Ancient Monuments Laboratory
Report 182/87

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Summary

Examination of the residues recovered from the site show that smithing debris had been deposited during the mid-twelfth century A.D. It is suggested that the smithy was not located on the area excavated but was in the close vicinity. No metallurgical or chemical analysis was undertaken.

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# he Ironworking Residues from Eastgate Beverley, North Humberside

## 1 Introduction

A total of 19Kg of ironworking residues were recovered from the excavations at Eastgate, Beverley. The main deposits of slag were recovered from deposits dated to the mid-twelfth century A.D. Both iron smelting (the extraction of the metal from the ore) and iron smithing (the working of the metal into artefacts and their subsequent repair or alteration) generated residues as by-products. These processes, the identification and interpretation of the ironworking debris have been discussed elsewhere[1]. There was no iron smelting slag recovered from the excavation.

## 2 The Classification of the Residues

They were classified morphologically into five groups:

| Residue Type | Weight (Kg) |
|---|---|
| Smithing Slag | 10.583 |
| Hearth Bottoms | 6.657 |
| Cinder | 0.830 |
| Fuel Ash Slag | 0.224 |
| Hearth Lining | 0.984 |
| TOTAL | 19.278 |

Fuel ash slag and hearth lining are considered to be non-diagnostic residues, because they may derive from processes other than ironworking. Their association with ironworking debris, however, may indicate that they resulted from the working of iron. Fuel ash slag is a high silica residue formed by the

reaction of ash component of the fuel and silicieous material, e.g. clays and soils. It is normally formed under high temperature oxidising conditions. The fuel ash slag recovered from the Eastgate Site had a typical morphology, less than 50mm maximum dimension, grey/yellow in colour, vitrified surfaces and very vesicular. A total of 0.224Kg was identified and the majority (0.206Kg) occurred in contexts that contained no ironworking debris. It is therefore probable that the fuel ash slag derived from activities other than ironworking, such as kiln firing or use of the domestic hearth.

Hearth lining is the vitrified clay lining of a hearth or furnace. Vitrification only occurs in the regions of highest hot-face temperature, and these are normally in the tuyere (air inlet) zones. The larger proportion of a clay hearth structure would only be lightly fired and classified as burnt clay. The majority of the hearth lining (0.789Kg) occurred in contexts containing smithing debris. In particular, Contexts 485 and 486 contained 0.420Kg of hearth lining and large amounts of smithing slags. Four tuyere-mouths were identified (in Contexts 947, 987, 1253 and 1373); their diameters were between 15-20mm, which appears to be the standard dimension recorded on many sites.

The diagnostic residues are smithing slag, hearth bottoms and cinder. Smithing slag and hearth bottoms are silicate slags formed in the smithing hearth, the latter are morphologically distinct plano-convex accumulations of slag. The former are randomly shaped pieces of slag that have not developed the characteristic plano-convex form. The mean dimensions of the Eastgate hearth bottoms were:

| | Mean | S.D |
|---|---|---|
| Major Diameter (mm) | 122 | 29 |
| Minor Diameter (mm) | 95 | 18 |
| Depth (mm) | 42 | 17 |
| Weight (Kg) | 0.555 | 0.288 |

These results results fall within the ranges of those obtained from other sites, but are larger than those recorded from Lurk Lane, Beverley (A.M.L. Report 38/87 p2). Some of the smithing slag was cindery, i.e. had a high silica content. The material described as cinder had a composition between the silicate slags and that of fuel ash slag, and had a wholly cindery, i.e. friable, morphology, was vesicular and had a low 'apparent density'. Less than 1Kg of cinder was identified, of which less than half (0.332Kg) occurred in contexts containing smithing debris. The remainder probably derived from other processes.

## 3 Distribution of the residues

The site was divided into two by an east-west property boundary that has prohibited the preparation of a single phasing sequence for the whole site. Therefore, each area has been phased into Context Groups (Appendix 1), which may be cross related at a later stage. The Groups for each area do form stratigraphic sequences, therefore some Groups can be considered as a phasing unit, e.g. Groups 3 and 4. A full listing of the residues by Group is given in Appendix 2. The distribution of smithing slag and hearth bottoms are discussed together, e.g. combined weights are given from either a context or Group, and are described as smithing slag. The distribution by contemporary Groups (as phasing units) and by property is given in Figure 1.

The weight for each set of Groups is given as a percentage of all the smithing slag (and hearth bottoms) recovered from the site.

Prior to the division into two properties in the earliest period of the site (Group 2), slag was incorporated into a levelling deposit (Context 487). The largest deposit of smithing slag (7.7Kg, 45% of the total weight of smithing slag plus hearth bottoms) occurred in Group 4 (on the northern property) with significant deposits in Layer 486 and in two gullies, Contexts 1334 and 1383. Over 50% of the hearth lining (0.540Kg) was found in contexts belonging to this Group. Groups 14 and 15 probably represent contemporary activity in the southern property and they included a significant quantity of slag (5.272Kg, 31% of the total), but it was dispersed in 18 contexts, only one of which contained more than 0.7Kg of smithing slag (Context 965, 1.058Kg). The later Groups contained different quantities of slag, the largest being Group 16, (weight 1.070Kg, 6.2% of the total) which superseded Groups 14 and 15 on the southern property, but included one large hearth bottom (weight 0.798Kg) which distorts the distribution pattern. Each of the remaining 'phases' of the site contained less than 4% (0.700Kg), of the total slag, and can be considered as a background level of slag, i.e. the quantity of slag that may occur on any urban site and is not indicative of ironworking activity. There was no significant deposit of slag associated with the industrial activity proposed for Groups 7 - 10.

The distribution of the slag between the properties shows that the northern property had 53% and the southern 41% of the total smithing slag recovered from the site, (Groups 1 and 2 are excluded since they pre-date the division into properties).

## 4 The Interpretation of the Distribution

The temporal distribution clearly indicated some period of blacksmithing activity during the time of Groups 3 and 4 (northern property) and Groups 14 and 15 (southern property), i.e. in the mid-twelfth century A.D.. The debris from other phases can be considered as background material. There is no strong evidence that the smithing activity occurred on the site. The spatial distribution in Groups 14 and 15 suggest widespread deposition, while that in Groups 3 and 4 was concentrated in the western part of Group 4. The overall pattern indicates equal distribution between the northern and southern properties. This would suggest a source of the slag, i.e. a smithy of some form, either to the east or the west of the site. The concentration in Group 4, suggests a western location for this smithy.

## 5 Conclusions

The majority of the residues recovered from the Eastgate, Beverley excavations derived from the iron smithing process. There was no evidence of iron smelting. A small quantity of fuel ash slag probably derived from other processes, e.g. the domestic hearth. The temporal and spatial distribution indicated a period of iron smithing during the mid-twelfth century A.D. (Archaeological Groups 3 and 4, and 14 and 15), but it was probably not carried out on the area excavated. It is suggested that the site of the 'smithy' lay to the west of the excavated area.

## REFERENCES

1 McDonnell J.G. The Classification of Early Ironworking Slags 1986 Aston University PhD Thesis. (copy in A.M.L.Library)

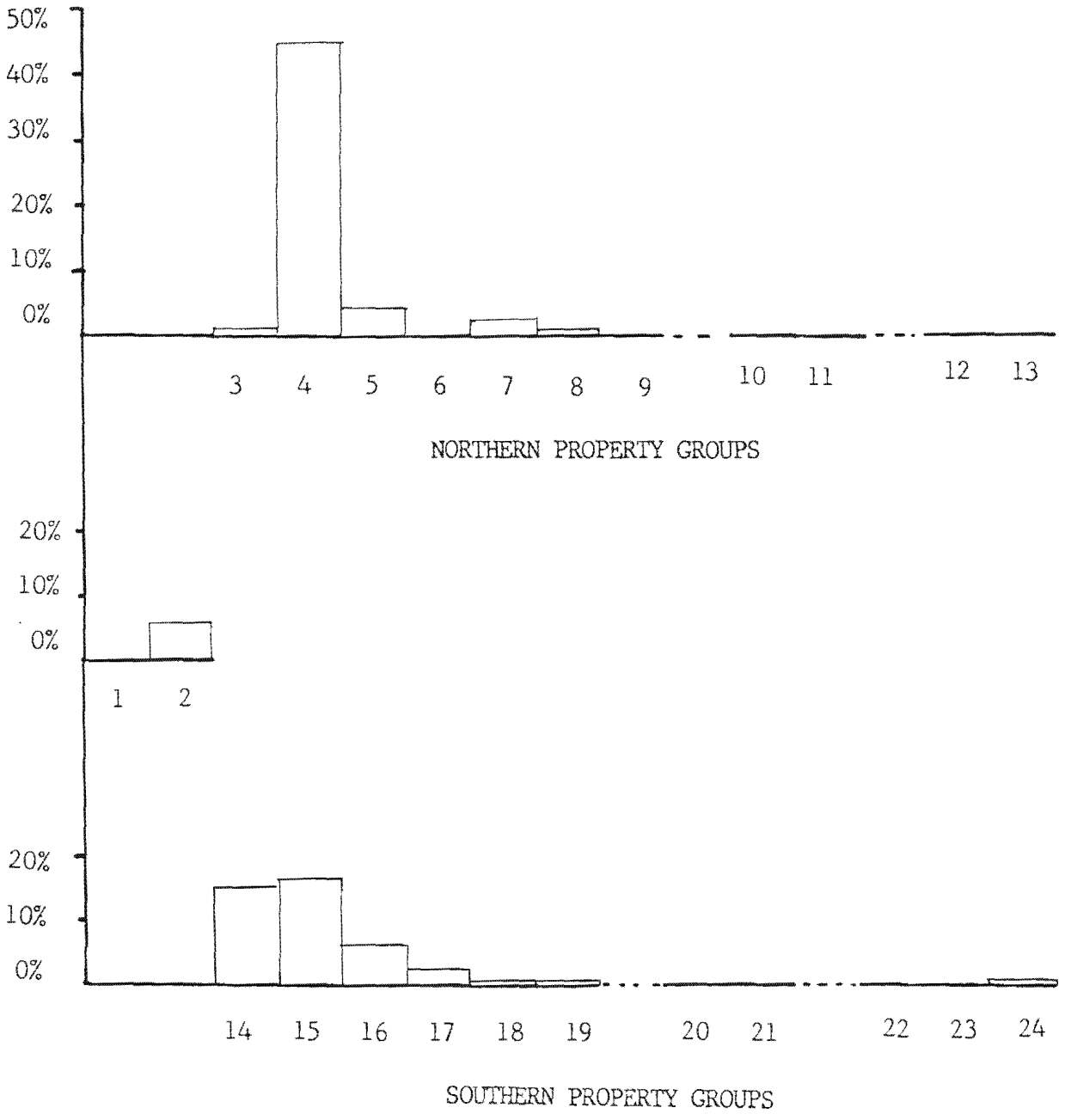


FIGURE 1 DISTRIBUTION OF SMITHING SLAG AND HEARTH BOTTOMS BY GROUP AS PERCENTAGES (TOTAL SMITHING SLAG + HEARTH BOTTOMS=100%)

## APPENDIX 1 PROPERTY DIVISION OF GROUPS

| Northern Property | Southern Property | Date* |
|---|---|---|
| 1 and 2 | | |
| 3 | 14 | Mid-12th |
| 4 | 15 | |
| 5 | 16 | |
| 6 | 17 | |
| 7 | 18 | |
| 8 | 19 | |
| 9 | | |
| | 20 | Late 12th |
| 10 | 21 | |
| 11 | | |
| | 22 | |
| 12 | 23,24 | 14th(?) |
| 13 | | |

* Dates are Provisional

APPENDIX 2

EASTGATE BEVERLEY SLAG LISTING BY GROUP

CONTEXT - Context Number

SMITH - Weight of Smithing Slag in Grammes

HB - " " Hearth Bottoms " "

CINDER - " " Cinder " "

FAS - " " Fuel Ash Slag " "

HL - " " Hearth Lining " "

* TOTAL IN GROUP 2

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 487 | 976 | 0 | 0 | 0 | 30 |
| 1595 | 0 | 0 | 21 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 976 | 0 | 21 | 0 | 30 |

* TOTAL IN GROUP 3

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 1483 | 95 | 0 | 0 | 0 | 0 |
| 1533 | 25 | 0 | 0 | 0 | 0 |
| 1556 | 30 | 0 | 0 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 150 | 0 | 0 | 0 | 0 |

* TOTAL IN GROUP 4

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 485 | 752 | 260 | 0 | 0 | 190 |
| 486 | 2474 | 230 | 0 | 0 | 230 |
| 1253 | 0 | 0 | 0 | 0 | 43 |
| 1333 | 0 | 0 | 32 | 0 | 0 |
| 1334 | 793 | 970 | 0 | 0 | 110 |
| 1335 | 89 | 0 | 0 | 0 | 0 |
| 1337 | 0 | 0 | 100 | 0 | 0 |
| 1367 | 0 | 690 | 0 | 0 | 0 |
| 1373 | 169 | 0 | 0 | 0 | 10 |
| 1383 | 0 | 1282 | 0 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 4277 | 3432 | 132 | 0 | 583 |

APPENDIX 2 (Continued)

* TOTAL IN GROUP 5

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 479 | 0 | 0 | 0 | 0 | 12 |
| 495 | 60 | 0 | 0 | 0 | 0 |
| 542 | 21 | 0 | 0 | 0 | 0 |
| 740 | 98 | 0 | 0 | 0 | 0 |
| 947 | 0 | 504 | 0 | 10 | 45 |
| ** Subtotal ** | | | | | |
| | 179 | 504 | 0 | 10 | 57 |

* TOTAL IN GROUP 7

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 478 | 159 | 0 | 0 | 0 | 0 |
| 504 | 0 | 0 | 31 | 0 | 0 |
| 705 | 0 | 274 | 0 | 0 | 0 |
| 737 | 0 | 0 | 0 | 0 | 22 |
| 778 | 7 | 0 | 0 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 166 | 274 | 31 | 0 | 22 |

* TOTAL IN GROUP 8

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 291 | 20 | 0 | 0 | 0 | 4 |
| 392 | 0 | 0 | 28 | 0 | 0 |
| 518 | 0 | 0 | 0 | 7 | 0 |
| ** Subtotal ** | | | | | |
| | 20 | 0 | 28 | 7 | 4 |

* TOTAL IN GROUP 14

| CONTEXT | SMITH | HB | CINDER | FAS | HL |
|---|---|---|---|---|---|
| 925 | 0 | 0 | 0 | 10 | 0 |
| 1112 | 76 | 0 | 0 | 0 | 0 |
| 1114 | 152 | 0 | 0 | 0 | 0 |
| 1486 | 0 | 625 | 104 | 0 | 0 |
| 1497 | 209 | 0 | 0 | 0 | 0 |
| 1504 | 122 | 0 | 0 | 0 | 0 |
| 1511 | 123 | 0 | 0 | 0 | 20 |
| 1514 | 0 | 564 | 0 | 0 | 20 |
| 1523 | 193 | 0 | 0 | 0 | 0 |
| 1535 | 0 | 0 | 0 | 0 | 21 |
| 1560 | 84 | 0 | 0 | 0 | 0 |
| 1561 | 492 | 0 | 0 | 0 | 0 |
| 1569 | 0 | 0 | 83 | 0 | 0 |
| 1575 | 0 | 0 | 0 | 12 | 0 |
| ** Subtotal ** | | | | | |
| | 1451 | 1189 | 187 | 22 | 61 |

| * TOTAL IN GROUP | 15 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 733 | 0 | 0 | 0 | 0 | 9 |
| 963 | 487 | 0 | 0 | 0 | 0 |
| 965 | 598 | 460 | 0 | 0 | 0 |
| 967 | 0 | 0 | 27 | 0 | 0 |
| 968 | 45 | 0 | 92 | 8 | 40 |
| 1200 | 463 | 0 | 100 | 0 | 26 |
| 1269 | 0 | 0 | 23 | 0 | 0 |
| 1351 | 86 | 0 | 0 | 0 | 0 |
| 1374 | 305 | 0 | 0 | 0 | 0 |
| 1394 | 150 | 0 | 84 | 0 | 25 |
| 1417 | 90 | 0 | 4 | 0 | 0 |
| 1423 | 0 | 0 | 10 | 0 | 0 |
| 1484 | 141 | 0 | 0 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 2365 | 460 | 340 | 8 | 100 |

| * TOTAL IN GROUP | 16 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 756 | 117 | 0 | 0 | 0 | 0 |
| 761 | 100 | 0 | 0 | 0 | 0 |
| 797 | 38 | 0 | 0 | 0 | 0 |
| 871 | 17 | 0 | 0 | 0 | 0 |
| 898 | 0 | 0 | 0 | 32 | 0 |
| 987 | 0 | 0 | 0 | 0 | 22 |
| 1099 | 0 | 798 | 0 | 0 | 0 |
| 1144 | 0 | 0 | 0 | 0 | 26 |
| 1192 | 0 | 0 | 44 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 272 | 798 | 44 | 32 | 48 |

| * TOTAL IN GROUP | 17 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 678 | 0 | 0 | 0 | 0 | 34 |
| 782 | 294 | 0 | 0 | 0 | 0 |
| 812 | 0 | 0 | 27 | 0 | 0 |
| 872 | 190 | 0 | 0 | 0 | 0 |
| 905 | 62 | 0 | 0 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 546 | 0 | 27 | 0 | 34 |

| * TOTAL IN GROUP | 18 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 185 | 0 | 0 | 0 | 0 | 15 |
| 674 | 83 | 0 | 0 | 0 | 30 |
| ** Subtotal ** | | | | | |
| | 83 | 0 | 0 | 0 | 45 |

APPENDIX 2 (Continued)

| * TOTAL IN GROUP | 19 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 295 | 0 | 0 | 0 | 85 | 0 |
| 314 | 47 | 0 | 0 | 0 | 0 |
| 559 | 0 | 0 | 0 | 60 | 0 |
| ** Subtotal ** | | | | | |
| | 47 | 0 | 0 | 145 | 0 |

| * TOTAL IN GROUP | 22 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 1619 | 0 | 0 | 20 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 0 | 0 | 20 | 0 | 0 |

| * TOTAL IN GROUP | 24 | | | | |
|---|---|---|---|---|---|
| CONTEXT | SMITH | HB | CINDER | FAS | HL |
| 1173 | 51 | 0 | 0 | 0 | 0 |
| ** Subtotal ** | | | | | |
| | 51 | 0 | 0 | 0 | 0 |

| ** Total ** | | | | | |
|---|---|---|---|---|---|
| | 10583 | 6657 | 830 | 224 | 984 |