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EXAMINATION OF SLAG FROM THE UPPER DELPHS, HADDENHAM AND QUEENSHOLME, CAMBRIDGESHIRE, 1984-7

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Summary

The two sites date from the middle Iron Age to the early Roman period. Haddenham produced low amounts of slag totalling 737g. Some of the slag is diagnostic of iron smithing, but two fragments may have resulted from smelting. There is no evidence for the working of non-ferrous metals. Queensholme produced no evidence of metalworking.

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ANCIENT MONUMENTS LABORATORY REPORTS SERIES

Examination of Slag from the Upper Delphs, Haddenham and Queensholme, Cambridgeshire, 1984-7

Megan Dennis

Introduction

The Upper Delphs, Haddenham, Cambridgeshire (TL 413733) was excavated between 1984 and 1987 by Cambridgeshire Archaeological Unit. The excavations revealed the presence of a number of Iron Age enclosures and an associated field system. The investigation concentrated on two sub-square Iron Age enclosures (Had V and Had VI) which were linked by a ditched boundary. The main emphasis was placed on complete excavation of one of these enclosures (Had V) were all the slag was found. This enclosure was used during several phases of settlement. The initial phase, before the enclosure was built, included three round buildings and associated areas of ploughed land. The first enclosure phase containing a large round house which was replaced by two smaller round buildings after it was destroyed by fire. The enclosure was abandoned when flooded in the later Middle Iron Age but reused in the Roman period as a stock enclosure until around the 4th century AD.

Queensholme, Cambridgeshire (TL 418717) was excavated in 1987 by Cambridge Archaeological Unit. It is a neighbouring site to Haddenham and evidence from the excavation suggests that it was a Late Iron Age/Roman settlement.

The aim of the examination was to provide a brief overview of the types of material present in the debris.

Examination of the Slag

The examination of the slag involved an initial visual assessment and classification of 862 g of material from Haddenham as shown in Table One and 679 g of material from Queensholme as shown in Table Two. To aid identification, some of the slags were washed gently to remove soil. The silt produced by this washing was tested for hammerscale by running a bar magnet through it and examining the particles that stuck.

Table One: Classification of Slag from Haddenham

Context No	Find No	Reference No	Weight	Interpretation	Measurements
-	-	-		flake hammerscale	
[839]	<6685>		117 g	fired clay (hearth lining?)	
[1308]	<7040>		4 g	undiagnostic ironworking slag	
[1312]	<11172>	882.1/602.9	54 g	fuel ash slag	
[1316]	<7124>		5 g	undiagnostic ironworking slag	
[1318]	<9769>	866.7/606.6	2 g	fuel ash slag	
[1332]	<11447>	872/609	3 g	daub/fired clay	
[1332]	<22177>	861.90/619.10	68 g	smithing hearth bottom 2 fragments	80x47x20mm
[1332]	<21605>	?<865>	73 g	tap/run slag	
[1376]	<25061>	861.7/606.03	38 g	smithing hearth bottom	45x40x15mm
[2116]	<22189>	850.92/604.40	232 g	smithing hearth bottom	75x55x50mm
[2220]	<26049>	872.1/606.6	243 g	smithing hearth bottom? 2 fragments	100x60x40mm
[2406]	<19556>	sieved posthole	5 g	daub/fired clay, 2 fragments	
[2411]	<24026>	870.40/629.7	18 g	undiagnostic ironworking slag	

Table Two: Classification of Slag from Queensholme

Context No	Find No	Weight	Interpretation
[3471]	<15150>	11 g	bone (cattle?)
[3476]	<28621>	141 g	heavily vitrified clay, fired twice, 2 fragments
[3492]	<28626>	226 g	heavily vitrified clay (possibly hearth lining)
[3492]	<28627>	35 g	heavily vitrified clay, fired twice, 2 fragments
[3666]	<28694>	266 g	natural concretion of gravel

Explanation of Classification

The assemblage of slag from Haddenham was small. On examination it contained clear evidence of smithing processes (*i.e.* hot working of iron), debris that could result from smelting processes, undiagnostic ironworking slags, undiagnostic slag and non-metalworking debris.

Smithing Slags from Haddenham

Smithing produces two types of slags: bulk slags and microslags. The only bulk slags diagnostic of smithing are **smithing hearth bottoms**. These are formed at the base of the hearth as a result of a high temperature reaction between the iron scale and silica from the clay hearth lining or sand, used as a flux by the smith. They are recognisable by a rough convex base and smooth vitrified upper surface. This upper surface may be hollowed by the action of air being blown through a tuyère onto the slag. The hearth bottoms usually have a plano-convex form that fits easily into the palm of the hand. Compositionally hearth bottoms

are predominantly fayalitic (made of iron silicate; $2FeO.SiO_2$). Fayalitic compounds leave a grey mark when scratched across a white ceramic tile, but are present in other slags as well as smithing hearth bottoms.

Two types of micro slags are produced by smithing - **flake hammerscale** and **spheroidal hammerscale**. Flake hammerscale is small flat fragments of the oxide and silicate skin of the iron, dislodged as it is worked. Spheroidal hammerscale is formed as small droplets of slag solidify after being expelled during the working of iron. Spheroidal hammerscale occurs particularly when two components are being fire welded together or when an iron bloom is first consolidated and worked into a bar or billet. Hammerscale is highly diagnostic of smithing and can be used to identify particular areas where smithing has taken place; hammerscale is not removed from the site for disposal, as many other slags are.

Possible Smelting Slags from Haddenham

The slags from Haddenham also contained one example of a tap or run slag (<1332>). True **tap slags** occur when a smelt is nearing completion and the slag that has built up within the furnace runs out of a hole in the furnace wall and away from the iron bloom. This results in substantial flows of slag which solidify in plate form, with a rope-like upper surface. Smaller flows of slag, termed **run slags**, can derive from smelting or smithing. The single fragment from Haddenham tends towards the first category and may be a result of a smelt, but this is uncertain. If there was a larger assemblage of this kind of slag it would be easier to categorise the debris. The presence of a single tap/run slag cannot provide evidence of smelting on the site.

Slags similar to smithing hearth bottoms can also be formed during smelting procedures particularly during small scale smelting as occurred during the Iron Age. These **furnace bottoms** are difficult to distinguish from smithing hearth bottoms and it is possible that the slag from Haddenham results from both smelting and smithing.

Undiagnostic Ironworking Slags from Haddenham

Undiagnostic ironworking slags may be formed during many different high temperature processes. It is often classified as such because the fragments are too small to be identifiable. The composition of these slags are predominantly fayalitic, but their morphology is irregular and similar materials can be made during several ironworking processes.

Undiagnostic Slags from Haddenham

Fuel ash slag is a very lightweight, light coloured (grey-brown), highly porous material which results from the reaction between alkaline fuel ash and silicates from the soil, sand or clay at high temperatures. This reaction can occur during many high temperature processes and is not diagnostic.

Non-metalworking Debris from Haddenham

The assemblage also contained three fragments of heated daub/fired clay (<11447>

and <19556>) and a larger piece of fired clay (<6685>). This may have been part of a hearth lining as it has been heated to high temperatures and become vitrified and glassy. It does not, however, have any slag or metal residues on it which might identify the processes producing it.

The assemblage from Queensholme contained no evidence of metal working.

Non-metalworking debris from Queensholme

The debris from Queensholme contained a fragment of bone (possibly cattle), a natural concretion of gravel and some heavily vitrified clay, that may have been a section of hearth lining. Vitrified clay can form in many high temperature processes, including metalworking. The fragment did not have any metal or slag residues remaining on it and therefore it is unlikely that it was involved in any metalworking process. The four fragments of vitrified clay have been fired twice. The first time in reducing conditions to produce the grey fabric and the second time, after the object had been broken, in oxidising conditions (as the red oxidised layer is also apparent on a fractured edge). The fragments have been heated at very high temperatures causing massive bloating within the fabric, increasing its volume and making it less dense. Under the microscope the extent of this vitrification can be seen with the fabric appearing spongy. The function of the original object is unknown.

Further Examination

X-ray fluorescence (XRF) analysis provides a non-destructive method of identifying the elements present in the samples and was used to identify the mineral deposits on the piece of bone from Queensholme (<15150>) and to confirm the tap/run slag from Haddenham (<21605>) was a product of ironworking.

The following elements were sought: copper (Cu), zinc (Zn), lead (Pb), tin (Sn), and iron (Fe), but only iron was detected.

Table Three: XRF Analysis of Samples from Haddenham and Queensholme

*** - strong signal
** - present
*- weak signal

Context No	Find No	Object	Cu	Zn	Pb	Sn	Fe	Comment
[3471]	<15150>	bone					*	iron staining
[1332]	<21605>	tap/run slag					***	iron slag

The iron staining on the bone is likely to be a post-depositional effect, perhaps because the context was naturally rich in iron or the bone was deposited together with an iron object. It is clear that the tap/run slag is an iron slag and not a bronze slag, as originally identified, despite its green surface colour.

Conclusions

The diagnostic components of the Haddenham assemblage were associated with smithing (the secondary working of iron). Smelting may also have been carried out on the site, but the small quantity of slag found makes this impossible to prove conclusively. There was no evidence of non-ferrous metalworking. The small amount of slag indicates that the debris is only very short term or small scale ironworking. There is no evidence for any metalworking on the Queensholme site.

Potential for Further Work

The slag does not warrant further examination. If soil samples are to be wet sieved or floated for archaeobotanical remains, then checking the sieve and flotation residues with a bar magnet would detect any hammerscale present. This may help locate the smithing activity taking place on the site.

Storage of Slag

The slag should be kept, but no special storage facilities are required.