CHAPTER 16

Slag

by Lynne Keys

16 Slag

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A total of 11.3 kg of slag and related material were recovered - not a large amount for the size of the area excavated. There are, however, indications that smithing took place as a one-off in different periods. Some evidence was found in a Late Bronze Age hearth (MTCP); smithing took place on at least one occasion in the Late Iron Age (M11), certainly in the Late Iron Age/early Romano-British and Romano-British periods (LTCP). No evidence for smelting - the production of iron in a furnace using ore and fuel - was found anywhere in the excavated areas.

Methodology and Quantification

The material was visually examined and categorised on the basis of morphology alone. Each slag type in each context was weighed, smithing hearth bottoms being individually weighed and measured to obtain their dimensions for statistical purposes. Additionally a magnet was run through the soil in bags to detect micro-slags such as hammerscale. Quantification details are given in Table 16.2 below.

Metalworking evidence by period

Late Bronze Age

MTCP site
Hearth 340004, fill 340002. Described as being charcoal rich, the deposit contained some micro-slags and hammerscale spheres. There is the possibility it may have been used as a smithing hearth for high temperature welding.

Late Bronze Age/Early Iron Age

M11 site
Pit 434009, fill 434010. A small amount of magnetic micro-slags (runs etc.), a very small amount of undiagnostic slag, charcoal and some copper-alloy waste.

Late Iron Age/early Roman

LTCP site
Pit 136012, fills 138026, 138027, 136030. This feature contained two smithing hearth bottoms, some undiagnostic slag, lots of micro-slags and some flake hammerscale, all of which point to secondary smithing. The focus of activity is probably very near the pit, in a structure/or building nearby. The piece of flint with hole found in fill 138028 may be a weight but could have been used as a piece of the hearth through which the tuyure projected, protecting the bellows from the fire inside.

M11 site
Intervention 433026, fill 433028 (Ditch 433033). A smithing hearth bottom (indicating smithing), some vitrified hearth lining and cinder.

Pit 434011, fill 434012. In a deposit of burnt charcoal a small quantity of iron-rich slag and some micro-slags (runs and dribbles) were found.

Early Romano-British

LTCP site
Intervention 129035, fill 129025 (ditch 109214). A small amount of flake hammerscale, probably originating from ordinary smithing of iron objects.

Hearth 150028, fills 150026 and 150027. This hearth contained hammerscale spheres indicating it was probably used to carry out high temperature welding. Context description mentions the dark (charcoal ash) colour of the fill.

Late Romano-British

MTCP site
Intervention 333024, fill 333026 (ditch 333082). The smithing hearth bottom, undiagnostic slag and vitrified hearth lining indicate some smithing activity took place nearby.

Pit 333049, fill 333052. Some undiagnostic slag and vitrified hearth lining were found in the backfill of this pit.

Hearth 324002, fill 324001. The fill of this hearth contained very tiny hammerscale spheres. The pieces of quern and flint could have formed part of a raised fire bed or low superstructure of a ground level hearth where smithing took place.

Unphased

LTCP site
Pit 110129, fills 110130 and 110131. Some hammerscale spheres indicate high temperature welding or primary smithing of an iron bloom after smelting. As no other evidence for smelting was found it probably indicates the former.
Hearth 138058, fill 150041. Some hammerscale spheres.
Hearth 152021, fill 152022. Some hammerscale spheres.

Slag types and terminology

Activities involving iron can take two forms:

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

16 **Smithing** comprising:

a) *primary smithing* (hot working by a smith using a hammer) of the bloom on a stringhearth (usually near the smelting furnace) to remove excess slag. The bloom becomes a rough lump of iron ready for use; the slags from this process include smithing hearth bottoms and micro-slags, in particular tiny smithing spheres.

b) *secondary smithing* (hot working by a smith using a hammer) of one or more pieces of iron to create an object or repair it. As well as bulk

slags, including the smithing hearth bottom, this generates micro-slags: hammerscale flakes from ordinary hot working of a piece of iron or tiny spheres from high temperature welding to join two pieces of iron.

Both these activities produce slag, some diagnostic of the process, others not. Some slag may be described as undiagnostic (6100 g recovered in total) because it was broken up during deposition, re-deposition or excavation. Other types of debris encountered in the slag assemblage may be the result of a variety of high temperature activities - including domestic fires - and cannot be taken on their own to indicate iron-working was taking place. They include materials such as fired clay (49 g), vitrified hearth lining (312 g), cinder (209 g) and fuel ash slag (109 g). However if found in association with iron slag, as they sometimes were, they may be products of the process.

The diagnostic slags (smithing hearth bottoms and hammerscale) all point to secondary smithing activity, the ordinary hot working of an iron shape by a smith or high temperature welding to join two pieces of iron. A smithing hearth bottom is plano-convex in shape and was formed as a result of high temperature reactions between the iron, iron-scale and silica from either a clay furnace lining or the silica flux used by the smith. Before it could grow large enough to block the tuyere hole (where the air from the bellows entered the hearth) it was removed and dumped in the nearest pit, ditch or unused area.

Table16.1: Smithing hearth bottom statistics (eight examples, total weight 2182 g)

	range	mean	standard deviation
weight (g)	106 - 1008	273	302
length (mm)	65 - 130	86	21
breadth (mm)	45 - 120	68	23
depth (mm)	20 - 55	28	116

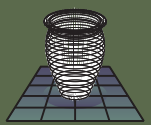
Table16.2: Quantification details for the iron slag and related debris (dimensions in mm)

Site	context	< >	identification	Wt (g)	len	wid	dep.	comment
LTCP (BAACP00)	106057		undiagnostic	28				
	106066	547	micro-slags	0				& magnetic clay
	110075	255	fired clay	11				
	110075	255	fuel ash slag	1				
	110075	255	undiagnostic	32				
	110075	255	vitrified hearth lining	10				
	110082		undiagnostic	26				
	110109		stone	22				ironstone?
	110130	537	hammerscale	0				some spheres
	110130	540	hammerscale	0				limited amount spheres
	110131	413	hammerscale	0				some spheres
	113003		cinder	26				
	116007	109	clinker	1				
	129025	539	hammerscale	0				limited amount flake
	129031		cinder	1				
	129032	296	cinder	2				
	134064		undiagnostic	2				
	136030	311	cinder	4				
	138026		undiagnostic	138				
	138027	399	micro-slags	0				lots, & some flake
	138027	399	undiagnostic	6				
	138027		smithing hearth bottom	182	80	60	30	
	138027		undiagnostic	228				
	138028		smithing hearth bottom	106	60	50	20	
	138041		cinder	4				
	138051		fuel ash slag	18				
	138052		fuel ash slag	18				
	138053		cinder	6				
	139033	391	fired clay	11				
	140013		undiagnostic	88				
	143071		undiagnostic	30				
	150006	312	clinker	2				
	150020		undiagnostic	4				
	150026	543	hammerscale	0				spheres - a better sample
	150027	390	hammerscale	0				limited amount spheres
	150041	536	hammerscale	0				some spheres
	152022	563	hammerscale	0				some spheres
	157009		fired clay	4				
	157009		undiagnostic	32				
LTCP (BAACP01)	447012		iron object	132				
	449015		charcoal	8				
	449063		coal	48				burnt
	449063		nail	2				
	449063		undiagnostic	301				
	449064		coal	19				burnt
	449064		undiagnostic	26				
	449065		coal	10				burnt
	457039		undiagnostic	222				
	459020	828	coal	35				burnt
	459020	828	coal	64				
	459020	828	fired clay	14				
	459020	828	undiagnostic	240				

Site	context	< >	identification	Wt (g)	len	wid	dep.	comment
	459054		cinder	2				
	459054		undiagnostic	5				
	461001		coal	18				
	461001		glassy run	2				not ironworking?
	465034	850	undiagnostic	6				
	466023	839	cinder	6				
	466023	839	coal	1				
	466023	839	undiagnostic	6				
	467008	876	charcoal	2				
	467008	876	cinder	27				
	467008	876	coal	17				burnt
	467008	876	fired clay	4				
	467008	876	undiagnostic	182				
	467008		coal	44				burnt
	467008		coal	79				
	467008		undiagnostic	800				
	480081		undiagnostic	24				
	Trans. 1		coal	9				burnt
	Trans. 1		coke	2				
LTCP (BAACP99)	990101		Undiagnostic	4				
	990201		undiagnostic	1				
	990401		clinker	1				
	990401		undiagnostic	4				
	990501		cinder	2				tempered
	990501		undiagnostic	12				
	990701		undiagnostic	2				
	992301		coal	3				
	992301		undiagnostic	6				
	992305		undiagnostic	2				
	992401		clinker	4				
	992401		coal	4				
	992401		undiagnostic	358				
	992500		clinker	24				
	992500		coal	10				burnt
	992500		undiagnostic	92				
	992700		undiagnostic	138				coal as fuel
FLB (BAAFL00)	401006		undiagnostic	76				
	401013		Cinder	2				
	401016	5002	iron	1				iron sliver
	402020		undiagnostic	138				
	402027		undiagnostic	4				
	403001		cinder	20				
	403054		undiagnostic	4				
	405065		coal	4				
	405065		undiagnostic	58				
	406022		coal	22				
	406022		undiagnostic	456				
	406022		vitrified hearth lining	60				
	406022		vitrified hearth lining	60				
	407006		undiagnostic	116				
M11 (BAALR00)	420051		undiagnostic	6				
	423133	6155	cinder	1				
	430021		undiagnostic	4				iron rich
	431004	6105	cinder	2				

Site	context	< >	identification	Wt (g)	len	wid	dep.	comment
	431004	6105	undiagnostic	1				
	433028	6128	cinder	2				
	433028		smithing hearth bottom	226	90	75	25	
	433028		vitrified hearth lining	75				
	433042	6247	fired clay	1				
	433208		fuel ash slag	1				
	434010	6102	charcoal	2				
	434010	6102	micro-slags	4				some magnetic
	434010	6102	undiagnostic	3				
	434012	6103	charcoal	2				
	434012	6103	iron rich slag	1				
	434012	6103	micro-slags	1				magnetic
	434014	6104	charcoal	2				
	434021	6111	charcoal	1				
	434021	6111	cinder	1				
	434021	6111	micro-slags	8				one hammerscale sphere, charcoal
	434021	6111	undiagnostic	4				
	439060		fired clay	4				
	439060		undiagnostic	2				
	441007		coal	3				burnt
MTCP (BAAMP00)	309191		undiagnostic	50				
	310028	2073	fired stone	4				
	314067		undiagnostic	2				
	319199		undiagnostic	1				
	320060	2277	stone	0				
	320132		stone	14				ironstone?
	321055		cinder	1				
	321227		fuel ash slag	12				
	321227		vitrified hearth lining	4				
	321233		undiagnostic	30				
	321234		undiagnostic	24				
	324001		hammerscale	0				small spheres
	326046		undiagnostic	112				
	328167	2448	cinder	38				
	328167	2448	undiagnostic	2				
	328208		smithing hearth bottom	142	80	45	20	
	328221		stone	180				
	333026		smithing hearth bottom	160	85	60	25	
	333026		undiagnostic	76				
	333026		vitrified hearth lining	50				
	333052		iron-rich slag	14				
	333052		undiagnostic	268				
	333052		vitrified hearth lining	26				
	334006		undiagnostic	6				
	334012		undiagnostic	134				
	334012		vitrified hearth lining	1				
	334031		cinder	14				
	335012		undiagnostic	84				part of smithing hearth bottom?
	335022	2431	undiagnostic	14				
	335022	2432	undiagnostic	2				
	339042		cinder	4				
	339087		stone	12				ironstone?
	340002		hammerscale	0				limited micro-slags & spheres
	345025		cinder	12				
	349053		fuel ash slag	59				

Site	context	< >	identification	Wt (g)	len	wid	dep.	comment
	353009		undiagnostic	68				poss. smithing slag
	356015		iron object	1568				
	356015		undiagnostic	1128				
	360012		smithing hearth bottom	252	95	75	30	
MTCP	6526		vitrified hearth lining	12				
(BAAMP99)	6527	22	undiagnostic	4				
	6527		smithing hearth bottom	1008	130	120	55	
	6606		undiagnostic	50				poss. smithing slag
	6609		undiagnostic	14				poss. smithing slag
	6609		vitrified hearth lining	14				
	6615		undiagnostic	38				poss. smithing slag
	6617		smithing hearth bottom	106	65	60	20	
	6617		undiagnostic	70				poss. smithing slag
	7903		undiagnostic	6				
Total				11,335				



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