ASSESSMENT OF IRON SLAG AND RELATED HIGH-TEMPERATURE DEBRIS FROM FIELD H, HUNTS GREEN FARM (GRIM'S DITCH ENVIRONS), BUCKS. (Site Code: 1C19HGFTT)

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Introduction and methodology

A large (over 115kgs) quantity of material, initially identified as slag, was recovered by hand on site and from soil samples processed after excavation. It currently fills eleven standard boxes and two half-sized boxes.

For this report it was examined by eye and tested with a magnet. The material was categorised on the basis of morphology; a magnet was used to test for iron-rich material and detect smithing micro-slags in the soil adhering to slags. Each slag or other material type in each context was weighed except for smithing hearth bottoms, which were individually weighed and measured for statistical purposes. Quantification data and details are given in the table below in which weight (wt.) is shown in grams, and length (len.), breadth (br.) and depth (dp.) in millimetres.

This report will discuss the types of slag present and the activities that produced them. It will also attempt to determine what its presence may tell us about the site.

Table 1: Quantification details

			IC19.HGFTT					Hunts Farm, Ph 2. Field H
Tr.	**cxt**	**sample**	**slag type**	**wt**	**len**	**br**	**dp**	**comment**
1003	**100304**		undiagnostic	12				very weathered & abraded.
1003	**100306**		undiagnostic	20				
1003	**100306**		undiagnostic	643				x1. very weathered. Heavy
1003	**100310**		undiagnostic	200				very abraded
1006	**100605**		undiagnostic	15				
1009	**100903**	100901	undiagnostic	700				x3
1009	**100903**		undiagnostic	602				
1010	**101003**		undiagnostic	2423				
1010	**101005**	101001	heat-magnetised material	17				grit; some tiny broken iron flakes.
1010	**101005**		undiagnostic	622				
1010	**101011**		iron-rich undiagnostic	6				
1010	**101013**	101004	heat-magnetised material	24				grit; very occ broken flake hammescale; some tiny smithing spheres; iron flakes.
1010	**101013**	101004	iron-rich undiagnostic	38				
1010	**101013**	101004	undiagnostic	1528				
1010	**101013**		fuel ash slag	436				
1010	**101013**		furnace ceramic	94				
1010	**101013**		furnace slag	553				with tap slag
1010	**101013**		iron-rich undiagnostic	139				x1. incomplete
1010	**101013**		iron-rich undiagnostic	320				

1010	**101013**		slag runs	251				flattened tops on the runs
1010	**101013**		slag runs	774				
1010	**101013**		smithing hearth bottom	120	80	50+	40	incomplete
1010	**101013**		stone	115				x2
1010	**101013**		tap slag	8326				
1010	**101013**		undiagnostic	164				silica rich
1010	**101013**		undiagnostic	236	100	75	25	incomplete smithing hearth bottom?
1010	**101013**		undiagnostic	593	120	100	50	incomplete smithing hearth bottom?
1010	**101013**		undiagnostic	15305				
1010	**101013**		undiagnostic	19983				furnace slag?
1010	**101013**		vitrified hearth lining	232				
1010	**101016**	101005	heat-magnetised material	83				grit; some very tiny iron bits
1010	**101016**	101005	slag dribbles	10				
1010	**101016**	101005	slag runs	105				x1
1010	**101016**	101005	undiagnostic	1293				
1010	**101019**	101006	heat-magnetised material	7				1-2 broken flake hammerscale, 1 sphere; rest is grit
1010	**101023**		slag runs	141				like tap slag
1010	**101023**		undiagnostic	463				furnace slag?
1010	**unstrat**		undiagnostic	1216				
1011	**101103**	101101	heat-magnetised material	31				grit
1011	**101103**	101101	slag runs	11				
1011	**101103**	101101	undiagnostic	289				
1011	**101103**		furnace slag	3546				
1011	**101103**		undiagnostic	1049	145	110	50	x1.
1011	**101108**	101103	heat-magnetised material	15				grit; very occ hammescale spheres; a few broken iron flakes.
1011	**101108**	101103	run slag	33				x1
1011	**101108**	101103	undiagnostic	1056				
1011	**101108**		slag runs	400				
1011	**101108**		smithing hearth bottom	382	90	90	40	
1011	**101108**		undiagnostic	518	60+	65		frag. of smithing hearth bottom?
1011	**101108**		undiagnostic	704	130	110	50	frag. of smithing hearth bottom?
1011	**101108**		undiagnostic	5822				prob furnace slag
1011	**101110**	101104	heat-magnetised material	22				
1011	**101110**	101104	undiagnostic	190				silica rich
1011	**101110**	101104	undiagnostic	3422				
1011	**101110**		furnace slag	4876				

1011	**101110**		slag runs	13			silica-rich
1011	**101110**		slag runs	42			
1011	**101110**		tap slag	6000			x3. huge runs on surface
1011	**101110**		undiagnostic	80			blue-grey, glossy.
1011	**101110**		undiagnostic	5533			similar to dense or tap slag
1011	**101112**	101105	heat-magnetised material	5			
1011	**101112**		iron-rich undiagnostic	48			
1011	**101112**		undiagnostic	137			
1011	**101113**	101106	iron-rich undiagnostic	144			
1011	**101113**	101106	slag dribbles	73			
1011	**101113**	101106	undiagnostic	160			silica rich
1011	**101113**	101106	undiagnostic	1789			
1011	**101113**		undiagnostic	2614			one fragment is massive
1011	**101115**	101102	heat-magnetised material	5			grit
1011	**unstrat**		iron-rich undiagnostic	76			
1018	**101803**		undiagnostic	45			cindery
1020	**102003**		slag runs	502			x1. large voids
1020	**102003**		slag runs	3214			rather like tap slag
1020	**102003**		undiagnostic	431	130	85 50	smithing hearth bottom frag?
1020	**102003**		undiagnostic	7500			
1020	**102005**		undiagnostic	649			
1020	**102007**		undiagnostic	1044			rather weathered
1021	**102103**	102101	cinder	93			
1021	**102103**	102101	fired clay	32			
1021	**102103**	102101	heat-magnetised material	54			grit; some very broken flake hammerscale; a few spheres; broken iron flakes
1021	**102103**	102101	iron-rich undiagnostic	137			
1021	**102103**	102101	slag dribbles	11			
1021	**102103**	102101	undiagnostic	1517			
1021	**102103**		iron-rich undiagnostic	63			
1021	**102103**		undiagnostic	684			
1021	**102105**		undiagnostic	4			
1021	**102107**		run slag	343			x2; very weathered
1021	**102107**		undiagnostic	276			x1; very weathered
1021	**102110**		run slag	92			x1
1021	**unstrat**		undiagnostic	48			
1022	**102209**		iron-rich undiagnostic	1158			x1
1022	**102209**		undiagnostic	211			
			Total wt = 115,002g				

Table 2: Slag types in assemblage

Slag type	Wt. (g)	Process represented
furnace slag	8975	smelting
run slag	468	smelting
tap slag	14326	smelting
microspheres/hammerscale	3	smithing
smithing hearth bottom	502	smithing
iron-rich undiagnostic	2129	undiagnostic
slag dribbles	94	undiagnostic
slag runs	5453	undiagnostic
undiagnostic	81790	undiagnostic
fuel ash slag	436	non-diagnostic

Total weight = 114.2kg

Explanation of terms

Activities involving iron can take two forms: smelting or smithing:

Smelting is the manufacture of iron from ore and fuel in a smelting furnace. The products are a spongy mass called an unconsolidated bloom consisting of iron with a considerable amount of slag still trapped inside, and slag (waste).

Furnace slag is a general term used for slag recognised as having been produced by smelting but which is incomplete or has no particular morphology which can identify the furnace type or technological method used.

Tap slag is a dense, low porosity, fayalitic (iron silicate) slag with a 'ropey' flowed structure (a well-known analogy for illustration: it usually resembles thick lava flows). It is formed as the liquid slag is allowed to flow out, continuously or intermittently, through a hole in the furnace side into a specially made channel leading to a hollow in the ground. This removal of the slag facilitated retrieval of the bloom after the smelting operation. Because of the fragmentary nature of the assemblage, only small amounts of tap could be identified. Numerous pieces from which the top had been erased or abraded by re-deposition were observed; these could well be tap slag.

Dense slag is of low porosity like tap slag but lacks the flowed surface; it too represents smelting activity. Although present, very little was present in the Hunts Farm material.

Run slag is what its name suggests, and is a product of smelting; if tap slag is very fragmentary it can be hard to identify as such and the term 'run slag' has been used in these instances. Quite a number of fragments of run slag were present.

Smithing involves the hot working (using a hammer) of the bloom to remove excess slag (primary smithing) or, more commonly, the hot working of one or more pieces of iron to create or to repair an object (secondary smithing). As well as bulk slags, including the smithing hearth bottom (a plano-convex slag cake which builds up under the tuyère hole -

hottest part - where the air from the bellows enters the hearth), smithing generates micro-slags; these can be hammerscale flakes from ordinary hot working of a piece of iron (making or repairing an object) and/or tiny spheres from bloom smithing or high temperature welding used to join or fuse two pieces of iron. Hammerscale, because of its tiny size, is usually only recovered by taking soil samples from fills and deposits but it is very magnetic and its presence can be detected using a magnet; it is most prevalent (thickest) in archaeological contexts in the immediate area of smithing, i.e. in the vicinity of the anvil and between it and the smithing hearth.

Slag described as undiagnostic cannot be assigned to smelting or smithing either because of morphology or because it has been broken up during deposition, re-deposition or excavation. Undiagnostic slag formed the bulk of the assemblage.

Other types of debris in an assemblage may derive from variety of high temperature activities - including domestic fires - and cannot be taken on their own to indicate iron-working was taking place. These include fired clay, vitrified hearth lining, cinder and fuel ash slag. If found in association with iron smelting and/or smithing slag they are almost certainly products of the process.

Key groups
The keys groups are from Trench 10 (with 55.617kg of slag), Trench 11 (39.085kg), and Trench 20 (13.340kg).

Discussion of the assemblage
The assemblage had suffered re-deposition, possibly more than once. Frustratingly, this meant all the slags was fragmented, which made identification of morphology impossible in most cases. Even usually distinctive slags such as the smithing hearth bottom were fragmentary, meaning only a few of these could be recognised; many other fragments are probably present amongst slag recorded as undiagnostic. Where larger fragments of slag may have come from smithing hearth bottoms, these were individually weighed and measured.

The presence of smelting waste such as tap, dense and run slags indicates some smelting (primary production of iron) took place. Smithing is represented by fragments of what appear to be smithing hearth bottoms. The almost complete absence of micro-slags (hammerscale flakes and smithing spheres) lends support to the theory of successive re-deposition of the slag. When found, the presence of both types of micro-slags indicates both high temperature welding and ordinary hot working of iron were carried out. Very occasionally, tiny flat flakes of iron were present in soil adhering to the slags; these may indicate the type of material being produced or worked.

Charcoal appears to be the fuel used for both smelting and smithing; no coal or burnt coal was present amongst or incorporated in the slags.

Significance of assemblage

The assemblage is significant because it indicates that at some period iron making and iron working were taking place in the area intensively as a one-off or as a sporadic activity over an extended period of time. The assemblage is possibly medieval in date, if the pottery found with it is a true indicator, but could just as likely be Roman material moved and dumped in the medieval period. The assemblage amplifies the evidence for ironworking from the Hunts Farm Phase 1 excavations.

Importance – locally, regionally, nationally
The assemblage is of local and regional importance.

Recommendations for further work
Historical records of ironmaking or ironworking in the area may exist and should be examined to see whether they tie in with the Hunts Farm material and provide more detail.

Radiocarbon dating of any suitable charcoal specimens from the slag dumps will provide a firmer date, although oak wood – if used – will give an earlier date than short-lived species.

No useable plans were available at the assessment stage so the special distribution of the slag could not be examined; if further work is to be undertaken, labelled plans will be required by the archaeometallurgist.