2349

Ancient Monuments Laboratory
Report 4/94

ASSESSMENT OF POTENTIAL FOR TECHNOLOGICAL RESEARCH OF SILVER, COPPER-ALLOY AND GLASS ARTEFACTS FROM BOSS HALL & ST STEPHEN'S LANE CEMETERIES, IPSWICH, SUFFOLK

Catherine Mortimer BTech DPhil

Ancient Monuments Laboratory Report 4/94

ASSESSMENT OF POTENTIAL FOR TECHNOLOGICAL RESEARCH OF SILVER, COPPER-ALLOY AND GLASS ARTEFACTS FROM BOSS HALL & ST STEPHEN'S LANE CEMETERIES, IPSWICH, SUFFOLK

Catherine Mortimer BTech DPhil

Summary

Technological aspects, including composition, construction and decoration, of 119 copper alloy artefacts, 34 silver artefacts, 64 glass beads, three palm cups and 256 amber beads are thought to have considerable potential to assist in the interpretation of these two Anglo- Saxon cemeteries. Technological data from the site can also be examined in local and national contexts.

Author's address :-

Catherine Mortimer BTech DPhil

Ancient Monuments Laboratory
English Heritage
23 Savile Row
London
W1X 1AB

Assessment of potential for technological research of silver, copper-alloy and glass artefacts from Boss Hall and St Stephen's Lane (Buttermarket) Anglo-Saxon Cemeteries, Ipswich, Suffolk

Catherine Mortimer

Introduction

a) Boss Hall. An Anglo-Saxon cemetery was found unexpectedly during a watching brief at Boss Hall Industrial Estate, Ipswich in 1990 (site number IAS7914). Most of the 22 burials can be dated to the sixth and seventh centuries AD. They contain a range of typical early Anglo-Saxon grave goods amd a small number of unusual artefact types.

b) St Stephen's Lane (also known as Butter Market, IAS3104). Nineteen seventh- to ninth-century Anglo-Saxon graves were found at this site. The graves have a variety of grave goods, of which some are unusual types, including artefacts which may be continental in origin. The site is also notable for its mid- to late-Saxon high-temperature industrial debris.

Technological data

The results of technological research will clarify catalogue entries and provide data for archaeological discussions (*eg* on the significance of individual artefacts within their site, on technological changes over time, and on the position of the sites in their regional and national contexts). The data produced will also be used as input for research projects (*eg* on early Anglo-Saxon non-ferrous metals and glass) and added to relevant in-house databases, where it will be useful comparative material for future projects on Anglo-Saxon material.

Technical aspects of some of the non-ferrous material from Boss Hall have already been studied; the results of an extensive analytical project on the contents of an unusually rich grave (context 93) have been reported elsewhere (Shearman 1993) and a report has been prepared on the technology of a cruciform brooch found in context 301 (Mortimer 1993c). The results of these studies will be collated within the overall report. Most of the comments below exclude artefacts from context 93 (most of which have not been seen for this assessment).

The artefacts are referred to by small find numbers which, in computer listings, are normally suffixed with the site code and their material type *eg* 1/7914CU.

Non-ferrous metalwork

a) Boss Hall: In total, 50 copper alloy artefacts and 5 silver artefacts were found at Boss Hall (excluding context 93). Six gold artefacts and c. 17 silver artefacts were found in context 93. The artefacts have been conserved and are all well packed, but the state of preservation is variable, with some of the silver artefacts especially being deeply corroded and very fragile.

b) St Stephen's Lane: 29 silver artefacts and 69 copper alloy artefacts were found at the site. The metalwork was generally in a rather corroded condition (especially the silver), but some interesting technological details can nonetheless be recovered from this material.

Composition

A knowledge of the types of alloys found on the sites, and the manner in which they were employed, gives an insight into the resources and techniques available to the Anglo-Saxon metalworker. Compositional data from non-ferrous artefacts at Boss Hall and St Stephen's Lane may be considered in several ways. The data can be used to give information about the objects themselves, as well as about their position within the site and within broader contexts.

The types of alloy used on a single site illustrate types of metal which were available to the metalworkers, although they may not represent all the types of alloy available at the time. The range of alloys used at each of the two sites can be compared, as can the prefered alloy types at each site. It is thought that recycled metal was the main source of 'raw' materials in fifth- and sixth-century copper alloy metalworking, but there is relatively little information on the middle Saxon situation. The data from Ipswich, together with observations made on other datasets,[1] can be used to evaluate whether there is evidence for the introduction of new metal during the middle Saxon period.

Compositional data can be used to investigate technological diversity of several items in a single grave. This may give information about casting techniques. For instance, if the seven copper-alloy pieces from a belt set in context 1306, St Stephen's Lane are all of the same composition, this suggests they are all from the same melt. If not, the pieces may have been made on different occasions, or made using the contents of more than one crucible. There are two other belt sets from the same site (contexts 2297 and 3871) which could also be analysed for this purpose. Analytical results should be integrated with the results of examination of other metalworking details (*eg* punchmarks or decoration) and of the organic elements of the belt set (mineral-preserved traces are present). The results of this analysis should be compared with the results of a similar survey on grave groups from Boss Hall, for example, the ten copper-alloy artefacts (brooches, rings, girdle hangers) from context 301, as there may be differences between the early and middle Saxon situations.

Evidence for selectivity in alloy use is important in understanding the level of skill used by the Anglo-Saxon metalworkers. Particular artefact types may have been made using particular alloy types. For instance, although casting is normally a composition-tolerant technique, where artefacts are to be coated or cold-worked afterwards, some types of copper-alloy may be preferred or avoided. The compositions of the cast artefacts could be compared

[1] *eg* Oddy 1983; Mortimer *et al* 1986; Mortimer 1988; Mortimer 1993a-b; Blades forthcoming; also forthcoming work on material from Gunthorpe, Cambridgeshire.

with the sheet metal artefacts, and artefacts with surface coatings (gilding/tinning) could be compared with those without any special treatments. The compositions of the Ipswich artefacts can be compared with other appropriate datasets,[2] to see how they fit in with the general picture. The compositional diversity observed within artefact sets (*eg* the belt sets, above) gives an idea of when the compositional similarities between two artefacts from different contexts can be said to be significant.

Compositions of non-ferrous metals may also have regional attributes, as a result of differences in alloy supply and metal technologies; the Ipswich datasets can be compared with other datasets to examine this subject. Some of the artefacts on these sites may have been imported and hence have very different technical characteristics. For example, the unusual serrated belt set from St Stephen's Lane context 1306 should be examined to see if it has characteristics (alloy type, manufacturing details) which add strength to the argument that this is an imported piece.

The two highly-decorated silver bangles from Boss Hall, context 313 (SF 4 and 5) are very well-preserved and deserve careful technical analysis. Very few early Anglo-Saxon silver objects have been analysed quantitatively,[3] so it will be difficult to put the compositions of these objects in their context, but quantitative analyses of these pieces will serve as reference data for future projects. Other silver objects from the sites are too corroded to analyse quantitatively.

The seven gold pendants from Boss Hall context 93 have been analysed semi-quantitatively (Hook *et al* 1993). This analytical data may be compared with other relevant datasets (*eg* Hawkes *et al* 1966; Brown and Schweizer 1973; Kent 1972), to evaluate whether any chronological inferences can be made.

Chemical analysis methodology. Several of the artefacts are unsuited to any sort of chemical analysis, either because they are deeply corroded or because they are unstratified and probably not Anglo-Saxon in date. Others cannot be recommended for sampling, because they are too fragile (in the case of cast artefacts) or because to cut a sample from an edge would cause unacceptable damage to the artefacts' integrity (in the case of sheet metal artefacts). An assessment of the type of analysis which is possible has been made for each of the artefacts (see summary table).

Surface analysis of the artefacts (*eg* by non-destructive X-ray fluorescence (XRF)) tells us the approximate alloy type and, where the artefact is coated or plated, it may help identify the type of coating or plating. However, any analysis without surface preparation may give a misleading impression of the bulk metal composition, as a large proportion of the analytical information in this sort of analysis will come from the corroded surface.

Taking drilled samples from the more solid (*ie* cast) artefacts and cutting samples from sheet-metal artefacts allows fully-quantitative analysis with a full range of elements (*eg* by X-ray micro-analysis in a scanning electron microscope (SEM) or by inductively-coupled plasma spectroscopy (ICPS)). The preparation method for X-ray analysis in an SEM takes the form of mounting samples in resin, grinding and polishing to 1μ. Hence where a piece is cut from an artefact in preparation for this type of analysis, information on the structure of

[2] Mortimer 1990; Oddy 1983; Blades forthcoming.

[3] But see Hawkes *et al* 1966, 107. The analyses in Leigh *et al* 1984 should be thought of as qualitative, because of problems in surface analysis in complex silver alloys.

the metal may be gained from the same sample (for instance, evidence for cold-working and/or annealing). Samples taken for X-ray analysis in an SEM may be returned with the artefacts, if desired (in their mounted form). Otherwise they can be archived at the laboratory. ICPS samples are destroyed during analysis.

Surface XRF analysis of the white metal buckle from Boss Hall context 74 would confirm the basic metal type. Such artefacts are normally made of very high-tin copper alloys based on iron cores; this can be seen in radiographic work (Sherlock and Welch 1992, Plate 26). As the surfaces tend to be enriched in tin, relative to the interior, and the underlying layers may be highly corroded, any analysis of a drilled sample would give limited information about the composition. A more informative method of analysis might be to look at abraded areas, which can provide natural taper sections, allowing SEM examination and analysis of the different layers (Meeks 1993, 252). This example can be compared with other white metal artefacts, especially examples from France, and gives a possible continental connection for this context.

Construction and applied decoration

Clearly, construction and composition are closely inter-related and the results of investigations into these areas should be integrated. Artefacts from Boss Hall contexts 93 and 301 have had their construction methods and materials thoroughly discussed (Hook *et al* 1993; Mortimer 1993c). These results and the results of examination of other metal artefacts from the sites should be collated to give an impression of the skills used at this period.

Wire and filigree. Useful information was gained from examining the construction of the gold pendants from Boss Hall (Hook *et al* 1993), for instance, it was possible to suggest that one element on one of the pendants was repaired or replaced. Other material from the sites does not seem to have much potential for this sort of work.

Metal coatings. The most distinctive metal coatings on the copper alloys from Boss Hall are the white metal coatings on SFs 31, 51 and 52; these should be analysed using surface XRF. Other coatings (*eg* gilding) may possibly be identified on other artefacts, also using XRF.

Punchmarks. Characterising the shapes of punchmarks used on artefacts may allow individual tools and hence workshops to be identified. Seven copper-alloy artefacts have punchmarks and these could be examined and catalogued, using an optical microscope and an electron microscope (the latter probably using impressions). The silver bangles from Boss Hall context 313 have spectacular multiple punchmark decoration which merit careful study; such artefacts are ideal material for primary research into this area, for instance, establishing the amount of variation introduced by tool wear, variation in the angle and depth of strike *etc.* An analysis of the punchmarks on silver objects may be carried out as part of a current AML research project (code TE203).

Construction. In a small number of cases, comparatively uninspiring artefacts have contexts which are so unusual that they should be given careful examination. For example, it will be useful to review the technology of the copper-alloy artefacts found in St Stephen's Lane contexts 2962 and 4275; although these artefacts are not particularly significant in themselves, they were found in association with intriguing silver artefacts (see below) and similar methods of construction may have been used for both types of alloy. Several copper-alloy artefacts from St Stephen's Lane context 1306 will need XRF analysis to confirm their metal type (*ie* copper alloy rather than silver) and possibly to suggest the alloy type (*eg* bronze or brass) as this is not clear visually.

All the silver artefacts at St Stephen's Lane came from two contexts, 2962 and 4275, and consist of beads or pendants from necklaces of complex design. These elements are mostly made from sheet metal, but include a possible sceatta. It will be important to establish the method of manufacture, using a combination of X-radiography and careful microscope work. The production techniques of these items should be compared with those of the silver beads found at Boss Hall (Shearman 1993) and with examples from The Brooks, Winchester. A small number of these elements could be analysed by non-destructive XRF, in order to confirm that they are indeed silver, but all the silver artefacts at St Stephen's Lane are much too corroded to be analysed quantitatively.

X-radiography will play an important part in the examination of the ferrous artefacts at the site (these will be assessed elsewhere) and may also be necessary to understand the structure of some of the copper alloy artefacts.

Conclusions Quantitative analysis of the non-ferrous metal artefacts would be informative in putting the material into context, but aspects of construction and decoration may prove to be as significant. X-ray micro-analysis can be carried out at the AML, as well as any XRF thought necessary.

Boss Hall: Analysing and reporting on compositions of the 18 copper-alloy artefacts and 2 silver alloy artefacts selected as being suitable for quantitative analysis would take two weeks. Surface XRF analysis of coatings *etc.* would take less than half a day. Examination, recording and reporting upon the punchmarks on these objects would take approximately four weeks.

St Stephen's Lane: Quantitative analysis and reporting on *c.* 20 copper-alloy samples would take 3 weeks. The other technological research outlined above would require at least a week and a further week should be allowed to permit integration of these results with those from other researchers.

Glass

Eight glass beads were found at St Stephen's Lane and 56 beads at Boss Hall; they are of various sizes and colours and several are multi-coloured. The most notable glass artefacts from St Stephen's Lane are three palm cups (contexts 1306 and 4681); no other vessels were found at the sites.

In both cases, the technology of manufacture should be carefully investigated. The compositions of the beads could be compared with other compositional datasets, to investigate changes from the sixth to the ninth century. This is a period in which significant changes in glass technology occurred. The compositions of the glass beads can be compared with the compositions of glass vessels to see if the production systems were similar.

Chemical analysis methodology. Large-scale surveys using non-destructive XRF analysis have been carried out on beads from several other early Anglo-Saxon sites (*eg* Sewerby (Biek *et al* 1985) and Buckland (Bayley 1987)). This technique identifies some of the major glass components in a qualitative or semi-quantitative form, but it is difficult to detect sodium and some minor elements. It is often difficult to produce useful results by XRF on beads with more than one colour on them, although it is usually possible to deduce which elements are present in which part of the bead, based on previous analyses of plain beads.

Fully quantitative analyses have rarely been carried out on early Anglo-Saxon beads.

Quantitative analysis was carried out on some of the Sewerby beads (analyses by Gilmore and Henderson, in Biek *et al* 1985). The techniques used were not ideal for analysis of this sort of material. Five beads were analysed by XRF with some surface preparation (Henderson), which produced figures which should be reasonably representative of the interior compositions. As three of these beads are polychrome, the large area 'sampled' (*c.*1 cm^2) means that the analytical information must be average compositions of the glasses used to make these beads. In the other quantitative method used at Sewerby (Gilmore, neutron activation analysis), lead, an important oxide in coloured glasses, is not detectable and where multi-coloured beads are examined, the totals quoted will be an average value for all the colours present on the beads, together with the information from the corrosion. In the largest fully-quantitative analysis programme so far, Henderson (1990) analysed 28 different glasses from 22 sixth- or early seventh-century beads from Apple Down, West Sussex, using an electron microprobe.

The Apple Down glass analyses suggest that the majority of the glass used to make beads in the early Anglo-Saxon period was of the soda-lime-silica type, with various additives to colour and/or opacify the glass. A single example of a mixed-alkali glass was found at the site. It is difficult to compare these analyses directly with the Sewerby data, but at least some of the Sewerby beads were also made of soda-lime-silica glasses.

Non-destructive XRF analysis could be applied to the Boss Hall and St Stephen's Lane glass beads to gain some chemical information but it is recommended that, after full recording, quantitative X-ray micro-analysis should be carried out by cutting or chipping small samples[4] from selected beads. This would allow all of the most important oxides/elements to be analysed, giving an important insight into the manufacture of Anglo-Saxon beads. The results can be compared with the Apple Down compositions (and, with caution, to the Sewerby results), to determine whether any regional characteristics emerge. The data from the beads can be compared with the information from the vessel glass to determine whether both types of glass artefact were made from similar glass types.

An XRF survey of the glass beads would take two days. Quantitative analysis of a representative selection, perhaps 30 beads, would take three weeks, including background research.

The palm cups should be analysed using quantitative X-ray micro-analysis. Two of the cups are broken and finding suitable samples should be straightforward; the complete example (28/3104G) will probably not be suitable for sampling. The compositions can be compared with those of examples from this country and abroad.[5] This would enable a start to be made on research into regional compositional patterning in England; it has already been shown (Sanderson and Hunter 1982) that there is a significant chemical difference between glasses from Hamwih (Southampton), Helgö (Sweden) and Dorestad (Holland). Analysis and reporting writing would take a week.

---

[4] The minimum dimensions of the sample are limited only by visibility: if the sample can be seen, it can be analysed. Practically, this means that samples are at least 1mm long in one dimension.

[5] *eg* Sanderson and Hunter 1982; Sanderson, Hunter and Warren 1984; Heyworth 1991; Henderson and Holand 1992 and forthcoming research on vessel glass from Flixborough, Humberside.

Jet and amber

Three jet beads and 253 amber beads were found at Boss Hall.

The jet beads were not available for assessment. Although it is likely that the bead material has been properly identified, if required, the beads could be analysed using XRF and examined using radiography to confirm this. This would take about half a day.

It is not recommended that any scientific analysis is carried out on the amber beads; analysis on comparable material (Castledyke, Humberside) demonstrated that the amber most probably came from the Baltic, but also that it is impossible to tell whether the amber was brought to Britain by the sea or by trade.

References

Biek L, Bayley J and Gilmore G 1985 'Scientific analysis of the glass beads' in Hirst S (ed) *An Anglo-Saxon Cemetery at Sewerby, Yorkshire*; 77-85.

Blades N forthcoming. 'Copper alloys from English Archaeological Sites 400-1600 AD: An analytical study using ICP-AES' Royal Holloway and Bedford New College, University of London, PhD thesis

Brown P D C and Schweizer F 1973 'XRF analysis of Anglo-Saxon jewellery' *Archaeometry* 15; 175-192.

Hawkes S C, Merrick J M and Metcalf D M 1966 'X-ray fluorescent analysis of some Dark Age Coins and Jewellery' *Archaeometry* 9; 98-138

Henderson J and Holand I 1992 'The Glass from Borg, an Early Medieval Chieftain's Farm in Northern Norway' *Medieval Archaeology* 36; 29-58.

Heyworth M P 1991 *An Archaeological and Compositional Study of Early Medieval Glass from North-west Europe* PhD thesis, Bradford

Hook D, La Niece S, Lang J, Cartwright C and Meeks N 1993 'Report on the scientific examination of an Anglo-Saxon composite disc brooch and other jewellery from Bosshall, Suffolk' Internal report, British Museum, Depts of Scientific Research and Medieval and Later Antiquities.

Kent J P C 1972. 'Gold standards of the Merovingian Coinage, AD 580-700' in Hall and Metcalf (eds) *Methods of Chemical and Metallurgical Investigation*; 69-74

Leigh D, Cowell M and Turgoose S 1984 'The composition of some sixth century Kentish Silver brooches' in *Historical Metallurgy* 18(1); 35-41

Meeks N 1993 'Surface characterization of tinned bronze, high-tin bronze, tinned iron and arsenical bronze' in La Niece S and Craddock P T (eds) Metal Plating and Patination; 247-275

Mortimer C, Pollard M and Scull C 1986 'XRF analyses of some Anglo-Saxon copper-alloy finds from Watchfield, Oxfordshire' *Historical Metallurgy* 20,1; 36-42.

Mortimer C 1988 'Anglo-Saxon copper alloys from Lechlade, Gloucestershire' *Oxford Journal of Archaeology* 7 (2); 227-233.

Mortimer C 1990 'Some aspects of early medieval copper-alloy technology, as illustrated by a study of the Anglian cruciform brooch', DPhil thesis, Oxford.

Mortimer 1993a 'Chemical Compositions of Anglo-Saxon brooches in the Ashmolean collection' in MacGregor A and Bolick E *A Summary Catalogue of the Anglo-Saxon Collections*; 27-30.

Mortimer 1993b 'Analysis of early Anglo-Saxon brooches from Castledyke, Barton on Humber, South Humberside' Ancient Monuments Laboratory report 46/93

Mortimer C 1993c 'Technological comments on an early Anglo-Saxon cruciform brooch form Grave 301, Boss Hall, Ipswich' Ancient Monuments Laboratory Report no 54/93

Oddy W A 1983. 'Bronze alloys in Dark Age Europe' in R Bruce-Mitford (ed) *The Sutton Hoo Ship burial Volume 3 (II)* (British Museum); 945-961

Sanderson D and Hunter J 1982 'The neutron activation analysis of archaeological glasses from Scandinavia and Britain' *PACT* 7,2; 401-411

Shearman F 1993 'Excavation, examination and conservation of Anglo-Saxon jewellery from Bosshall Ipswich' in *The Conservator* 17; 26-33.

Sherlock S J and Welch M G 1992 *An Anglo-Saxon Cemetery at Norton, Cleveland* Council for British Archaeology 82

Summary table of recommended technological analyses for Boss Hall copper-alloy artefacts

SF	Context	Type	Analysis	Punchmarks	Other
9*	93	Fragment			
10*	93	Fragment			
11*	32	Fragment			Part of 13?
13	32	Wrist-clasp			Assembly details
14*	32	Coin			
15*	32	Fragment			Part of 13?
16*	32	Fragment			Part of 13?
20*	74	Fragment			
21	94	Small-long brooch	D		Casting info
22	94	Small-long brooch	D?		Casting info
23	150	Cruciform brooch	D	✓	
24	150	Small-long brooch	D	✓	
25	150	Cruciform brooch	D	✓	
26	150	Ring	D		
27	150	Ring	D		
28	97	Ring	D		
29	97	Sheet			
30	97	Strap end?			
31	97	Saucer brooch	D +ND (WM)		
32	95	Fitting	D		Part of 31; assembly?
33*	32	Fragment			
34*	95	Object			
35	74	WM buckle	D?		Xray, casting details
36	97	Annular brooch	ND		
37*	150	Fragments			
38*	150	Fragments			
39	301	Knob of cruciform brooch			Part of 50
40	301	Annular brooch	D?	✓	
41	301	Girdle hanger	D	✓	
42	301	Girdle hanger	D	✓	
43	301	Fragment	D?		
44*	301	Fragments			Part of 41-42?
45	301	Annular brooch	D		
46	301	Ring	D?		
47	313	Annular brooch			
48	313	Annular brooch			
49	301	Annular brooch			
50	301	Cruciform brooch	D	✓	
51	74	Stud + WM	ND (WM)		
52	74	Stud +WM	ND (WM)		

* artefact not seen; mostly fragments

Codes: D = destructive analysis, ND = non-destructive analysis, WM = white metal

SF1-8 and SF17-19 are unstratified stray finds, probably not of AS date. Only two copper-alloy finds from context 93 are noted here; these were not inspected by Fleur Shearman.