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BOWES ROMAN FORT, COUNTY DURHAM EXAMINATION OF IRONWORKING DEBRIS

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Summary

An assemblage of ironworking debris from Bowes Roman fort was visually examined and compared to other slag assemblages from both military and civilian sites. This showed that the metalworking process occurring on site was iron smithing as there was a complete lack of smelting evidence. The XRF analysis showed that coal was the main fuel used. From the spatial distribution of the slag the focus of smithing activity was within the fort. The chronological distribution showed that smithing was occurring on site from the first through to the fourth century AD, with a peak of activity in the third century.

Keywords

Technology, Roman, Metalworking-Fe

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Introduction

An assemblage of ironworking debris was recovered from Bowes Roman fort. A visual analysis and supplementary X-ray fluorescence (XRF) analysis was undertaken to identify the processes occurring on site and the material that was being used as fuel.

Background

The Roman fort at Bowes (named *Lavatris)* in County Durham, national grid reference NY 993 135, was excavated by B R Hartley and S S Frere in 1967 and 1970. The area of the fort is approximately 1.6 hectares and it is of the usual playing card shape.

From surviving inscriptions on altars there is evidence of the presence of Thracian and Frisian cohorts (Wooler 1913); this suggests that Bowes operated as an auxiliary fort. The evidence for occupation provided by surviving coins and altar inscriptions shows that the site was in use from the first through to the fourth century AD. The *Notitia Dignitatum* states that the *Numerus Exploratorum* was stationed at the fort about AD 400. However there is no absolute date for the abandonment of the fort. From this array of evidence it may be presumed that the fort was in constant occupation from the reign of Nero by auxiliary troops. The fort had an annexe, an additional enclosure to the north, added during the Flavian period which was abandoned during the reign of Hadrian. There was also a *vicus* (an extra-mural civilian settlement) approximately 140m east of the fort which appears to have been occupied throughout the Roman period.

During excavation the trench and layer numbers were recorded with letters, Roman and Arabic numerals, an example being E I 11. This refers to the excavation of 1970 (E), trench I, layer 11. All the trenches labelled A were in the Flavian annexe, trenches B were in the *vicus*, trenches C were over the eastern fort defences, trenches D were placed over the southern fort defences, with trench D I reaching the *praetorium,* and trenches E were within the fort. Hartley and Frere excavated several structures within the fort north of the *principia* and east of the *Via Principalis*, which were identified as workshops (Frere *et al* 1987, 251).

Aims

The aims of this report were to identify the metalworking processes that occurred on site, examine the spatial and chronological distribution of the assemblage, assess the scale of production, and identify the type of fuel(s) used.

Methodology

The assemblage was visually examined and classified following the methods set out in Bayley *et al* (2001). The weight of material of each type (from each context) was recorded. The types of material identified were smithing hearth bottoms, vitrified ceramic material, non-diagnostic ironworking slag, fuel ash slag, stone and other material. Smithing hearth bottoms (SHB) are plano-convex masses of slag that collect in a smith's hearth. The vitrified ceramic material (VC) is parts of the hearth or furnace which has vitrified due to the high temperatures causing reaction with the alkali fuel ash. The non-diagnostic ironworking slag (ND) is ironworking slag which lacks any distinctive morphology which would allow it to be

recognised as originating from either smithing or smelting processes. Fuel ash slag (FAS) can be formed when alkali fuel ash vitrifies at high temperatures and is not necessarily associated with any metallurgical processes. The assemblage also included small amounts of stones which have vitrified surfaces, and coal. The vitrified surfaces of the stones suggest that they had been exposed to high temperatures and they may have been part of the structure of the hearth or furnace.

A selection of samples were analysed qualitatively using energy dispersive X-ray fluorescence (EDXRF) to confirm that they were not non-ferrous slags and to identify the nature of the fuel used (coal or charcoal). EDXRF analysis of specimens of charcoal and coke from the reference collection showed that charcoal contains calcium and potassium but little aluminium and sulphur (as well as other elements), while coke contains some calcium and potassium but more aluminium and sulphur.

Results

Table 1. Weights of different materials recovered from Bowes

Material	Weight (kg)
Smithing Hearth Bottoms	0.847
Vitrified Ceramic Material	3.050
Non-Diagnostic Slag	4.247
Fuel Ash Slag	0.002
Stone	0.167
Coal	0.019

The weight of each type of slag from each context is listed in the appendix and summarised in Table 1. The total recorded mass of the assemblage was 7.744kg. This is relatively small, and along with the lack of smelting evidence suggests that the process occurring was smithing. This in turn indicates that the vitrified material recovered is vitrified hearth lining rather than furnace lining. Similarly, the lack of diagnostic smelting slags suggests that the non-diagnostic slags were produced by iron smithing. The chronological and spatial distribution of the ironworking slags is discussed below.

The Fuel(s)

The recovery of fragments of coal from the excavations suggests that coal may have been used as a fuel. A review the evidence for the use of coal in Roman Britain as a whole suggests that it was used for iron smithing (Dearne and Branigan 1995, 84). A visual examination of the slags from Bowes showed that many contained fragments of partially burnt fuel, however, in almost all cases the fuel was too burnt to demonstrate whether it was charcoal or coal. The EDXRF analysis of several fuel inclusions showed substantial aluminium and sulphur peaks and confirmed that the coal used was as a fuel in the smithing process. The nearest outcrop of Coal Measures to the fort at Bowes is 5km to the north.

Spatial distribution of the ironworking slags

The ironworking slag was not evenly distributed across the site (Table 2). The excavation of the Flavian annex produced only a single fragment of slag but this was of fuel ash slag (ie not necessarily metallurgical) from a medieval context. No ironworking slags were recovered from the excavations in the *vicus* or the trenches on the eastern defences. Most of the slag came from the interior of the fort in Areas D and E. The spatial distribution of the ironworking slags suggests that the ironworking took place inside (and not outside) the fort.

Table 2. Weight of slag from each area (in grams)

Area	Description	Weight
A	Flavian Annexe	2
B	Vicus	0
C	Easter defences	0
D	Southern Defences and interior	4106
E	Interior	4224

Chronological distribution of the ironworking slags

Ironworking slags were recovered from a range of contexts dating from the first to the fourth centuries AD (Table 3). It appears that ironworking took place throughout the occupation of the fort but most of the activity in the excavated areas took place in the third century.

Table 3. Chronological distribution of ironworking slags (in grams)

	SHB	ND	VC	Other	Total
First or second century	0	185	272	0	457
Second or third century	0	483	0	0	483
Third century	847	2271	2371	19	5508
Fourth century	0	1308	307	167	1782
Medieval and unphased	0	0	100	2	102
Total	847	4247	3050	188	8332

Comparison with other Roman sites

The excavation of almost any Roman site will produce at least some slag. The range of ironworking slag recovered from the excavations at Bowes is broadly comparable with that from many other sites, both military and civilian. The quantity of iron smithing slag recovered from Bowes is relatively small however; this is due to the small area that was excavated. To allow comparisons between different sites, the mass of slag per hectare excavated has been calculated for Bowes and a range of military and civilian sites (Table 4).

The concentration of ironworking slag at Bowes is higher than at Housesteads or Birdoswald. The concentration of ironworking at Birdoswald might be under-represented as it has been suggested that some was disposed of over the cliff edge at the site (McDonnell 1991). Most non-military sites in Roman Britain have produced relatively small concentrations of iron smithing debris (Table 4). The concentrations of iron smithing slag from most civilian sites are lower than at Bowes and Birdoswald. The only civilian site (in Table 4) with a higher concentration of slag than Bowes is the Courage Brewery site in Southwark which specialised in metalworking, and iron smithing in particular (Hammer 2003). The quantity of iron smithing slag recovered from Bowes is high given the limited

extent of the excavation and is comparable to specialised iron smithing sites rather than 'ordinary' civilian sites, rural or urban.

Table 4. Concentration of iron smithing slags from Bowes compared to other sites.

Site	Source	Area Excavated (ha)	Weight of Slag (kg)	Concentration (kg/ha)
Bowes	This report	0.026	8.144	313.2
Birdoswald	McDonnell 1991	0.178	7.77	43.6
Housesteads	Dungworth 2001a	0.754	13.148	17.4
Southwark	Hammer 2003	0.23	317.964	1382.4
London	Dungworth and Bowstead-Stallybrass 2001	0.57	22.838	40.1
Shepton Mallet	Leach 2001	1.8	50	27.8
Bancroft	Williams and Zeepvat 1994	1.0	25.6	25.6
Heybridge	Dungworth 2001b	21	187.727	8.9
Higham Ferriers	Hatton 2004	2.5	5.3	2.1

Conclusion

The examination of the assemblage has shown that iron smithing (and not iron smelting) took place as Bowes. The EDXRF analysis of fuel inclusions within the slag demonstrated that coal was used. The material from dateable contexts indicates that ironworking activity began in the first century, but was mostly concentrated in the third century. The majority of iron smithing activity occurred inside the fort; no significant slags were recovered from the Flavian annex or the *vicus*. While the total weight of iron smithing slag recovered from Bowes is small, the concentration of slag (in kg/ha) is high. This concentration of iron smithing slag is higher than most civilian settlements and is only exceeded by the specialised iron smithing site in Southwark (Hammer 2003). This high concentration lends weight to the idea that the Roman army was engaged in the manufacture of it own equipment (Bishop and Coulston 1993).

References

Bayley, J, Dungworth, D and Paynter, S 2001 *Archaeometallurgy.* Centre for Archaeology Guidelines 2001/01. London: English Heritage

Bishop, M C and Coulston, J C N 1993 *Roman Military Equipment.* London: Batsford

Dearne, M J and Branigan, K 1995 'The use of coal in Roman Britain'. *The Antiquaries Journal* **75**, 71–105

Dungworth, D 2001a *Metal Working Evidence from Housesteads Roman Fort, Northumberland*. Centre for Archaeology Report 109/2001. London: English Heritage

Dungworth, D 2001b *Metal Working Debris from Elms Farm, Heybridge. Essex*. Centre for Archaeology Report 69/2001. London: English Heritage

Dungworth, D and Bowstead-Stallybrass, H S 2000 *Metal Working Evidence From No.1 Poultry, London*. Ancient Monuments Laboratory Report 54/2000. London: English Heritage

Frere, S S, Rivet, A L F and Sitwell, N H H 1987 *Tabula Imperii Romani Britannia Septentrionalis.* Oxford: Oxford University Press

Hammer, F 2003 *Industry in North-West Roman Southwark. Excavations 1984–8*. London: Museum of London Archaeological Service

Hatton, G 2004 *The Identification of Metalworking Debris from Kings Meadow Lane, Higham Ferriers, Northamptonshire*. Centre for Archaeology Report 31/2004. London: English Heritage

Leach, P 2001 *Fosse Lane, Shepton Mallet, 1990*. London: Society for the Promotion of Roman Studies

McDonnell, J G 1991 *The Ironworking Evidence from Birdoswald Roman Fort, Cumbria*. Ancient Monuments Laboratory Report 100/91. London: English Heritage

Williams, R J and Zeepvat, R J 1994 *Bancroft*. Aylesbury: The Buckinghamshire Archaeological Society

Wooler, E 1913 *'The Roman Station of Lavatrae (Bowes)., Yorkshire Archaeological Journal* **22**, 400–410

Appendix

Weights of non diagnostic slag (ND), vitrified ceramic material (VC), stone, fuel ash slag (FAS), coal and smithing hearth bottoms (SHB), shown in grams

Year	Trench	Layer	ND	VC	Stone	FAS	Coal	SHB	Context Description	Context Date
1966	A II	3	0	0	0	2	0	0	Residual material from Flavian annexe	Medieval
1967	D I	10	89	0	167	0	0	0	Street make-up	Late fourth century
1967	D I	12	0	91	0	0	0	0	Debris from praetorium bath-apse	Late fourth century
1967	D I	19	0	216	0	0	0	0	Make-up of street 11	c. 325-350 AD
1967	D I	29	588	0	0	0	0	0	Metaling of street 9	Fourth century
1967	D I	35	149	0	0	0	0	0	Drain	Late second or early third century
1967	D I	36	501	0	0	0	0	0	Metaling of street 8	Third century
1967	D I	37	111	0	0	0	0	0	Street make-up	Third century
1967	D I	43	256	0	0	0	0	0	Pit in debris	Fourth century
1967	D I	49	126	0	0	0	0	0	Street make-up	Third century
1967	D I	50	989	973	0	0	19	0	Street make-up	Third century
1967	D I	58	69	26	0	0	0	0	Street make-up	Third century
1967	D I	71	110	0	0	0	0	0	Street make-up	Third century
1967	D I	72	0	155	0	0	0	0	Rampart 3	First or second century
1967	D I	75	10	0	0	0	0	0	Drain	Late second or early third century
1967	D I	104	0	49	0	0	0	0	Street make-up	Third century
1970	E I	7	44	0	0	0	0	0	Deposit in the central north range	Possibly Fourth century
1970	E I	11	338	1181	0	0	0	847	Hearth deposit with coal	Possibly thrid century
1970	E I	17	0	125	0	0	0	0	Deposit in the central north range with coal	Third century
1970	E I	37	0	100	0	0	0	0		
1970	E IV	43	116	0	0	0	0	0	Disturbed area in principia	Early fourth century
1970	E IV	44	0	119	0	0	0	0	Make-up of Severan flagged floor	First or second century
1970	E VI	7	62	0	0	0	0	0	Post hole in the central north range	Second half of the fourth century
1970	E VI	14	27	15	0	0	0	0	Layer deposit in the central north range	Third century
1970	E VII	2	24	0	0	0	0	0	Black soil	Late Roman
1970	E VII	5	24	0	0	0	0	0	Rubble in the central north range	Late Roman

Year	Trench	Layer	ND	VC	Stone	FAS	Coal	SHB	Context Description	Context date
1970	E VII	6	120	0	0	0	0	0	Robber trench	Possibly second century
1970	E VII	7	105	0	0	0	0	0	Black soil	Late Roman
1970	E VII	16	65	0	0	0	0	0	Pit	First or second century
1970	E VIII	10	324	0	0	0	0	0	Brown soil	Possibly Mid Roman