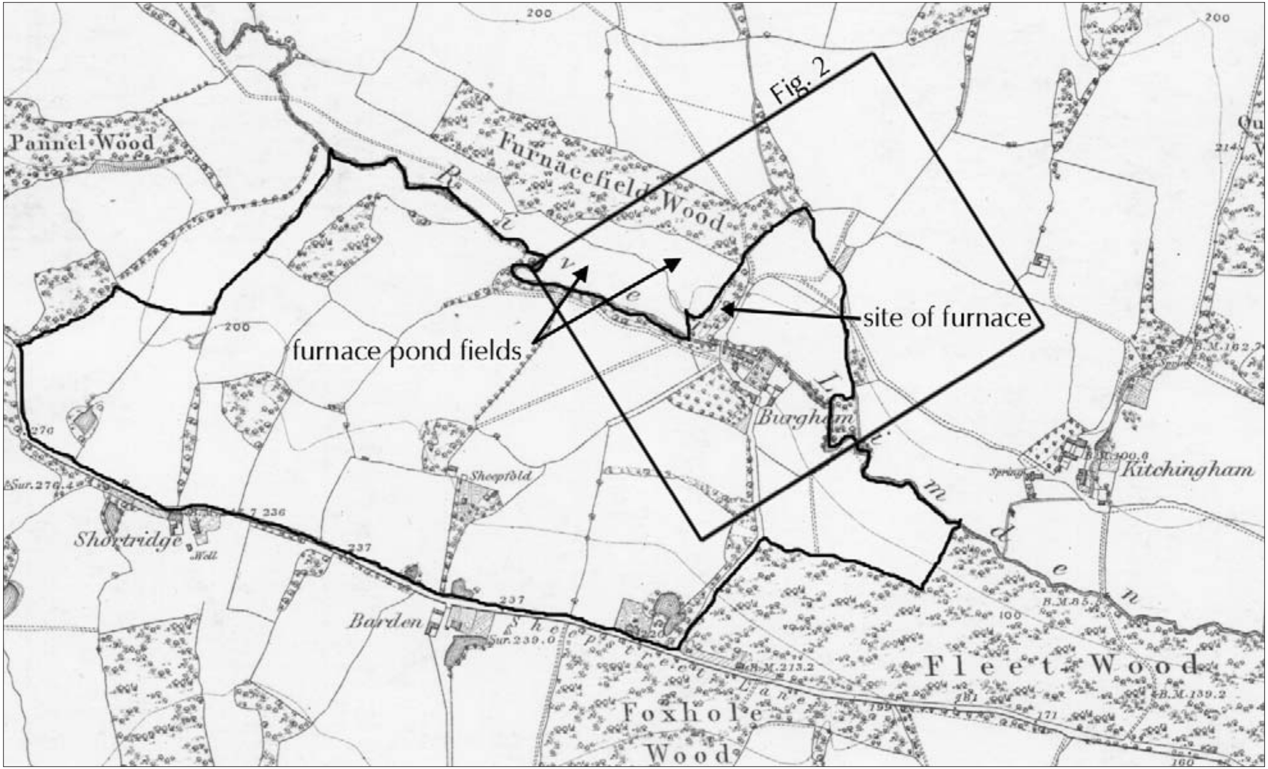



***Figure 2: Map showing the bounds of Burkham in 1597, based on Vivian, 1953, maps A4, A5 (pp. 233-4), B4 and B5 (pp. 238-9). Detail of Ordnance Survey 1st ed. 6in. map, Sussex XXX, 1878. The rectangle shows the approximate outline of the map shown in Figure 3.***

Tyrwhitt as per a lease of 1568;[11] and Thomas May who operated a furnace in Etchingham, though in one list it was referred to as a forge (Fig. 1). However, Thomas May has become associated with the furnace (and forge) in Ticehurst parish named from, and lying to the northeast of, his house and estate at Pashley, and not with a furnace in Etchingham.[12] May's father, also Thomas, had purchased the manor of Pashley from Sir James Boleyn, uncle of the late queen, in 1540. It included an iron furnace 'with eight acres of land covered with water'.[13] All of the 1574 lists put Thomas May's ironworks in Etchingham parish, not Ticehurst, and this is reinforced in a survey of the manor of Etchingham and Salehurst of 1597 which included a property called *Burkham and Younge Woods* that corresponds to the modern Burgham Farm and land to the south and west of it (Fig. 2). The relevant text in the survey describes the property as containing 70 acres of meadow, pasture and wood and, significantly,

> '*adioyninge to the Lords woodd called Feetwoodd, <u>and Mr Mayes Furnis called Paslye Furnis</u>*'.[14]

The two fields immediately upstream from the Burgham pond bay, numbered 201 and 203 on the Ordnance Survey 25in. map (Sussex XXX), and indicated on Fig. 2, cover 4·69 and 3·379 acres respectively, which total 8·069 acres.

A 1754 map of Burgham and the neighbouring property called Kitchingham (Fig. 3), both then owned by Francis May as part of his Pashley Estate, shows the site of the furnace and its adjoining 'Cinderbanks' but a piece of land which would have corresponded to the working area of the furnace is excluded from the parcels of land coloured on the map as part of the Burgham property, although it is indicated that it was part of either Wardsbrook Farm or Gibsreed Farm, other properties then belonging to the Mays.[15] Wardsbrook, which is delineated on a splendidly coloured map of 1612 and did not extend as far east as Burgham, was purchased by Anthony

11. East Sussex Record Office, Brighton (hereafter ESRO), DUN 14/1.
12. TQ 710295; Cleere and Crossley, *Iron Industry*, 349.
13. ESRO, AMS 7002/1/1/3.
14. S. Vivian, *The Manor of Etchingham and Salehurst* (Lewes, Sussex Record Society vol. **53**, 1953), 144.
15. ESRO, AMS6681/1.


***Figure 3: Detail of a map of Kitchenham and Birkham Farms, Etchingham, belonging to Pashley: the estate of Francis May Esq, by T. Redford, 1754; East Sussex Record Office, AMS6681/1, reproduced by permission.***

May in 1630, so the furnace was presumably part of Gibsreed.[16]

This would seem to confirm that the furnace referred to in the survey of 1597 was adjoining, but not part of, the Burgham property. What this shows clearly is that in that year, and presumably in 1574, this ironworking site was being called Pashley Furnace. This leaves a question mark over the identity of the furnace hitherto called Pashley, the location of which could not remotely be described as adjoining the Burgham property.

In the subsidy roll of 1524 for Shoyswell hundred, foreigners had been listed in the borough of Pashley but without any indication of who they were working for, nor with a clear definition of the boundaries of the borough.[17]

16. ESRO, SAS/CO 5/2; AMS 7002/1/16.

17. B. G. Awty, *Adventure in Iron* (Tonbridge, Wealden Iron Research Group, 2019), 827.

However, in the subsidies in the late 1540s and early 50s workers for Thomas May were being listed in Shoyswell, and in the Portsmen's complaint of 1548 'the iron mill of Etchingham' and 'the iron mill of Paschely' were among those singled out as potentially consuming large amounts of wood to the detriment of the seaborne trade in timber to the English ports in northern France.[18] It was stated that they were, respectively, within five and four miles of the salt water. The bed of the River Rother is below the mean high tide level up as far as Bodiam,[19] but that is further than five miles distant from either of those ironworks, so the claim was an exaggeration and does not help distinguish between the two Pashley sites. Furthermore, both ironworks were in Shoyswell hundred so it is impossible to distinguish between them on that basis either.

In 1611 there is a reference in a deposition in the Archdeaconry Court of Lewes to the furnace in Etchingham belonging to Anthony May, who was the great-grandson of the Thomas May who had acquired the furnace from Sir James Boleyn.[20] In the last reference to Anthony May's ironworks, in a settlement on his marriage in 1614, two iron mills are mentioned,[21] and the 'eight acres covered by water', but no parishes are specified.[22] Was the ironworks to the north-east of the May's seat at Pashley which, from the evidence of slag, incorporated both a furnace and a forge, Anthony May's other iron mill?

Another ironworks in Etchingham possibly associated with Anthony May is Burgh Wood Forge (TQ 7170 2755), which had belonged to John Fowle of Kitchingham in 1542.[23] It lay in the eastern part of Fowle's property which

18. Straker, *Wealden Iron*, 114.

19. J. Eddison, '"Drowned Lands": Changes in the Course of the Rother and its Estuary and Associated Drainage Problems, 1635-1737', in J. Eddison and C. P. Green (eds.), *Romney Marsh: evolution, occupation, reclamation* (Oxford University Committee for Archaeology Monograph **24**, 1988), 142.

20. B. Phillips, 'References to Ironworks in Records at the Sussex Record Offices', *Wealden Iron*, 2nd ser., **5** (1985), 41.

21. The term 'iron mill' was customarily used to embrace a forge with the furnace that supplied it, but it was often used less precisely to mean a furnace or a forge, and it should not be assumed that the term has been used uniformly in the different documents quoted.

22. ESRO, AMS 7002/1/1/6.

23. A. Dalton, 'Burgh Wood Forge, Etchingham', *Wealden Iron*, 2nd ser., **17** (1997), 40-5.

remained in the hands of his descendants until 1695 when it was purchased by the Mays. The western part of Kitchingham was already in Anthony May's possession on his death in 1636, but he was also seized of an annuity from the eastern part of the property, suggesting it may have been mortgaged to him and offering the possibility that his interest might have included a lease of the forge before then.[24] The map of 1754 shows that the forge was in May ownership then, although the absence of buildings at the forge site indicates that it was no longer in operation, and had probably been so for some considerable time.

In conclusion, documentary evidence points to Pashley Furnace originally being Straker's 'Darfold' site at Burgham in Etchingham, and not in Ticehurst. Some time before 1636 the ironworks north-east of Pashley, in Ticehurst parish, would seem to have been constructed but evidence of its operation, and by what name it was known, is wanting. It is somewhat extraordinary that with all the documentary evidence pointing to Thomas May's Pashley Furnace being in Etchingham successive writers have placed it in Ticehurst. This writer suggests that the Burgham site be renamed Pashley Old Furnace and the existing Pashley site, Pashley New Furnace and Forge.

I am grateful to Christopher Whittick for commenting on an earlier draft of this article.

24. Vivian, *Manor of Etchingham*, 195, 237 Map B3.

# EXAMINATION OF ORE SAMPLES FROM HORAM MINE PITS, EAST SUSSEX

*Alan F. Davies*

## Introduction

Simon Stevens, Senior Archaeologist with Archaeology South-East, and WIRG member, has provided some background details of a recent archaeological study of a site at Horebeech Lane in Horam in the Weald of East Sussex. This archaeological work has revealed a landscape pockmarked with more than a thousand minepits from the former extraction of iron ore. Whilst not yet fully proven, this mining activity is presumed to be post-medieval and thought to be associated with the nearby Heathfield Furnace. Even so, some site slag and furnace debris show clear evidence of Romano-British smelting. However, apart for some shafts, there is neither evidence of Roman quarrying nor of a furnace location.

This analytical study of ore samples is part of the wider archaeological excavation before the land is redeveloped. Simon Stevens has commented that in, this respect, the only consistent factor at the site is how inconsistent the ore seams are across the excavated area, a problem made worse by the skill of the ore miners in removing so much of the material and yet leaving so little on the edges of their workings. Added to these factors, the builders placed restrictions on which areas could be excavated to depth and sampled.


*Figure 1: Site plan*

Shown in Figure 1 is part of the site with the three sample pits circled. In total 12kg of lump ore from the edges of these mine pits have been provided for analyses. These lump ore samples comprise ten separate bags of ore with each bag marked with a source mine pit code (1101, 902 or 438) and the ore mined depth in metres.

## Aims of the Investigation

These are to:

- Assess the consistency of the ore specifications across the pits
- Establish the smelting suitability of different pit deposits
- Comment whether the ores are more suitable for either blast furnace or bloomery use
- Assess whether these pits supplied ore to Fuller's Heathfield furnace.

### Conditions of Ore Samples Provided

Of the ten samples supplied Figure 2 shows typical examples of ore types and conditions:

***Figure 2: Examples of some ore samples from pits***

### External Characteristics of Ore Samples

- All ores are encrusted with varying thicknesses, and many spalling sections, of brown limonite over a brown limonite core or, for several, some grey or light-yellow core siderite
- Many show layering structures from variable geological strata deposition conditions. Likewise, many are encrusted with a strata layer of small *cyrena* clam shell fossils and fragments co-deposited in a limonite matrix
- Several surfaces of bulk limonite samples are covered with dried mud mixed with *cyrena* shells.

These general features show siderite ore formation during the early part of the

Lower Cretaceous period in the Wadhurst Clay of the Hastings Beds. There is abundant evidence of freshwater *cyrena* bivalve clam fossils deposited in thinner strata, either before, co-deposited or after multiple strata formations of siderite within interbedded brackish swamps, lagoonal muds and alluvial channel sands.

Whilst siderite ore mineral is naturally grey, most samples exhibit a through thickness conversion to brown limonite mineral. Siderite converts to limonite through exposure to air and water over time.

Initial limonite shows as yellow goethite mineral and is seen in some samples as a transition layer close to core siderite. Thereafter the ores transition progressively into variations of darker brown limonites and iron content. Calcining a mined ore before furnace reduction will convert iron minerals to ferric oxide of 70% iron content. This iron value will be reflected in the actual calcined ore grade according to the balance of gangue mineral contents.

### Validity of Ore Conditions

The presence of significant limonite ore raises a question as to the extent that these Horam ore samples represent the conditions at the time of Fuller during the mid-18th century. Mined siderite from other Wealden locations usually shows a higher proportion of grey core siderite mineral with much less crustal brown limonite. These two features still indicate long time burial but with very limited air and water ingress to initiate limonites formation. So it is speculated that historical widespread intensive pit mining at the current Horam site broke up and aerated to depth a large area of the locality. Even with mine pit back-filling, weathering processes still had relatively easier access to alter residual siderite ore to limonite, which now forms part of this study.

## Mineral Analyses

Limonite layers spalled easily to provide specimens for analysis whereas ores with siderite core were much harder to fracture. Analyses of specimens of ore from each pit and strata depth include a combination of volumetric ($Fe^{2+}$, $Fe^{3+}$ and total iron), gravimetric (moisture, volatiles, silica, alumina, lime and magnesia) and colourimetric (manganese) methods. Ferric oxide percentage for a specimen is factored from specimen total iron content. The set of analysis results is given in the Appendix.

## Findings

### Ore Mineral Profiles by Pit and Depth

Results of specimen analyses are grouped and presented as:

- Individual ore mineral contents by pit and strata depth
- Profiles of minerals across pits

Figure 3 shows individual mineral percentages within each strata depth for each pit.

Results show a fairly consistent general profile of minerals in ores across pits and strata but with variability in contents between each. Expectedly total iron content, shown as equivalent ferric oxide, dominates in all but two strata where silica content dominates. Particularly striking are the differences between nearby pits 438 and 902.

- Dominant silica contents in ores from Pit 438 for depths 1.2m and 3.7m and high silica contents in Pit 1011 for depths 1.3m and 2.5m
- Pits 902 and 1011 show generally more higher-grade ore at depths

### *Cyrena* Clam Shell Fossil Mineral Strata

Many limonite samples have a spalling dried muddy surface layer of small *cyrena* clam shell fossils and fragments. A combined sample, taken from several layers, was analysed.

The representative mineral profile for this material, Figure 4, shows a

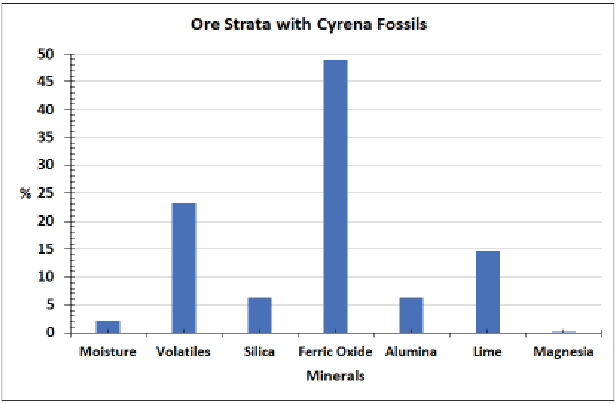



***Figure 4: Analysis of** cyrena **containing ore/mud strata***

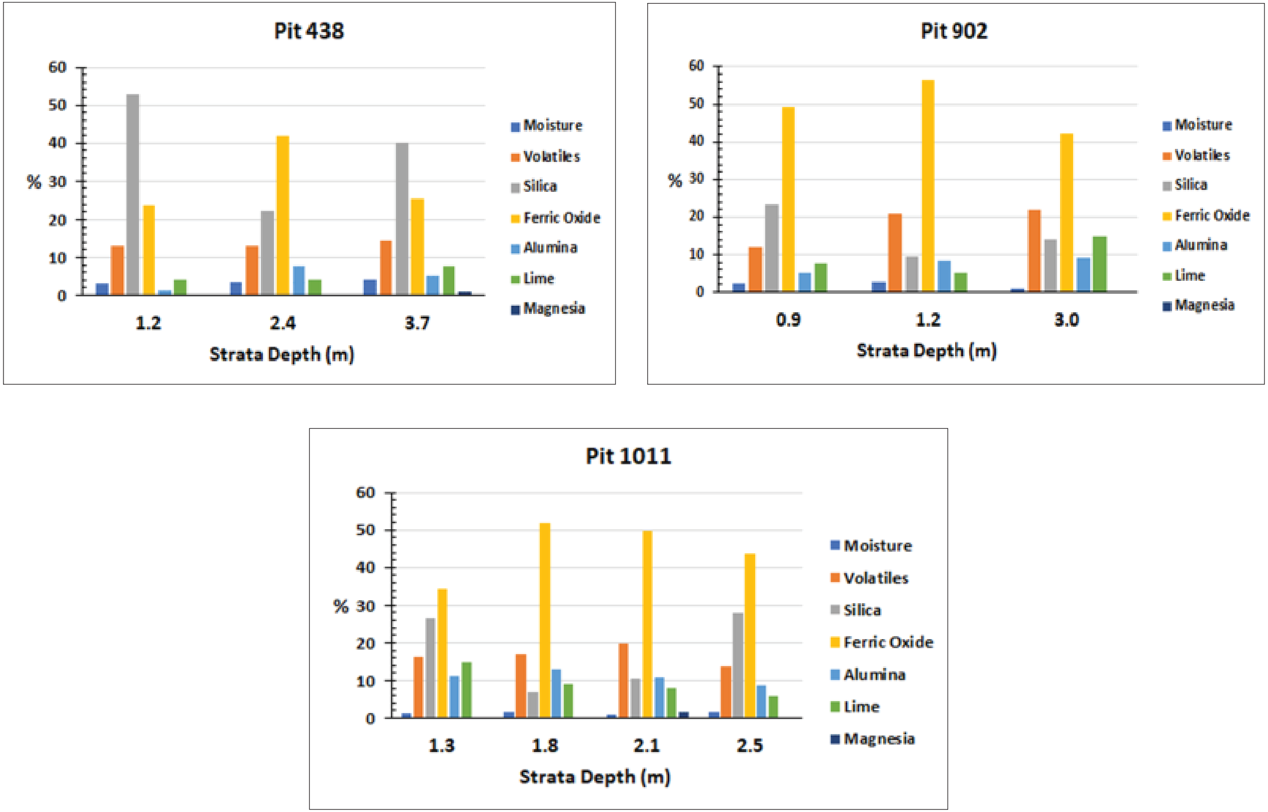


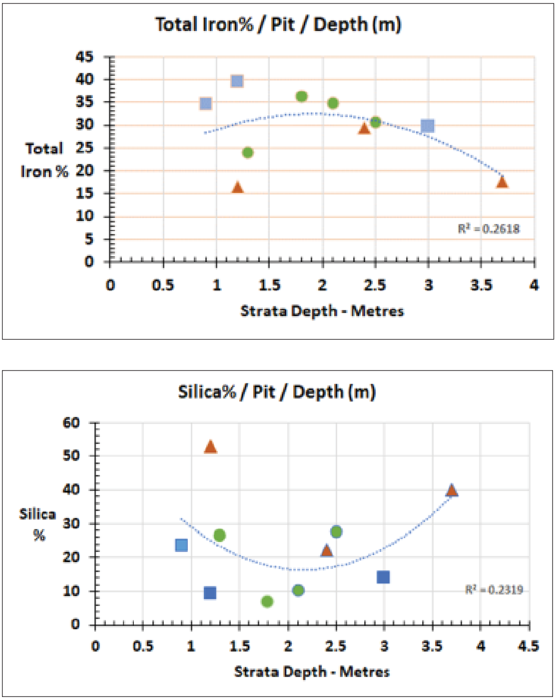

*Figure 3: Main mineral content of ores at depths in pits*

relatively high yielding ore of 34% iron with basicity of 1.18. This higher-grade material is comparable with several of the best ores from pits 902 and 1011. Smelting this material with general pit ore boosts overall ore grades, ore basicity and fluxing.

## Alignment of Findings to Investigation Aims

### Consistency of the Ore Specifications across the Pits

This comparison shows profiles for how individual minerals are distributed by depth across the three pits:



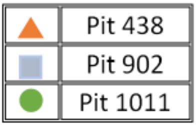



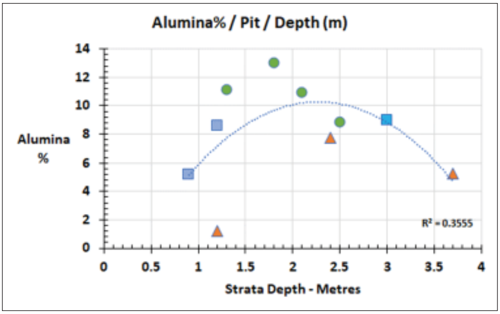

*Figure 5: Distribution of iron and silica contents at depth and pit location*

Figure 5 top, shows how the Total Iron% in mined ore varies according to the pit location and, importantly, from the strata depth mined. These pit depth profiles show iron content is relatively lower nearer the surface than average for a pit. Then at the next lower strata level iron content is at its highest but then reduces again at the deepest levels mined. This variability means higher iron content ores are found at different strata depths in different pits. However, ore suitable for blast furnace working can be mined from all depths but with a pit average iron yield lower than the best ore in the pit. In this example pit 438 overall gives a low metal yield.

The dotted line shows the statistical best fit line for the data points showing this effect for total iron across pits and peaking at an average depth of 1.5 to 2.5 metres generally for higher iron content ore. Even so, the $R^2$ Coefficient of Determination value of only 26% still shows there is a lot of uncertainty for finding high grade ore in a pit.

A distribution of ore silica by depth and pit is shown in Figure 5 bottom. This shows an almost mirror-image effect from results for iron contents. This is supported by a correlation factor of - 0.9 between silica and total iron data sets. The lowest silica bearing ores lie between about 1.0 to 3.0 metres deep in pits and align closely with the higher-grade ores. There is a best depth within any one pit for mining a low silica ore.

The following charts show profiles for the other mineral distributions for a pit and strata depth:



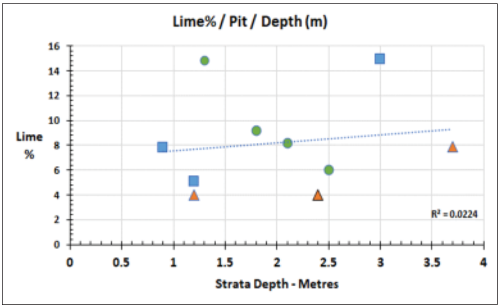




*Figure 6: Distribution of alumina and lime in ores at depth and pit location*

As for the iron and silica distributions, the alumina content shows a repeating profile of peak values generally nearer the surface and at different strata levels across pits and with higher grade ore in pit 902. However, the lime profiles differ in that for pit 1011 lime content decreases almost lineally with deeper strata depth whereas the other two pits show an inflection at the lower depths.

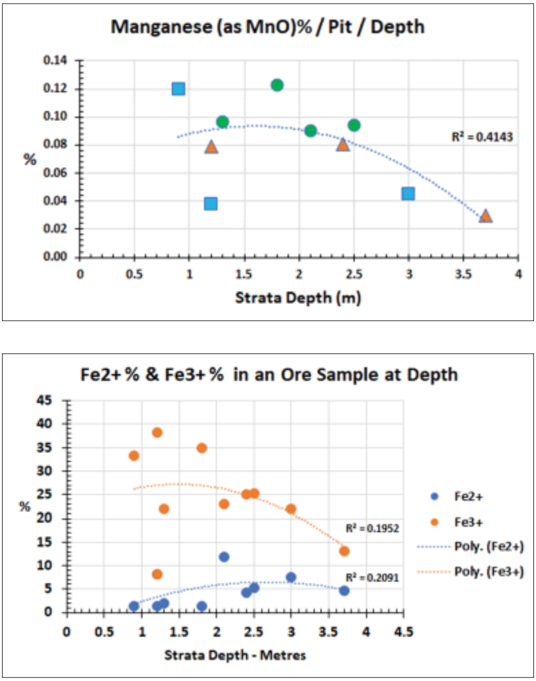



*Figure 7: Top - Manganese in ores at depth and pit. Bottom - Iron oxidation at depth*

Manganese content, Figure 7 top, is very low in these ores but still shows inflections across pits and a trend for lower values in deeper strata. Figure 7 bottom, shows how ferric to ferrous iron proportions in ores vary by strata depth across pits. Even with some wide variations the trends do show a proportionally higher ferric to ferrous iron ratio content at shallower depths where more siderite is transformed to limonite ore.

## Smelting Suitability of Different Pit Ore Deposits

The following charts, Figure 8, compare the average mineral contents

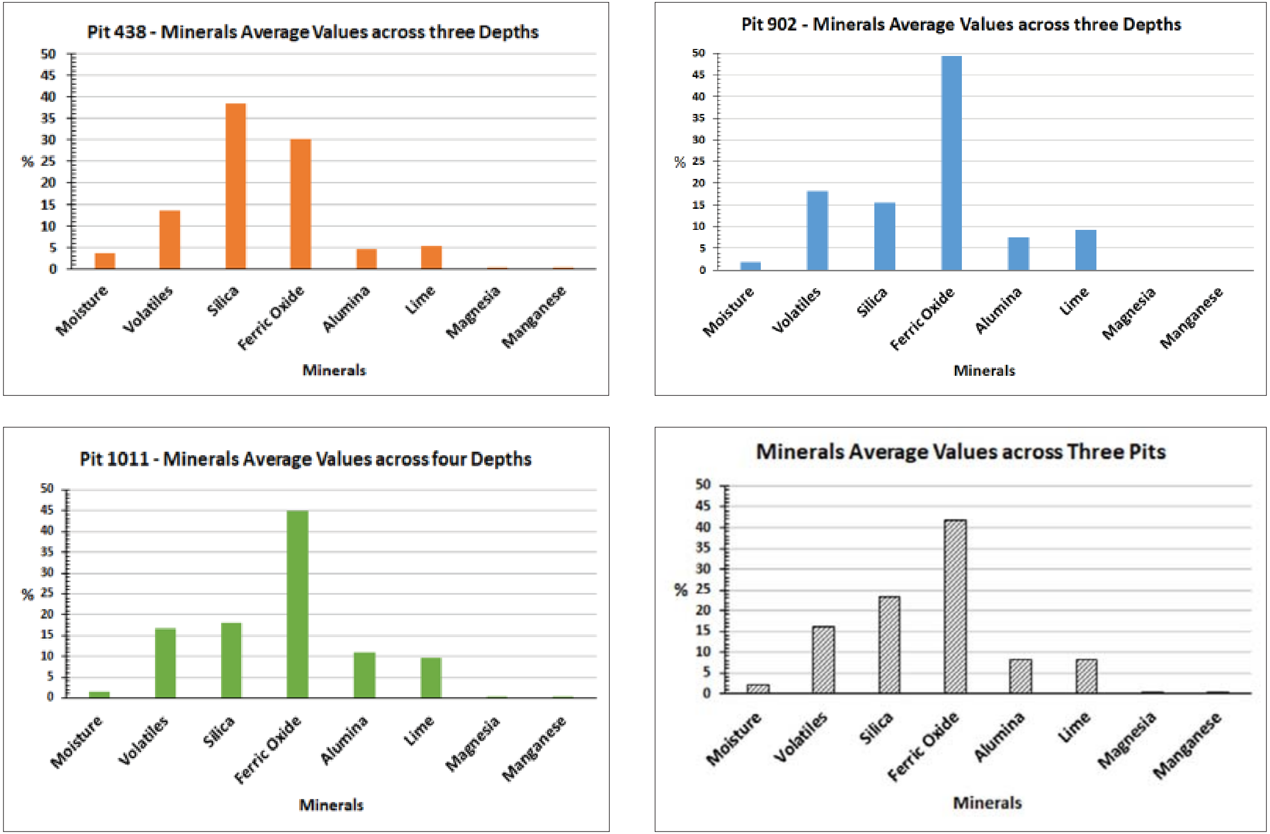



*Figure 8: Comparison of mineral strata contents across pits*

available within each pit and a summary chart of average values across the three pits. They show how mineral profiles vary across the three pits and the average of these three pits (of 1000+) can typify general ore properties for the whole site.

Smelting suitability is examined using proxies for the relative costs of fuel, transport and fluxing to smelt the ore in a blast furnace. Ore grade and basicity set criteria for smelting control of the burden mix and metal yield.

To meet an end product target iron production quantity, such as for pig iron or for a number of directly cast cannons, more of a lower-grade ore is needed than a higher-grade ore. Using a lower grade ore incurs more mining and transport costs and so makes it of lower economic value. However, the quantity of fuel used, and its cost, is primarily related to the metal quantity produced.

Secondly, the relative values of ores depend also on the costs of any additional fluxes needed to modify ore gangue materials to produce the required metal quality. Basicity is the balance between basic and acid minerals in the ore and creates the need for additional smelting fluxes and costs. A higher starting basicity means less flux is needed giving lower operating costs and so a higher economic value for the ore. Table 1 compares these two key proxy criteria for average values of ores across strata within each of the three Horam Pits:

| Pit No. | Average Grade Ore Total Iron % | Ore Average Basicity |
|---|---|---|
| **438** | 21.20 | 0.13 |
| **902** | 34.60 | 0.40 |
| **1011** | 31.42 | 0.37 |

***Table 1: Pit proxy economic values***

For highest iron content and high basicity Pit 902 is of highest value whilst more distant Pit 1011 (about 200m away) scores closely for second place. However, nearby Pit 438 (about 60m away from Pit 902) scores significantly lower on both measures from low average iron and higher silica contents. These sample results illustrate the high variability in ore qualities, even between nearby pits, and across the site.

## Suitability of Ores for either Blast Furnace or Bloomery Smelting

Blast furnaces and bloomeries each smelt the same ores differently to produce dissimilar types of iron and slag.

For blast furnace smelting Figure 9 compares the mineral profiles of an equivalent non-Wealden siderite blast furnace ore with the average ore specification from each Horam pit. There is a close similarity for volatiles, silicas and iron oxides between pits 902 and 1011 and, in turn, with the blast furnace ore. The high silica and lower average ferric oxide for pit 438 contrasts with the two other pits giving an overall lower average grade for the three pits. Even with a lower grade, on balance pit ores do benefit from the higher lime content which offsets the silica and alumina contents.

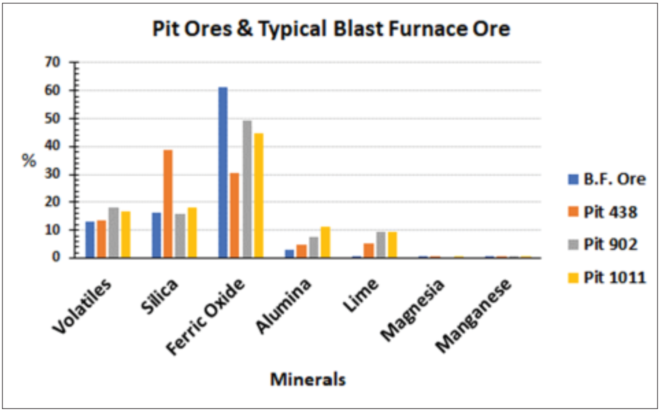



*Figure 9: Pit ores and a typical blast furnace ore specification*

Additional statistical $\chi^2$ tests for no differences between ores confirmed a significant difference at the 1% level between the overall averages for volatiles, silica and ferric oxide for the three pits together compared with the blast furnace ore. However, the averages for just pits 902 and 1011 together showed no significant difference meaning these two are comparable to the blast furnace ore. Even with variations these pit ores are suitable technically for blast furnace smelting although metal yields will vary by pit.

Ore suitability for bloomery smelting is gauged by its 'Bloom Potential'.

This index gives a measure for getting an iron bloom from a given ore specification using good furnace management. It ensures there is sufficient iron in the melt at bloomery temperatures, over that needed to form just fayalitic slag, to give free iron and so bloom formation. The index is calculated from ore iron% divided by its silicon% (0.47 x silica%). A value well above a minimum index value of '4' indicates the potential for sufficient excess iron for a bloom. This index is useful for assessing the suitability of a new ore source or to explain, partly, why a smelt failed to produce a bloom.

Figure 10 shows the index value for each ore in the strata across pits. Clearly only ore from mid-deep strata in two pits exceed the criterion. Even then, one of these strata, 902-3.0m, shows a very low marginal index value. Overall, just three strata out of ten or say 30%, are very likely to produce a bloom from the ore. However, ores averaged equally from all strata within a pit give for Pit 438 an index of 1.46 and still well below the critical value. In contrast Pits 902 and 1011 give an average value of 5.50 and 5.64 respectively and so are likely to get only a low smelt yield of iron overall from either.

For historical bloomery smelters and for the effort expended, the probability of finding consistently suitable ore in this locality would be very subjective.

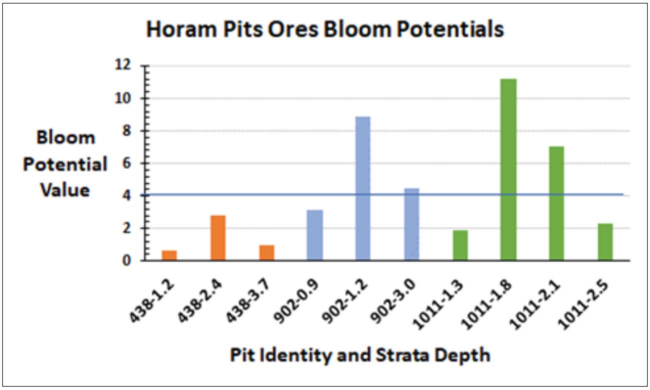



*Figure 10: Horam pits ores bloom potential*

## Could these Pits have supplied Ore to Fuller's Heathfield Blast Furnace?

Comments and advice given by John Fuller in his Letter to Hans Stanley, Old Bond Street, 22 December 1741, are compared with themic information about ore types, strata sequences and properties found for the three Horam pits.[1]

John Fuller makes particular reference to pricing by 'Veins' ore, which is the best, compared with the worst which he calls 'Eleven foot Pitty' and 'Bottom ore'. Miners should take the deepest higher grade, better paying vein ore first and follow it up till they come to the flittest (i.e. ore that can be mined with little trouble). His reason is to avoid incoming water seepage making the lower and more valuable vein ore very difficult or impossible to extract, against the lower grade but less deep ore easily extracted and so easier money for the miners.

However, a key issue, commented on earlier, is whether the ore used for analyses reflects truly the conditions existing at the time of Fuller's letter some 278 years ago. However, aside from this comment, Table 2 uses Fuller's statements against which to match current findings.

| Fuller's Statements | Themic Findings for Horam Pits | Match |
|---|---|---|
| Veins ores are best paying | • All ore samples originate from discrete strata at defined pit depths<br>• Shallower depth ores tend to have higher iron and silica contents<br>• Average iron, silica and other minerals proportions vary between pits<br>• Pit 902 has, on average, better grade ores of higher value<br>• Pit 438 has, on average, poorer grade ores of lower value | Y<br>Y<br>N<br>Y<br>N |
| Eleven Foot Pitty & Bottom ores worst | • Deeper ores tend to be of lower grade and higher in silica<br>• Pit 438 has high silica at 3.7m deep and low iron content<br>• Pit 438 at 1.2m deep has low iron, high silica ore | Y<br>Y<br>(Y) |
| Deepest ore veins better | • Deepest ores are more likely to have converted less to limonite and retain some core siderite<br>• Core siderite and high grade limonites have similar iron contents<br>• Deepest veins tend to show lower total iron contents | Y<br>Y<br>N |
| Flittest ore easy to mine | • Most pit ores are now liminites and relatively easy to break and extract | Y |

***Table 2: Ore characteristics and findings at Horam pits  Y - Yes, (Y) - Maybe, N - No***

1. D. Crossley and R. Saville (eds.), *The Fuller Letters 1728 – 1755* (Lewes, Sussex Record Society, **76**, 1991), Letter 412, 155.

Of the 12 findings there seems to be reasonable agreement with the statements for eight (67%), a 'maybe' agreement for one (8%) and three thought to be unlikely (25%). Whilst accepting caveats of only three pits examined and the effects of time on ore properties, there is, still, some evidence linking Fuller's statements and findings to show this nearby site may well have provided ore to Fuller for his Heathfield Furnace.

## Summary of Conclusions

This section summarises the findings for each of the study aims. In doing so, it is important to keep in mind that study findings are based on ores from different strata depths in only three pits out of over one thousand pits owing to technical limitations on access to sampling locations. Fortunately, the excavated pits are reasonably separated within part of the site with each pit location revealing its own characteristics and properties. Together they give a small sample of the range of possible findings and which, typically, might be inferred or even apply for the other parts of the site. However, conclusions are based solely on the analytical and comparative findings from these three pits.

### Assess the consistency of the ore specifications across the pits

Consequences of ore geological formation, deposition timing and local conditions means these three mine pits reveal a wide variation in ore grades and mineral compositions across strata depths. The highest-grade ores are only found in just a few medium level strata in different pits. The findings add even more details to the comment, given in the Introduction, that 'the only consistent factor at the site is how inconsistent the ore seams actually are across the excavated area'.

### Establish the smelting suitability of different pit deposits

Smelting suitability is compared as the overall economic value of an ore assessed on two broad proxy measures of iron grade and ore basicity. Respectively these represent firstly, productive efficiency and a quantity of ore and costs for fixed metal output and secondly, as a measure of a need for additional costs for fluxing minerals (for blast furnace smelting). Ranking average pit values for these two proxy measures show that Pit 902 scores highest for suitability and Pit 1011 scores a close second place. However, Pit 438, whilst nearby to pit 902, scores much lower from its low iron grade and higher silica content. This shows each pit, even for those close by, gives a different economic value for smelting its ore to iron.

### Comment whether the ores are more suitable for either blast furnace or bloomery use

Bloomeries and blast furnaces each process the same ores differently producing dissimilar types of iron and slag.

A comparison is made between a known equivalent blast furnace siderite ore profile and the pit ores. Close agreement for three key minerals between two of the three pit ores and a marginal case for the third pit 438, shows the three pit ores are suitable for blast furnace smelting but each will give different metal yields.

For bloomery smelting, however, only three medium level strata out of a total of ten pit strata sampled could supply suitable ore. For the considerable effort and costs involved miners would have only a modicum of a chance of finding suitable bloomery ore.

### Assess whether these pits supplied ore to Fuller's Heathfield furnace

Comments and advice given by John Fuller in his letter to Hans Stanley, 22 December 1741, about ideal types of ore and strata locations are compared with themic findings about ore types and position found. Of the four Fuller statements there are reasonable agreements with eight of the 12 themic findings. Even allowing for caveats about the limited number of pits examined, ores suitable for smelting and the effects of historical environments, it is concluded there is some practical evidence this site may well have provided ore to Fuller for the nearby Heathfield Furnace.

**Overleaf: Appendix – Horam mine pits - analytical data values**

| **Pit >** | 438 | 438 | 438 | 902 | 902 | 902 | 1011 | 1011 | 1011 | 1011 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pit/Depth >** | 438-1.2 | 438-2.4 | 438-3.7 | 902-0.9 | 902-1.2 | 902-3.0 | 1011-1.3 | 1011-1.8 | 1011-2.1 | 1011-2.5 |
| **Depth (m) >** | 1.2 | 2.4 | 3.7 | 0.9 | 1.2 | 3.0 | 1.3 | 1.8 | 2.1 | 2.5 |
| Moisture | 3.17 | 3.3 | 4.29 | 2.29 | 2.63 | 0.78 | 1.23 | 1.72 | 1.00 | 1.74 |
| Volatiles | 13.19 | 13.12 | 14.49 | 11.97 | 20.79 | 22.07 | 16.31 | 16.83 | 19.87 | 13.90 |
| Silica | 53.02 | 22.45 | 40.16 | 23.44 | 9.49 | 14.06 | 26.56 | 6.87 | 10.45 | 27.82 |
| Ferric Oxide | 23.56 | 41.88 | 25.45 | 49.46 | 56.59 | 42.21 | 34.35 | 51.79 | 49.69 | 43.78 |
| Alumina | 1.24 | 7.72 | 5.26 | 5.23 | 8.57 | 8.97 | 11.11 | 13.06 | 10.97 | 8.84 |
| Lime | 4.00 | 4.00 | 7.87 | 7.82 | 5.11 | 14.96 | 14.88 | 9.16 | 8.2 | 6.02 |
| Magnesia | 0 | 0 | 0.86 | 0 | 0 | 0 | 0 | 0 | 1.78 | 0.27 |
| Manganese | 0.08 | 0.08 | 0.03 | 0.12 | 0.04 | 0.05 | 0.10 | 0.12 | 0.09 | 0.09 |
| **% TOTAL =** | 98.26 | 92.55 | 98.41 | 100.33 | 103.22 | 103.10 | 104.54 | 99.55 | 102.05 | 102.47 |
| % Fe2+ | 8.24 | 4.19 | 4.60 | 1.39 | 1.39 | 7.56 | 2.06 | 1.34 | 11.81 | 5.33 |
| % Fe3+ | 8.25 | 25.12 | 13.21 | 33.22 | 38.21 | 21.98 | 21.98 | 34.9 | 22.96 | 25.31 |
| **% Iron Total** | 16.49 | 29.31 | 17.81 | 34.61 | 39.6 | 29.54 | 24.04 | 36.24 | 34.77 | 30.64 |
| **Bloom Potential** | 0.66 | 2.78 | 0.94 | 3.14 | 8.88 | 4.47 | 1.93 | 11.22 | 7.08 | 2.34 |
| **Ore Basicity** | 0.07 | 0.13 | 0.19 | 0.27 | 0.28 | 0.65 | 0.40 | 0.46 | 0.47 | 0.17 |
| Fe3+%- Fe2+% | 0.01 | 20.93 | 8.61 | 31.83 | 36.82 | 14.42 | 19.92 | 33.56 | 11.15 | 19.98 |
| Fe3+ % of Total Iron | 50 | 86 | 74 | 96 | 96 | 74 | 91 | 96 | 66 | 83 |

***Appendix – Horam mine pits - analytical data values***

# ETCHINGHAM FORGE: A note on its water supply

*J. S. Hodgkinson*

Ernest Straker wrote that Etchingham was a river forge, drawing its water from a long leat.[1] In a recent article Brian Herbert and Tim Cornish described various water management features which, they concluded, provided water to power the forge.[2] In their introduction they noted the doubt which previous writers had expressed about the existence of a forge pond and drew attention to a deed of 1733 (not 1773) which referred to 'Land covered with water and ponds ... and all waters, watercourses, sluices and easements'. From the results of fieldwork, they have identified a number of water features which may have been related to the forge site.

However, evidence does exist of a pond that once supplied water to the forge. In a published survey of the manor of Etchingham, dated 1597, there is a little-noted description of the works:

> *The Forge house in great decaye wherein ys one Hammer, Wheelde, Beame Hamer and Anvile with all the harnys belonginge to it, one Chaferye wheele and the beame one payre of large bellows and theire Attyre, And twoe fynerie Beames and wheeles with two payre of large bellowes wth their Attyre with all necessarie ymplements and Tooles fitt and necessarie for the Forge with ponde conteyninge xxxv acres Twoe Fluddgates and one watercourse, twoe Iron houses walled with bordes, wth a wast peice of grownde for the placinge of Coles, Sewer* [Sowes?], *Tymber and other necessaries for the Forge conteyninge one Acre.*[3]

The survey also names the two principal forgemen: Edward Standen, the master finer, and John Levitt the hammerman.

1. E. Straker, *Wealden Iron* (London, Bell, 1931), 298.

2. B. Herbert and T. Cornish, 'The Location of Etchingham Forge', *Wealden Iron*, 2nd ser., **32** (2012), 28-34.

3. S. P. Vivian (ed.), *The Manor of Etchingham cum Salehurst* (Lewes, Sussex Record Society **53**, 1953), 203.


***Figure 1: The area around Etchingham Forge; detail of Ordnance Survey draft drawing Hastings sheet; British Library OSD 103/8***

The considerable extent of the pond at 35 acres (14ha), in common parlance about 20 football pitches, is unsurprising in the wide, flat valley of the River Rother. No detailed map is known which is contemporary with the forge in the 1590s. However, the draft drawing for the first edition of the Ordnance Survey map dates from 1806, less than 60 years after the forge was abandoned and precedes the building of the railway line between Etchingham and Stonegate stations by more than 40 years. It does not show a pond but it does delineate an area that might once have contained the pond (Fig. 1). Clear also is the Hammer Dyke running from the forge site, a man-made watercourse dug to contain one or more wheel pits and a tailrace. Evidently, the leat mentioned by Straker and traced by Herbert and Cornish was a later solution to the problem of maintaining a head of water in a wide shallow valley, as presumably the pond had proved unsatisfactory.

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