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The examination of metalworking waste from the Danebury Environs Roman Project, Hampshire

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Summary

Small assemblages of possible metalworking waste were recovered from Thruxton, Grateley South, Fullerton, Rowbury Farm and Flint Farm, all in Hampshire, as part of the Danebury Environs Roman Project. The assemblages were examined in order to identify and quantify different types of waste, particularly those diagnostic of particular metalworking processes. The assemblages were consistent with iron smithing, which took place at Thruxton and Fullerton in the Roman period and at Grateley South and Rowbury Farm in the late Iron Age (and perhaps Roman period). Copper alloys also appear to have been worked at Thruxton. A number of possible floor-level smithing hearths survived at Thruxton and Fullerton. The assemblage from Flint Farm was not diagnostic of metalworking.

Keywords

Metal Working Fe
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Introduction

The metalworking waste examined in this report is from 5 nearby sites in Hampshire that were excavated as part of the Danebury Environs Roman Project: Grateley South (GR98 and 99), Fullerton Villa (FL00 and 01), Thruxton Villa (TH02), Flint Farm (FF04) and Rowbury Farm (RF03) (Cunliffe 2001, 2002, 2003). Each assemblage has been approached in the same way (see methods below), but is discussed individually.

Background

Iron working involves two basic types of process: extracting the metal from the ore (smelting) and shaping the metal (smithing or forging). Early smelting took place using the bloomery process and resulted in a spongy mass of iron metal, known as a bloom, and an iron-rich slag by-product. The slag could be removed from the furnace in a variety of ways or left to cool within the furnace. Consequently the slag often retains a characteristic shape, texture and microstructure (Bayley *et al*, 2001) that can provide information on the type of smelting technology used.

Smithing is the process of hammering and shaping iron. Iron is more malleable when hot and so the metal was heated in a hearth, generally charcoal-fuelled. The hearth itself could be a shallow, walled structure built from clay or stone, either on the floor or at waist height. Smithing also resulted in the production of iron-rich slag waste, formed by the reaction of the lining of the hearth, ashes from the fuel and oxidised iron. Again, the slag generally has a diagnostic shape and texture and in this way can often be differentiated from bloomery smelting slag, even though it is quite similar in terms of its composition.

Metalworking waste was frequently removed from where it was produced and dumped in pits or ditches or re-used, for example for metalling roads. Therefore it can be difficult to identify where metalworking actually took place.

Methods

The metal working waste from the Danebury Environs Roman Project was examined and assigned to the categories described below.

Smithing hearth bottom (SHB) slags are lumps of iron-working slag that accumulated in the smith's hearth, in the fuel bed. SHB's are often roughly circular and have a characteristic plano-convex section.

Hammerscale is a by-product of smithing and comprises tiny flakes and spheres of iron-rich slag, which are strongly magnetic and metallic in appearance. Hammerscale is found in large concentrations (in excess of 25wt% of the sample) *in situ* on floor surfaces where smithing took place. Smaller amounts of hammerscale are also found with dumped smithing slag.

Dense slag describes fragments of unusually well-consolidated iron-working slag. These fragments may be atypical smithing slags or possibly smelting slags from a non-tapping furnace.

Undiagnostic slag describes waste, particularly small fragments, lacking sufficient diagnostic features for it to be confidently attributed to any other group.

Iron metal is dense and strongly magnetic, and can also be recognised by characteristic orange/brown corrosion products and blistering. The iron in these assemblages appears to be mainly objects or stock iron but also includes some metal incorporated into lumps of slag.

Vitrified lining can be a by-product of both smelting and smithing, since both furnaces and hearths were often partly or entirely clay-built. The vitrified surface of the clay is the result of reactions that take place at high temperatures between the clay and ashes from the fuel. However other high temperature processes can also produce vitrified clay, so alone it is not diagnostic of metalworking.

Fired clay can also be produced by many processes involving heat, and so alone is not diagnostic of metalworking.

Geological material includes nodules of iron-rich stone, coal and lava fragments. Although the former should be investigated as potential sources of ore if smelting is taking place, this material is not necessarily related to metalworking.

A small number of objects were also analysed using XRF (X-ray fluorescence) analysis. This technique is rapid and non-destructive and can be targeted on small, selected areas (just under 0.5mm diameter). Here the technique has been used to obtain qualitative information on the composition of objects.

Results

The results for each site are discussed sequentially. The different types of waste are also listed and quantified by context for each of the sites (with the exception of Flint Farm) in Tables 5 to 8 of the appendix.

Thruxton

The results of the excavation at Thruxton included early curvilinear ditched enclosures, a ritual shaft and burial, and a Roman southern rectilinear enclosure and aisled hall with a mosaic room (room 3). The assemblage from Thruxton was the largest of those reported here, weighing just over 19 kg. The vast majority of the assemblage was made up of small dribbles and globules of undiagnostic slag. There were a number of smithing hearth bottom slags (8wt%), and 5wt% each of iron and vitrified lining, and very little geological material. The material from F1063 also included two atypically large and amorphous pieces of metallic iron. Hammerscale adhered to many of the undiagnostic slag fragments and was also recovered from flot samples from all of the contexts in Table 1, plus contexts F1107 (an oven in the aisled hall) and F1092 (in the northwest corner of the hall). The amount varied but never exceeded 1.5wt% of the total sample. Overall, this assemblage is consistent with iron smithing activity.

85wt% of the assemblage was from the 9 contexts listed in Table 1. F1138, F1120, F1118 and F1119 are a cluster of features just outside the north-east corner of the aisled hall. These features are all fairly shallow (up to 0.3m at the deepest point) with maximum lengths and widths ranging from 0.6m to 1.25m. The fill of all of these features was rich in charcoal, small pieces of slag and some flint nodules. Some burnt chalk and flecks of orange clay were also noted. F1063 is a ditch passing 10-15m to the southeast of the aisled hall, and forming the northwest side of the Roman southern rectilinear enclosure. Layers 759 and 778, and feature F1141 are all in room 3 of the aisled hall, where the mosaic was laid. F1141 was a shallow, oval feature, 0.8m by 1m, sealed below the layers making up the foundation of the mosaic. The feature had a basin-shaped profile and contained charcoal, ash, slag, a mass of broken flint nodules, fired clay and a large flint block (0.18m by 0.25m).

Table 1: Information on the contexts containing the most metalworking waste from Thruxton (not including geological material)

Context	Type	Date	Weight (g)
F1063	Ditch	Mid-3rd to 4th C AD	2434
F1118	Possible smithing hearth	Roman	527
F1119	Possible smithing hearth	Mid-3rd to 4th C AD	4021
F1120	Possible smithing hearth	2nd to 4th C AD	4405
F1138	Possible smithing hearth	2nd to 4th C AD	561
F1141	Smithing hearth in room 3 of hall	Roman	1280
720	Ploughsoil		1277
759	Layer, room 3 of hall	Roman	1182
778	Layer, room 3 of hall	Roman	581

A number of possible floor-level smithing hearths can be identified amongst the contexts listed above, including F1141, F1138, F1120, F1118 and F1119. The features share similar sizes and forms, and had similar fills, rich in charcoal and slag, with occasional evidence of burning. Slag from F1116, F1141 and F1138 included flint fragments, suggesting that the smithing hearths contained, or were lined with, flint pebbles. This was also noted in the probable smithing hearth at Fullerton (see below).

One piece of slag from context F1118 incorporated flakes and spheres of hammerscale, confirming that it was waste from iron smithing, but also contained a corroded copper alloy droplet. Analysis of the droplet using XRF detected copper, tin and a small amount of lead, consistent with a bronze alloy. It is possible that a bronze object was accidentally melted in the hearth; however two fragments of ceramic that appear to have been used for copper alloy working were also amongst the assemblage. A small rim fragment with an adhering corroded copper alloy droplet was recovered from layer 736 (mid-3rd to 4th C AD) outside the southwest corner of the aisled hall. XRF analysis detected copper and tin and also small amounts of zinc, lead and silver. From feature F1116 (a late Iron Age ditch also quarried in the Roman period), a base fragment from a fairly large vessel was recovered with corroding copper alloy droplets across the inner surface. XRF analysis detected copper, tin and small amounts of zinc and lead. The presence of alloy droplets on one broken edge of the fragment suggest that the sides of the vessel had already been removed before it was used for metalworking, and that just the base was required.

Therefore iron smithing took place at Thruxton in the vicinity of the aisled hall in the Roman period. The hearths were probably constructed in part using flint pebbles. Copper alloys may also occasionally have been melted in the smithing hearths.

Grateley South

The results of the excavation at Grateley South included late Iron Age and early Roman ditches and pits, a later Roman aisled hall (building 1), a villa (building 2) and two strip buildings. The assemblage from Grateley South was small, comprising around 0.5kg of waste. Half of this material was smithing hearth bottom slags and a third was dense slag, whilst undiagnostic slag and concretions of hammerscale comprised about 5wt% each. Therefore the assemblage is likely to be waste from iron smithing. The material from 3 features (see Table 2 below) comprised 80wt% of the assemblage.

Table 2: Information on the contexts containing the most metalworking waste from Grateley South (not including geological material)

Context	Type	Date	Weight (g)
427	Charcoal layer, beneath building 2	Roman	132
F826	Pit	LIA 1st C BC / AD	161
F749	Ditch	LIA	93

This assemblage is small, making meaningful interpretation difficult, but it is probable that iron smithing took place on a small scale in the vicinity of the site in the late Iron Age and possibly also the Roman period.

Fullerton

The excavation at Fullerton found building 1, a villa with mosaic-floored rooms and a bathsuite at the south end, and building 2, a masonry-built structure. The assemblage of possible metalworking waste from Fullerton was small (just less than 3kg of material) of which about 740g was geological in origin, such as iron-rich nodules, coal and fragments of vesicular lava. The latter is likely to be Niedermendig lava from broken quernstones. Of the remaining material, just over a third was smithing hearth bottom slags and a third was undiagnostic slag, with less than 10wt% each of iron, vitrified lining, fired clay and dense slag. As none of the waste definitely came from processes other than iron smithing, it is likely that the metalworking waste in this assemblage is all from iron smithing. Small quantities of hammerscale were also retrieved from layers 651 (1wt% of the total sample) and 597 (0.5wt% of the total sample) both in the bathsuite of building 1, also consistent with smithing.

Almost 90wt% of the metalworking waste (not including the geological material) comes from the five Roman contexts listed in Table 3. Much of the slag appears to have been dumped (for example in the enclosure ditch, the gully and the layers in the bathsuite of building 1). However some slag (472g) was recovered from a hearth, F943, in building 2. F943 was a shallow, circular depression with light burning and an upper surface partially lined with flints. Although this was not seen by the author, the magnetic fraction of a sample from the base of this feature (layer 3) was reportedly 28wt% of the total and included a small amount of hammerscale and other tiny slag fragments.

Table 3: Information on the contexts containing most of the metalworking waste from Fullerton (not including geological material)

Context	Type	Date	Weight (g)
F926	Gully along wall of building 2	Roman (240 AD+)	431
F943	Hearth, building 2	Roman (240 AD+)	472
F888	Enclosure ditch	Roman	418
651	Layer in stokehole F1002, building 1, south end (bath suite)	Roman (240 AD+)	285
592	Layer in building 1, south end (bath suite)	Roman	191

Smithing appears to have taken place on a small scale at the site in the Roman period, and hearth F943 may have been used for this purpose.

Rowbury Farm

There were three broad phases of activity at the site: the early-mid Iron Age, the late Iron Age and the early Roman period, during which a number of enclosures were laid out. The assemblage from this site was very small, around 800g, 225g of which was geological in origin (iron-rich nodules etc.). 90wt% of the remaining material was deposited in two enclosure ditches, in excavated sections within 10m of each other (see Table 4), and consisted predominantly of a smithing hearth bottom slag, a fragment of dense slag (possibly also a SHB slag) and some undiagnostic slag.

Table 4: Information on the contexts containing the most metalworking waste from Rowbury Farm (not including geological material)

Context	Type	Date	Weight (g)
F1196	Enclosure 5 ditch	Roman (mid-1st to early 3rd C AD)	142
F1183	Enclosure 2 ditch	LIA (mid-1st BC to mid-1st AD)	371

This assemblage is very small, making meaningful interpretation difficult, but it is probable that iron smithing took place on a small scale in the vicinity sometime in the late Iron Age and possibly early Roman period.

Flint Farm

The assemblage from Flint Farm was small, comprising an 18g bronze lump (containing copper, tin and a small amount of lead) from FF04/1 Ph 1774 1, sample 3443, which alone is not diagnostic of metalworking. The magnetic residues retrieved from samples taken at the site were largely fired clay, and so again were not diagnostic of metalworking.

Conclusions

The assemblages from Thruxton, Grateley South, Fullerton and Rowbury Farm are all consistent with iron smithing. The largest amount of waste was recovered from Thruxton, where 5 possible floor-level smithing hearths survived from the Roman period. There was also some evidence for copper alloy working, potentially using the same hearths. At Fullerton, another possible floor-level Roman smithing hearth, lined with flints, was identified. The assemblages from Rowbury Farm and Grateley South were small, but were probably the result of iron smithing activity nearby in the late

Iron Age and possibly early Roman period. The assemblage from Flint Farm was not diagnostic of metalworking.

References

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Appendix

Table 5: Different types of material by context in the assemblage from Thruxton Villa TH02 (weights in grams) over 5 pages

Context	Sample	Un-diagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geol-ogical	Other	Notes
PH1234 1	4168	25								
PH1232 1	4167	5								
F1162 1		8								
F1154 1									1	Carbonaceous matter
F1141 2	4174	261		140						
F1141 2	4196	315		83						Flake hammerscale in slag
F1141 2	4196								11	Carbonaceous matter
F1141 1	4139	126		71						Iron includes objects, slag includes hammerscale
F1141 2	4174	221								Large, strongly magnetic mass including lots of hammerscale
F1141 2	4174	63								Pebble, hammerscale and slag
F1138 2	4172	114		47						Piece of slag with large flint fragments
F1138 2	4135	124		24						
F1138 1	4157	232			20		3			
F1136 5	4191	12								
F1136 3	4190	5								
F1136 2	4189	58								
F1127 1	4144		20							

Table 5: continued.

Context	Sample	Un-diagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geol-ogical	Other	Notes
F1125 1	4123	27								
F1124 2	4112	20								
F1120 2	4148	537		36	14					Hammerscale in slag
F1120 2	4136	10								
F1120 1	4176	1498		49	651			35 nodule		Fe metal mainly objects, hammerscale in slag
F1120 1	4130	1340								Small dribbly pieces, some with hammerscale
F1120 1	4156	243		27						Slag includes some hammerscale
F1120 1									Cera-mic	Vitrified, oxidised base
F1119 2	4131	854		50				3 nodule		
F1119 2	4173	508		9	168		1			
F1119 1	4175	838	694	1						SHB large with adhered clay, slag plus hammerscale
F1119 1	4099	656	143		100					
F1118 2	4137	31								
F1118 1	4097	233		28						Slag includes lump with hammerscale and corroded green droplet
F1118 1	4133	229								

Table 5: Continued.

Context	Sample	Un-diagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geol-ogical	Other	Notes
F1118 1	4162	6								
F1116/1 3	4096		288							Dense, with large rounded flint pebbles
F1116/1 2	4122	17								
F1116/1 5									Cera-mic	Corroded copper alloy droplets
F1112 3	4129	21								
F1112 2	4186	10								
F1107 2	4165	53								
F1107 2	4169	32								
F1107 2	4161	30								
F1106 1	4141	22								
F1105 3	4070	2								
F1105 2	4158	15								
F1105 1	4121	21	51							
F1096 2	4128	19								
F1096 1	4113	53								
F1092 3	4188	40								
F1088 3	4127	5								
F1083 1	4117	21								
F1083 1	4142	10								
F1082/2 3	4108	22								
F1082/1 3	4107	8								
F1081 1	4118	32								
F1081 1	4143	7								
F1078 1	4171	26								
F1066/7 1	4114	9								

Table 5: Continued.

Context	Sample	Un-diagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geol-ogical	Other	Notes
F1066/3 1	4106	26								
F1066/2 1	4126	13								
F1064 1	4104	39								
F1063/5 2	4103	10								
F1063/4 2	4102	40								
F1063/4 1	4098	87				135				
F1063/3 4	4116	59								
F1063/3 3	4111	181								
F1063/3 2	4110	129								
F1063/3 1	4109	341		30						
F1063/2 4	4115	54								
F1063/1 3	4105	250			20					
F1063/1 2	4101	303		223		93				Two large pieces of iron, slag includes hammerscale
F1063/1 2	4068	337								
F1063/1 1	4100	142								
F10042 2	4187	19								
778	4184	581								
763	4170	122								
759	4185	570		51						
759	4134	561								
755	4125	71								
754	4124	12			10					
744	4089	100								
743	4140	18		16		16				
742	4088	276								

Table 5: Continued.

Context	Sample	Un-diagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geol-ogical	Other	Notes
742	4120				35					
741	4094	3			3					
736	4095	48								
736									4	Crucible with green spot
735	4093	26								
733	4092	34								
732	4091	97							8	Ceramic?
732	4086	8								
729	4085	80	80	58	2					
727	4084	11								
726	4083	269								
725	4082	40								
724	4081	141								
723	4080	105			7					
722	4079	43							2	Carbonaceous matter
721	4087	3								
720	4119	680	356	7	23					
720	4090	211								

Table 6: Different types of material by context in the assemblage from Grateley South GR98 and GR99 (weights in grams)

Context	Sample	Undiagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Other	Notes
427/430	2283					132			
F826	3402		120		4				
F826	3270	25							
F826	3404	12							
F793	3386					41	13		
F766/5	3271		42						
F750	2309	11							
F749	2301		93						
F719/2	2132						6		
F683	2086			7					
F663	2108							4	Green glazed clay
377	2085	2							

Table 7: Different types of material by context in the assemblage from Fullerton FL00 and FL01 (weights in grams)

Context	Sample	Undiagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geological	Notes
F980 1	4002							20	Lava
F980 1	3950							21	Lava
F972	2903	9							
F943 3	8386	13		10					
F943 2	8384	63		47					
F943 1	3826	208	83	48					
F939 3	3825	2							
F939 2	3824							20	
F926 1	4030	235			196		21		
F888 6	3873	24							

Table 7: Continued.

Context	Sample	Undiagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Fired clay	Geological	Notes
F888 3	3681		394						Quite dense slag.
653	4004	63					50		
651	4003		165						
651	4035	61							
651	4005	59							
650	4025							7	Lava
644	4009							6	Lava
621	3952							477	Coal
594	3910					117			
592	3909		191						
579	4031							187	Nodule
573	3907					33			
536	3725	2							
524	3823			13					
481	3819						78		
481	3849	1							
480	3722	2							

Table 8: Different types of material by context in the assemblage from Rowbury Farm RF03 (weights in grams)

Context	Sample	Undiagnostic	SHB slag	Iron	Vitrified lining	Dense slag	Geological	Notes
P440 3					4			
P437 5	4290				1			
P419 6	4222	2						
P413 6	4278	13						
P413 3	4224				1			
F140/7 1	4275			14			42 (heamatite)	
F1263 4		2						
F1263 2	4287	9						
F1253/6 1							17	
F1196/3 1	4274		142					SHB also dense
F1192/6 1							153 (nodule)	
F1184 1	4276						13 (nodule)	
F1183/15 1	4288					333		Dense slag may be SHB
F1183/13 1	4277	38						
F1181/11 1	4273	9						