7.8 ASSESSMENT OF FERROUS RESIDUES

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Summary

7.8.1 Over 590kg of ferrous metallurgical residues, hammerscale, ore and hearth or furnace linings were recovered (largely from contexts of Phase 3), of which about 115kg have been examined and identified. X-rays of iron objects have also been examined. There is evidence for both the smelting and smithing of iron. A preliminary analysis suggests a marked shift in the relative importance of these activities from Phase 2 to Phase 3, with a striking increase in the proportion of material attributable to smelting as opposed to that for smithing. Analysis of the remaining samples is recommended in order both to confirm this phenomenon and to investigate the relative spatial distributions of the various residue types.

Introduction

7.8.2 The site sampling strategy resulted in the recovery of over 590kg of ferrous residues and associated waste. A sub-sample of about 115kg (just under 20%) of this material has been examined and catalogued.

7.8.3 The residues are relevant to the following Fieldwork Event Aims;

- to establish the full extent and morphology and organisation of the ironworking site;
- to recovery artefact assemblages (especially pottery) to elucidate the sequence of site development;
- to provide information on the status and economy of the site and data on trade and exchange;
- to recover environmental and other economic indicators if these are found to be present on site;
- to determine the landscape setting of the site and interaction with the contemporary local environment.

Methodology

7.8.4 Three pits contained large quantities of residues and 10% samples (by volume) were recovered during the manual excavation of 50% (also by volume) of each of these features; each such sample therefore representing about 5% of the original assemblage (discounting truncation *etc.*). 50% of each remaining pit was also excavated and all of the residues found were kept from these. A total of just over 590kg of ferrous metallurgical residues were recovered by these means during excavation. In addition, further small quantities of hammerscale and slag were identified in 42 floatation samples taken from features seen to contain large quantities of metallurgical residues.

7.8.5 A sub-sample of a little over 115kg (just under 20%) of the collected material was examined and catalogued (Table One). This level of sampling is considered to be sufficient for assessment purposes in order to establish the presence (but not the spatial distribution) of the different forms of residue. It is unlikely that the remaining material is markedly different in range to that which has been sampled, although relative proportions may alter, particularly for the Anglo-Saxon period. All sampled material has been appropriately marked and labelled.

7.8.6 The sampling was targeted towards secure contexts with good assemblages of material, which were located towards the centre of the area of ironworking activity. The assessment was intended to examine the evidence for both smelting and smithing on site. The residues in the sub-sample were thus examined visually and categorised on the basis of morphology, colour, density and vesicularity.

Quantification

7.8.7 The quantity of sampled residues (about 115kg out of the roughly 590kg recovered) is presented by type in Table One. The remainder of the material collected has yet to be identified as to type, although total weights are available per context.

7.8.8 Table One

Sampled Ferrous Metallurgical Residues, sorted by Phase, Group and Sub-Group

Context	*Sub-Group*	*Group*	*Phase*	*SF*	*Residue*	*Weight (g)*
132	0	0	0	609	Tap Slag	20
542	0	0	0	580	Fired Stone	10
542	0	0	0	580	Undiagnostic	112
542	0	0	0	580	Tap Slag	814
622	160	2	2	1089	Hammerscale	28
622	160	2	2	434	Undiagnostic	74
622	160	2	2	434	Tap Slag	114
622	160	2	2	434	Smithing Hearth Bottom	714
622	160	2	2	434	Undiagnostic	776
622	160	2	2	434	Smithing Hearth Bottom	1116
622	160	2	2	434	Vitrified Hearth Lining	1342
347	25	6	3	214	Tap Slag & Undiagnostic	775
531	153	6	3	606	Fired Clay	38
531	153	6	3	606	Undiagnostic	52
531	153	6	3	606	Vitrified Hearth Lining	78
531	153	6	3	606	Tap Slag	350
531	153	6	3	606	Smithing Hearth Bottom	376
535	67	8	3	624	Smithing Hearth Bottom	106
328	33	10	3	51	Undiagnostic	15
331	39	10	3	37	Undiagnostic	10
659	72	10	3	501	Undiagnostic	88
659	72	10	3	501	Smithing Hearth Bottom	376
363	169	10	3	81	Smithing Hearth Bottom	166
545	128	11	3	556	Tap Slag	690
382	129	11	3	98	Smithing Hearth Bottom	118
382	129	11	3	98	Smithing Hearth Bottom	144
382	129	11	3	98	Smithing Hearth Bottom	400
382	129	11	3	98	Vitrified Hearth Lining	1300
383	131	11	3	1019	Hammerscale	0
525	152	11	3	307	Undiagnostic	598
525	152	11	3	307	Vitrified Hearth Lining	756
525	152	11	3	307	Tap Slag	3182
527	152	11	3	571	Stone	20
527	152	11	3	571	Vitrified Hearth Lining	588

Context	***Sub-Group***	***Group***	***Phase***	***SF***	***Residue***	***Weight (g)***
527	152	11	3	571	Undiagnostic	1320
527	152	11	3	571	Tap Slag	3330
440	164	11	3	1028	Hammerscale	12
338	134	12	3	191	Tap Slag & Undiagnostic	400
548	154	12	3	627	Undiagnostic	22
548	154	12	3	627	Vitrified Hearth Lining	104
548	154	12	3	627	Tap Slag	254
471	178	12	3	471	Vitrified Hearth Lining	192
471	178	12	3	471	Undiagnostic	468
471	178	12	3	471	Smithing Hearth Bottom	552
471	178	12	3	471	Tap Slag	1508
588	161	13	3	594	Cinder	36
588	161	13	3	594	Vitrified Hearth Lining	62
588	161	13	3	594	Smithing Hearth Bottom	208
588	161	13	3	594	Dense Slag	370
588	161	13	3	594	Smithing Hearth Bottom	460
588	161	13	3	594	Undiagnostic	990
588	161	13	3	594	Smithing Hearth Bottom	1178
588	161	13	3	594	Tap Slag	6946
599	161	13	3	1080	Hammerscale	20
599	161	13	3	489	Cinder	106
599	161	13	3	489	Smithing Hearth Bottom	214
599	161	13	3	489	Smithing Hearth Bottom	280
599	161	13	3	489	Smithing Hearth Bottom	312
599	161	13	3	489	Smithing Hearth Bottom	450
599	161	13	3	489	Smithing Hearth Bottom	890
599	161	13	3	489	Smithing Hearth Bottom	1088
599	161	13	3	489	Dense Slag	1310
599	161	13	3	489	Smithing Hearth Bottom	1360
599	161	13	3	489	Vitrified Hearth Lining	1816
599	161	13	3	489	Smithing Hearth Bottom	2310
599	161	13	3	489	Undiagnostic	7582
599	161	13	3	489	Tap Slag	15492
600	161	13	3	492	Ore?	82
600	161	13	3	492	Cinder	86
600	161	13	3	492	Fired Clay	96
600	161	13	3	492	Slag Around Tuyere	118
600	161	13	3	492	Smithing Hearth Bottom	180
600	161	13	3	492	Smithing Hearth Bottom	186
600	161	13	3	492	Smithing Hearth Bottom	240
600	161	13	3	492	Smithing Hearth Bottom	340
600	161	13	3	492	Smithing Hearth Bottom	340
600	161	13	3	492	Smithing Hearth Bottom	382
600	161	13	3	492	Smithing Hearth Bottom	464
600	161	13	3	492	Smithing Hearth Bottom	618
600	161	13	3	492	Smithing Hearth Bottom	724
600	161	13	3	492	Dense Slag	866
600	161	13	3	492	Vitrified Hearth Lining	1624
600	161	13	3	492	Smithing Hearth Bottom	1766
600	161	13	3	492	Undiagnostic	6078

Context	***Sub-Group***	***Group***	***Phase***	***SF***	***Residue***	***Weight (g)***
600	161	13	3	492	Tap Slag	10856
609	161	13	3	502	Smithing Hearth Bottom	540
609	161	13	3	502	Smithing Hearth Bottom	764
635	172	13	3	459	Tap Slag	3330
345	136	18	3	200	Tap Slag	65
608	114	19	3	417	Cinder	4
608	114	19	3	417	Fired Ore?	32
608	114	19	3	417	Bloom Frag/Iron?	96
608	114	19	3	417	Tap Slag	140
608	114	19	3	417	Undiagnostic	302
610	114	19	3	1087	Hammerscale	0
549	155	19	3	631	Tap Slag	158
551	156	19	3	616	Dense Slag	30
551	156	19	3	616	Tap Slag	3975
349	165	22	3	106	Tap Slag	1090
362	167	22	3	110	Tap Slag	235
311	37	23	3	74	Smithing Hearth Bottom	74
311	37	23	3	74	Smithing Hearth Bottom	428
311	37	23	3	74	Undiagnostic	914
311	37	23	3	74	Tap Slag	1616
319	36	26	4	142	Tap Slag	515
326	36	26	4	146	Tap Slag & Undiagnostic	1965
330	36	26	4	150	Tap Slag	335
332	36	26	4	43	Tap Slag	1315
343	36	26	4	209	Tap Slag	270
370	36	26	4	115	Undiagnostic	1384
370	36	26	4	115	Tap Slag	1768
497	56	27	4	518	Undiagnostic	114
497	56	27	4	518	Tap Slag	1140
508	56	27	4	579	Undiagnostic	162
508	56	27	4	579	Tap Slag	560

7.8.9 Iron ore is smelted in a furnace and the waste products include tap slag, dense slag and a spongy mass known as an unconsolidated bloom, consisting of iron with a considerable amount of slag still trapped inside it. Smithing of the bloom removes the excess slag and eventually transforms the raw material into objects (McDonnell 1989, 373). The most diagnostic slag from smithing is the smithing hearth bottom, which is formed below the tuyere and is periodically removed in order to allow the furnace to continue to work efficiently. Smithing also produces a vesicular form of slag as a by-product, which can be distinguished from the denser smelting slag. A piece of slag from context 600 had formed around the tuyere of a hearth. The tuyere had been removed but the slag had taken shape around it. Some fragments of heavily fired or vitrified clay hearth (or furnace) lining, representing walls at least 300-400mm thick, were found to be included in the samples, as were some fired ore and other stone.

7.8.10 The material examined can be divided into broad categories, according to whether it is characteristic of smelting or smithing or are ambivalent (Table Two).

7.8.11 Table Two

Sampled ferrous residues by phase and broad category

Largely characteristic of smelting

	Unstratified		*Phase 2*		*Phase 3*		*Phase 4*	
	Wt (g)	*%*	*Wt (g)*	*%*	*Wt (g)*	*%*	*Wt(g)*	*%*
Ore?					82	-		
Fired ore?					32	-		
Dense Slag					2576	3		
Tap Slag	834	87	114	3	53217	53	5903	62
Tap Slag & Undiagnostic					1175	1	1965	21
Sub-totals	***834***	***87***	***114***	***3***	***57082***	***57***	**7868**	**83**

Largely characteristic of smithing

	Unstratified		*Phase 2*		*Phase 3*		*Phase 4*	
	Wt (g)	*%*	*Wt (g)*	*%*	*Wt (g)*	*%*	*Wt(g)*	*%*
Hammerscale			28	1	32	-		
Smithing Hearth Bottom			1830	44	18034	18		
Slag Around Tuyere					118	-		
Sub-totals	**0**	**0**	**1858**	**45**	**18184**	**18**	**0**	**0**

Ambivalent

	Unstratified		*Phase 2*		*Phase 3*		*Phase 4*	
	Wt(g)	*%*	*Wt(g)*	*%*	*Wt(g)*	*%*	*Wt(g)*	*%*
Bloom Frag/Iron?					96	-		
Undiagnostic Slag	112	12	850	20	18471	18	1660	17
Vitrified Hearth Lining			1342	32	6520	6		
Fired Clay					134	-		
Fired Stone	10	1						
Stone					*20*	-		
Sub-totals	**122**	**13**	**2192**	**52**	**25473**	**24**	**1660**	**17**

Totals

	Unstratified	*Phase 2*	*Phase 3*	*Phase 4*
	Wt(g)	*Wt(g)*	*W (g)*	*Wt(g)*
	956	**4164**	**100739**	**9528**

7.8.12 The most significant figures in the foregoing are the sub-totals for smelting and smithing debris for Phases 2 and 3. From these, it appears that, whilst identifiable smithing waste outweighs identifiable smelting material by a factor of fifteen in the earlier period, in the later the smelting waste accounts for more than three times the weight of that from smithing.

Provenance

7.8.13 The material examined belongs largely to Phase 3 and is concentrated towards the centre of the site. There were reasonable quantities of residues also further to the south. It has been recovered from some 50 contexts and was also found during earlier evaluation work, where 31.6kg came from sixteen contexts (MoLAS 1998, 33-5). As the tables show, smaller quantities were recovered from contexts of Phase 2 and 4. This confirms the impression provided in the interim report, that smelting began at Mersham during the late Anglo-Saxon period and was at its height during the early medieval period. The results shown in Table Two suggest a marked increase in the relative importance of smelting as against smithing in the latter period. The small quantity from Phase 4 deposits may well be residual.

Conservation

7.8.14 Ferrous metallurgical residues are inherently robust and stable and, like ceramics, they tend to survive well in a buried environment. The material is stored as a bulk commodity and there are no problems with its storage over time. The residues are currently stored in 20 boxes and do not present any large storage problems. Following analysis, selected elements of the assemblage could be discarded.

Comparative material

7.8.15 Evidence for smithing is commonly seen on Anglo-Saxon sites, but traces of smelting are rare. Here, however, we are dealing with a site on the outskirts of the Wealden area, which is well known for the quantity of ironworking which was undertaken in the Roman, Anglo-Saxon, medieval and early post-medieval periods, by virtue of the presence of good ore and copious supplies of wood for furnaces (Drewett *et al.*, 1988, 330). Nonetheless it has been noted that, in the Weald and its immediate surroundings, physical evidence for iron smelting has seldom been encountered. A mid Anglo-Saxon smelting site is known from Millbrook in the Ashdown Forest in Sussex, and sparse traces have been discovered elsewhere (Tebbutt 1981; *ibid* 1982; Cleere and Crossley 1985). Within East Kent, massive quantities of smithing debris (amounting to over 4 tonnes of residues) have been recovered from excavations of a mid Anglo-Saxon site at Christ Church, Canterbury, but there is no unequivocal evidence there, as yet, for the smelting of iron (Bennett 1986; Jarman 1996; Houliston 1997). Charters relate Canterbury to the Weald in the Anglo-Saxon period (Appendix 7.21) and enhance the potential value of this assemblage.

Potential for further work

7.8.16 A good quantity of material survives, most of which is tap slag. Alongside the dense slag, this material provides good evidence for smelting in the immediate vicinity of the site. It has not proved possible to locate the furnaces by excavation or by remote sensing (MoLAS 1998, 16), but they may have been similar to those excavated at Ramsbury, Wiltshire and elsewhere (Haslam 1980). Smithing debris was also recovered and the types of hammerscale present (both spherical and flakes) indicate that both the primary smithing of blooms and the secondary smithing of iron were taking place at or near the site. Some of the end products could also be identified (see Appendix 7.11).

7.8.17 This intensive activity links the site with other 'industrial' complexes of this period, and notably those at Canterbury, Millbrook and Ramsbury, noted above. The sample of residues extends across the range of smelting and smithing processes, from the furnace to the finished product. Stock iron is not present, however, but the sample of finished material is relatively small. Mersham can, perhaps, be regarded as a site that came into operation at a time when the smelting and smithing of iron was no longer being carried out in the suburbs of Anglo-Saxon Canterbury. Equally, the material may have been prepared for other markets or, conceivably, for ecclesiastical projects. Pottery and tile kilns in and around Canterbury testify to the power and influence of the church at this time (Sherlock and Woods 1988; Cotter 1997).

7.8.18 The site appears to have been located on the fringes of the Weald for the specific purpose of iron production. It has been noted that late medieval sources suggest that iron production was centred in northern and central parts of the Weald (MoLAS 1998, 18), whilst known Roman iron working sites tend to concentrate in the southern Weald. The eastern Weald and downland is under-researched in this respect; it too lies close to appropriate sources of iron ore and the mechanisms that facilitated the industry in the Roman and late medieval period are not necessarily pertinent to the late Anglo-Saxon and early medieval period.

7.8.19 Ironworking sites of this date are scarce, as noted above. The value of this assemblage is enhanced by the systematic sampling programme, which has produced good quantities of hammerscale. The waste products are distributed around the central and southern parts of the site and spatial distributions by period may provide a tentative indication of the original location of the furnaces, which clearly lay close to or within the area of excavation.

7.8.20 In addition to contributing to the site's spatial analysis, examination of the remaining 80% of the residues may serve to confirm or correct, in the light of revised stratigraphic analysis and phasing, the impression provided by this assessment of a striking shift in the relative importance of smelting and smithing from the Anglo-Saxon to the early medieval period. If confirmed, this must reflect on the trading patterns and organisation of the site; it would seem to suggest either that the smiths operating here in the Anglo-Saxon period were importing most of their raw iron but smelting some and that local raw iron production met local demand in the early medieval period or, more probably, that local production met local demand in the Anglo-Saxon period and that the iron smelters working here in the early medieval period were exporting most of their raw iron but smithing some.

7.8.21 Bibliography

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