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Assessment of archaeometallurgical residues from Lurke St., Bedford (LUR17)

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Abstract

The submitted material comprised approximately 25.5kg, of which 14.3kg was two large slag blocks. The collection was derived from 11 contexts and included both hand-picked items (mainly from ditch-fills) and residues from bulk sampling (mainly from pit-fills).

The assemblage was dominated by residues from iron smelting. This material included large hand-picked blocks from the fills of ditches [129] and [137], as well from the fill of pit [223]. Small amounts of material from other contexts may also have largely been residues from iron smelting. The iron smelting residues were of slightly unusual appearance. Only two large blocks, and a proportion of the finer-grained material, were conventional tapped slags. Other materials were dominated by pale grey slags, sometimes with a slightly brownish-red surficial colour, but often without obvious surficial oxidation. One of the large blocks (from ditch fill (139)) was of this type. It comprised a rather chaotic accumulation of pale grey slag prills, and besides the lack of any evidence for an organic pit-packing, it closely approached the form and structure of some non-tapping slag pit furnace residues. Some of the smelting slags showed a rather low bulk density, a high vesicularity and a glassy texture. These characteristics all suggest a possible slightly calcareous composition to the slag. The assemblage is not able to provide a more precise interpretation of the technology, or technologies, employed

Alongside the smelting residues, was a lesser proportion of residue from iron smithing. These materials were particularly important in the assemblage from context (216). The abundance of coarse, often rather slaggy, tabular residues, of slag-rich spheroidal microresidues and a lack of classic fine spheroidal hammerscale, might suggest, perhaps, that these were residues from the consolidation of the smelted iron.

Bedford is not part of a recognised area for iron smelting, although smelting slags have been recorded from the town before. Large-scale medieval iron production is known from the outcrop of Jurassic ironstones 20 km northwest, and a much lesser scale of production from the Chilterns 20 km to the southeast. The unusual location and unusual characteristics of the assemblage may indicate a local ore source, perhaps a bog iron ore.

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Methods

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis.

The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

This assessment was conducted in January 2018 and was commissioned by Ed McSloy of Cotswold Archaeology.

Results

General description of the assemblage

The submitted assemblage comprises some 25.5kg of material. Over half of this was contributed by two large slag pieces (from contexts (132) and (139)). A further nine large pieces from contexts (132) and (226) contributes to total weight of 23.9kg for the large blocks. The other materials amounted to a total of 1.6kg, mostly derived from the processing of bulk samples.

Ironworking residues

Iron smelting slags

Dense slags interpretable as having been produced during iron smelting comprise most of the assemblage. This material is mainly in the form of flow slags, tentatively identifiable as having been tapped from the furnace.

A large (7.4kg) block from context (132) shows surficial reddening, indicative of interaction of the flowing slag with oxygen – and usually a good indicator of slag that has been tapped. The slag appears to have flowed from the furnace and fallen into an almost flat-bottomed pit from a tapping hole well above the base of the pit, and constrained laterally by ceramic – perhaps the sides of the tapping arch or channel.

A 2.4kg slab-like block from context (226) was probably also formed in a similar flat-bottomed pit.

In contrast, the large block (7.0kg) from context (139) is formed of an agglomeration of slag prills, possibly fragmented, formed of pale grey slags, with no surficial reddening. This agglomeration appears to have filled the bottom of a rounded pit. Such an accumulation might have formed in the base of an external tapping pit (brecciation has been observed in cakes believed to have formed in charcoal/ash filled pits at Hemyock, for instance; Young 2016). Similar slag cakes may also be formed within the basal pits of non-tapping furnaces (which lack the oxygenated atmosphere capable of producing the surficial reddening).

The other block material from context (132) also included several that are compatible with either the margins of blocks from a non-tapping slag block or an internal furnace bottom from a slag-tapping furnace. None of these shows any superficial reddening.

The finer-grained smelting residues included a variety of fragments of slag masses similar to the larger blocks, and also a variety of flow slags, ranging from thin sheets, to individual elongate prills. Most of these are pale grey in colour and often show a brown superficial colour.

Smithing hearth cakes

Slag pieces interpretable as being parts of smithing hearth cakes (SHCs) were recovered from contexts (216) and (226). Those from context (226) were very heavily weathered, which differentiated them from most of the remainder of the macroscopic assemblage which was well preserved. Only one was sufficiently complete to provide any indication of size, probably suggestive of a medium-sized example (140mm wide and 45mm thick). The weathering meant that the weight of the pieces was probably not representative of the original values.

A fragment of SHC from context (216) in the evaluation, was from the lower part of the thickness of a moderate to large example. The dense crust was approximately 30mm thick, with large bladed olivine extending through most of the thickness. Such textures have, in examples from Ireland, been demonstrated to be from SHCs associated with the working or remelting of blooms as part of their conversion to usable iron (e.g. the 'thick crust cakes' of Young 2012).

Hearth/furnace lining

Only tiny fragments of strongly vitrified ceramic were recovered (the largest scraps occurred in context (226)), with small fragments of both cermaic and lining slags across many of the residues from bulk samples.

Micro-residues

The residues from the bulk samples contained a variety of microresidues. Sample <9> from context (216) contained a moderately rich assemblage of smithing microresidues. These included examples of flake hammerscale (FHS), slag blisters, slag flats and spheroidal particles (in a separate sub-sample). The spheroidal particles mostly had a dull surface lustre and did not appear closely to resemble classic spheroidal hammerscale (SHS; Young 2011).

Lesser quantities of material resembling both FHS and SHS were present in several other samples, but almost all the material was atypical and an origin in iron smelting cannot be excluded for this material.

Some of the slag pieces (and possible iron) possessed adhering ferricrete with microresidues and charcoal.

Distribution of the assemblage

The residues were recovered from the fills a range of of pits and ditches. None of the contexts appears to be a primary metallurgical context, but rather places of waste disposal.

Interpretation

The presence of iron smelting slag is not entirely to be unexpected, given its record on other medieval sites in the town, including those described by (Baker *et al*. 1979), the Empire Cinema site (Hassall 1983), the Liberal Club site (Baker 1986), to a lesser extent the Bennett's Works site (Baker 1986). On most of these sites the iron smelting appears to have been 10th-12th century (Late Saxon – Norman). The technology was

described as slag tapping, but there is no detailed account of the slags in any of these reports. Some iron smelting may have continued to be undertaken in the area slightly later, for Amt (2002) suggested that some of the iron required for the siege of Bedford in 1224 was sourced very locally (she implies that some came from sources closer than the main nearby smelting areas).

The present material, with the possible exception of the large block from context (132), largely lacks the well-developed tapped slag accumulations that are typical of post-12th century iron smelting. The assemblage is perhaps more suggestive of tapping into pits with reducing conditions, rather than extended flow in contact with air. It is possible that the assemblage includes material from technologies both tapping and non-tapping. The period between the tenth and twelfth centuries shows rapidly-changing technologies, before a more standardised technology became established. This assemblage is insufficient, however, to provide unequivocal evidence for the nature of the technology.

Bedford is not part of a recognised area for iron smelting. Large-scale medieval iron production is known from the area of outcrop of Jurassic ironstones 20 km northwest, and a much lesser scale of production from the Chilterns 20 km to the southeast. Although examples are known for which iron ore was transported long distances from its source, usually to areas rich in woodland to provide the charcoal, they are typically associated with examples were the iron ore sources were physically compact. Iron ore from the Forest of Dean was taken up to 50km to be smelted in both the Roman and medieval periods, including to urban locations in Newport, Caerleon, Monmouth and Worcester. Perhaps it is significant, however, that there is little evidence for such trade in the 9th to late 11th centuries. Thus, although derivation of the iron ores from Northamptonshire is possible, it is perhaps more likely that there was an as yet unrecognised more local source – perhaps a bog iron source in the Ouse valley. Clarification of the resource behind what appears to have been an important industry in Saxo-Norman Bedford would be desirable.

The small amount of evidence for smithing may well be associated with the working of raw iron blooms into usable form.

Further work

The limited assemblage and the lack of association with any metallurgical features, means that the research potential for the assemblage is reduced – particularly for questions of a technological nature. The key issue that could/should be addressed through additional laboratory analysis would be to attempt to clarify the origin of the ore being smelted through examination of the chemical composition of a small representative selection of smelting slag samples.

Irrespective of the commissioning of any further investigation, the assemblage is of significance, despite its small size, because iron smelting in Bedford has not previously been investigated and should be deposited with the site archive in an appropriate receiving institution.

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Table 1: summary catalogue. SHC = smithing hearth cake, FHS = flake hammerscale, SHS = spheroidal hammerscale, assm = uncounted assemblage. Weights in grams.

Context	sample	fraction	S wt	Item wt	No.	Notes
LUR17						
117	<6>	industrial waste	30	30	16	6 siliceous hard stone granules, 1 ironstone grain, 1 probable stone with a clear glaze, 1 large greenish prill of slag, 4 fragments of vesicular probably tapped slag, 1 dark tabular grain of uncertain origin, 2 fragments of lining slag
117	<6>	hammerscale	<1	<1	2	2 spheroids, unclear if true scale, or more likely, slag droplets
117	<6>	magnetic material	<1	<1	assm	assemblage of rusty fragments, clay, slag and FHS-like flakes- however these may be surfaces of slag pieces rather than true scale
120	<1>	industrial waste	5	5	2	fine-grained slag prills, probably tapped slag fragments, maroon surfaced
120	<1>	magnetic material	<1	<1	assm	larger collection of small fragments of fired clay, rust, burnt stone, claystone particles, slag debris and probable flake hammerscale
126	<4>	industrial waste	<1	<1	2	small slightly clinkery appearing slag, but possible scraps of smelting slag, given the odd colour of these slags
132			7385	7385	1	220x200x110mm, large cake of tapslag, showing descending prills at proximal end, surface maroon/purplish colour, possible ceramic contacts on both sides - but possibly not in-situ channel walls, base shows small amount of inverted debris below lowest flows, basal surface appears to have been soil/clay and was possibly almost planar and probably flat, or vert slightly dipping wards furnace
132			5605	966	1	rounded dense block of grey slag with pale veins, similar to large block from 139, large mass of attached iron rust,
				1155	1	block of dense slag, flow lobes towards base, possible overhanging cermaic contact above, 100mm deep, large rounded voids, internally more massive rather than well developed lobes
				1260	1	possible proximal side of slag pit cake, dished top, steep side, lobes on base, more massive internally, similar pale grey colour with pale veins
				1150	1	dense slag block, slightly lobate on parts of outside, some pale streaks films inside, contains a single elongate charcoal clast, one side shows fracture through what might be a burr - with a contact with the other slag marked by a line of small vesicles,
				1085	1	dense massive grey slag block, some sides are straight fractures, outer side appears abraded and polished,
132	<3>	industrial waste	<1	<1	1	small dark slag fragment of uncertain origin

139			6970	6970	1	230x180x130mm, large dense slag block, formed of rather chaotic accumulation of prills, lots of lime? Coating, some iron corrosion, one probable wall contact, probable upper surface shows probable polishing, all rather unusual. Probably but not certainly a slag pit slag cake.
142	<5>	magnetic waste	<1	<1	assm	small collection of mostly rock fragments, maybe 4 slag particles
214	<8>		8	8	assm	7 fragments of partly botryoidal iron oxide crusts, 9 fragments of vesicular prilly slags, 1 ironstone granule, 1 possible rock fragment with burnt fossils, 1 dark fragment resembling a slag flat
216	<9>	hammerscale	<1	<1	assm	approximately 80 spheroidal particles, mostly individual, some amalgamated, purplish colour, might be SHS but probably not
216	<9>	magnetic material	27	27	assm	rich smithing waste assemblage, large FHS, blisters, flats, but no SHS, lots of rusty debris
216	<9>	industrial waste	230	230	3	charcoal -rich slag fragments encased in smithing floor concretion. Largest piece is elongate and shows some 'explosion' - it is unclear if it is cored on a long piece of slag with some iron, or a long piece of iron
216	<9>	industrial waste	731	731	assm	collection of debris from iron smelting, charcoal-rich rusty slags, dense (wustite-rich) flow slags, frothy black glassy slags and some more conventional flow slag fragments
226			3900	2400	1	150x170x100mm, parallel slab like tapslag lump, good maroon-surfaced, possibly slightly glassy rivulets on top, base rather more chaotic, bulk is good firm slag flows, but base is slightly different.
				1260	2	very highly weathered rounded lumps of charcoal-bearing slag, appears to be very highly altered SHCs, more complete example 130x140x45mm approximately, but not capable of determining whether complete
				226	1	rounded weathered slag lump, possibly also a SHC fragment but lacks diagnostic features
226	<7>	industrial waste	554	554	assm	assemblage of smelting slags, mostly flow slags with brown surfaces, some vitrified lining, all rather scrappy, Typical material is dense but vesicular
226	<7>	hammerscale	<1	<1	assm	spheroids and agglomerated spherules, probably slag droplets rather than true scale
237	<10>	hammerscale	<1	<1	assm	very small collection of possibly glassy microresidues, some are sub millimetre spheroids, but some are multiple, suggesting these are not true hammerscale
237	<10>	magnetic waste	2	2	assm	moderately-sized collection of slag, some scale-like material, rough rusty, stone like material, polished ferruginous granules,

237	<10>	industrial waste	<1	<1	assm	2 FHS like pieces, 4 slag fragments, 1 probably ironstone granule, scale like material has one almost cokey texture and the other shows possible slightly fragmental texture on its shinier side

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216			23	21	1	lime-coated probable SHC fragment, brown colour throughout, fresh bladed olivine very large, sub-spherical vesicles, dimpled base, possibly protruding olivine on upper surface, but obscured and worn
				1	1	highly vesicular dark glassy probable lining slag
				<1	2	tiny fragments of dark, abraded finely vesicular dense slag, at least one showing hint of oxide surface suggestive of a tapped slag
505			11	8	1	irregular mass of secondary iron oxides, binding cermaic and charcoal - unclear if it has a true slag core
				2	1	dimpled irregular lobate lump of dark glossy slag, an intra hearth/furnace drip

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