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ASSESSMENT OF POTENTIAL FOR TECHNOLOGICAL ANALYSIS OF NON-FERROUS METALWORK FROM GUNTHORPE ANGLO-SAXON CEMETERY, CAMBRIDGESHIRE

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Summary

Thirty-two items of non-ferrous metalwork were examined. Recommendations for technological analysis were made, including chemical analysis and punchmark studies. The results of the non-destructive analysis of 14 pieces were discussed. Conservation and storage requirements were considered.

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Assessment of potential for technological analysis of non-ferrous metalwork from Gunthorpe Anglo-Saxon Cemetery, Cambridgeshire

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Thirty-two items of non-ferrous metalwork were presented for evaluation (Table 1); items such as broken objects, wrist clasp 'sets' (*ie* matching 'hook' and 'eye' pieces) and wrist clasps made from two pieces of metal, were counted as one. These comprise a range of artefact types, most of which are familiar from other Anglo-Saxon inhumation cemeteries. There are eight brooches (two cruciforms, one penannular, one annular, three small-longs, one swastika), five sets or part sets of wrist clasps, three scutiform objects,[1] two coins and six other types of artefact (dress pin, button, stud, fragments from unidentifiable sheet- and wire-based artefacts).

All the artefacts appear to be copper-alloys, mostly without any sort of additional coating; however, the scutiform objects have white-metal coatings and the wrist clasps made from more than one piece were assembled using a solder which is still evident, in the form of a white-metal coating. The condition of the artefacts is generally good, although the sheet-metal artefacts are fragile. This collection has good potential for technological analysis in various respects.

Technological potential

The types of copper alloys found, and the manner in which they were employed, gives insight into the resources and techniques available to the Anglo-Saxon metalworker. Other aspects of Anglo-Saxon metalworking may be revealed by detailed studies of the artefacts using various techniques, including visual examination.

1) Chemical compositions

Several of the artefacts are unsuited to any sort of chemical analysis, either because they are thoroughly corroded (SFs 81, 93-94, 103, 106 and 107) or because they are unstratified and probably not Anglo-Saxon in date (SFs 78 and 79). 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 (Table 1).

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.

Results of preliminary non-destructive XRF analyses (for artefacts which are unsuitable for quantitative analysis) are presented in Table 2. This shows that these copper alloys are more often tin-rich, rather than zinc-rich (*ie* they are more often bronze-like than brass-like), but that most alloys have both tin and zinc present. Most of the artefacts contain some lead.

Bronze-like alloys were dominant in chemical datasets from other groups of early Anglo-Saxon copper alloy artefacts (*eg* Mortimer 1990). However, any analysis without surface preparation may give a misleading impression of the underlying alloy 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 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 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.

Compositional data from non-ferrous artefacts may be considered in several ways. The types of alloy used on a single site illustrate types of metal which were available to the metalworkers of the period, although they may not illustrate all the types of alloy available at the time. It is unlikely that significant patterns will emerge from the analysis of the Gunthorpe material on its own because of the small number of artefacts which can be analysed quantitatively. However, the balance of alloys used at Gunthorpe can be compared with observations made on other whole-site datasets (*eg* Mortimer *et al* 1986; Mortimer 1988; Mortimer 1993a; Mortimer 1993b; Blades forthcoming).

Compositional data also tells us which alloys were used for particular types of metalwork. Evidence for alloy control is important in understanding the level of skill used by the Anglo-Saxon metalworker. Particular alloys may have been chosen for particular types of object. For instance, although casting is normally a composition-tolerant technique, where artefacts are to be coated or cold-worked afterwards, particular types of alloy may be preferred or avoided. The Gunthorpe cruciform brooches can be compared with my own analytical dataset, and other artefacts can be compared with appropriate datasets from Nigel Blades' thesis.

Compositions of non-ferrous metals may also have regional attributes, as a result of differences in alloy supply; the Gunthorpe dataset and the comparative datasets noted above may be used to investigate this, as part of a wider research project.

In conclusion, quantitative analysis of the Gunthorpe non-ferrous metals would certainly be useful as part of wider analytical programmes, but the analysis would also be informative in putting the Gunthorpe material in context. SEM examination and X-ray analysis can be carried out at the AML, as can further XRF, if necessary.

Analysing and reporting on the eight copper-alloy artefacts selected as being suitable for quantitative analysis would take 1 week.

2) Other analysis

The Gunthorpe material displays a relatively limited variety of metalworking techniques. Apart from basic casting and sheet metalworking techniques, the material demonstrates the ability to solder pieces together (*ie* the wrist clasps made in more than one piece and repairing the catches and/or pinlugs on brooches SF91, SF87 and SF102), to make and apply decorative punches (seen on several objects), to make iron pins/pin assemblies and to provide a white-metal coating (*ie* on SF111, 112 and 113).

The solder used for joining sheet-metal wrist clasps together is probably a lead-rich soft solder. XRF analysis showed that the soldered areas were sometimes significantly higher in lead than the rest of the object (Table 2); such higher lead levels were not always noted, probably because the surface of the artefacts was very variable compositionally (due to corrosion).

There is little ongoing research into soldering techniques of this period, but it is not possible to investigate this subject in any detail without highly-destructive analysis.

It should be noted that the soldering techniques used in repairs may well be different to those used in the original manufacture of wrist clasps, since it is likely that repairs on brooches did not take place in the same location as the original manufacture.

Attaching flat strips of copper alloy to the sheet metal wrist clasps (*ie* Hines (1984) form B13a) appears to be straight-forward enough - there would be a wide area of contact for soldering - but it is not yet clear how thin, *curved-sectioned* sheet metal strips were attached to the flat surface of the wrist clasp (SF 100; Hines (1984) form B13b). Illustrations by Hines (1984; Fig 2.50-51) suggest that the curved-sectioned sheets at Gunthorpe may originally have been circular in cross-section, and that half of the sheet (the 'back half', next to the solder) is missing (as both curved sheets in SF100 are decorated with punchmarks, it seems unlikely that they are two halves of a single sheet, which originally had a circular or oval cross-section). Compositional data and punchmark studies may help our understanding of the construction of this artefact type, but as there is only one example of this type of wrist clasp at Gunthorpe, this problem is unlikely to be answered in this project.

The **punchmarks** observed on nine of the Gunthorpe artefacts may be a useful source of workshop information. For example, individual punches might be characterised by the presence of unusual features on the marks they made (*eg* extra elements or unusual proportions). If it could be shown that the same punch was used on two different artefacts, such artefacts are likely to have been made by the same person or at the same workshop. For instance, punchmarks might provide a connection between wrist clasps made in different ways (*eg* Hines type 13a and 13b).

Work on punchmark analysis has never been carried out on a large group of Anglo-Saxon grave-goods, although Leigh suggested that such work could indicate the number of workshops involved in the production of square-headed and other brooches from Kent (Leigh 1980). The usefulness of such techniques will be evaluated by work on the Gunthorpe samples, and by the application of similar techniques on similar groups of material from other sites (*eg* Barrington (Cambs) and Boss Hall (Suffolk)). Twenty-two impressions have been taken from the punchmarked areas of the Gunthorpe artefacts for examination under a microscope and in an SEM. As these techniques have rarely been exploited, it is difficult to say how much time it will take to complete the punchmark study, but at least two weeks would be required to photograph the marks and collate a basic report. An additional two weeks would allow further comparative work to be carried out, if the results of analyses on other groups of material are available at this time.

The white-metal coating on SF111, 112 and 113 was analysed using XRF (Table 2). It is most likely to be tinning; although the analytical results were not clear-cut, silver was certainly not involved. With compositional information available for these pieces, it will be interesting to see what sort of metals were being used for artefacts which were to be decorated using this technique, and to compare this information with that from other tinned artefacts (*eg* Blades forthcoming).

All the sheet-metal artefacts from the site were deemed too fragile to allow cut sections. Therefore, as the cast artefacts which can be sampled will be drilled, no samples will be available for metallographic examination.

Conservation and storage

The current storage is inappropriate. The artefacts are loose in their 'crystal' boxes and can knock into the sides of the boxes. Some of the boxes are barely big enough for the artefacts. Foam cut to the appropriate shape or acid-free tissue in appropriate shapes is required.

Summary of assessment

The non-ferrous metalwork at Gunthorpe G87 examined at AML amounts to 31 objects (listed in Appendix 1). This assessment is based solely on these artefacts and no contextual evidence was available.

Fully-quantitative compositional analysis is not justified for all these artefacts because of the small size of the collection and because of the fragility of several pieces. Where comparative material is available, analysis would be useful for research purposes, at site-specific and national levels. A punchmark study may be supported for it's site-specific and national importance. Some of the technological exploration has already been carried out during the preparation of this report. The technological studies recommended in this assessment require 3-5 weeks work and an additional week would allow consultation with other professionals working on the material as well as the production of an integrated report.

The artefacts require some re-packing.

References

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Notes

1. These objects cannot be simply designated as scutiform pendants, as they do not have a loop on an edge, or any sign of such a loop. The loops at the back may indicate the method of fastening/attachment, but evidence of the way in which these were used in burial is necessary for a proper understanding.

Table 1: Listing of material

Context	SF	Type	Analysis	Surface treatment
F1	81	Fragments	-	-
F7	82	Pennannular brooch	ND	-
F15	84	Stud	ND	-
F22	192	Sheet fragments	ND?	-
F23	85	Annular brooch	ND	pm
F24	88	Cruciform brooch	D	pm
	89, 90	Wrist clasps; two matching sets, cast	D	-
	87	Swastika brooch	D	R+D; repair
F28	91	Cruciform brooch	D	repair
	93, 94	Coins, pierced for suspension	-	-
	95	Wire fragment	-	-
F53	98	Large pin	ND	-
	100	Wrist clasps; 2 applied thin, curved sheet strips but only one base piece	ND	pm
	99	Wrist clasp; sheet and solid strip type	ND	pm
	101	Wrist clasps; matching set to SF99	ND	pm
	97	Small-long brooch	D	pm
F55	103	Wire fragments	-	-
	102	Small-long brooch	D	pm, repair
F57	104	Stud	ND	-
F61	106	Sheet fragments	-	-
	107	Decorated sheet strip	-	pm
F74	108, 109	Wrist clasps; two sets of sheet and thin strip type	ND	-
F75	114	Sheet fragments	-	-
F80	111 112 113	Scutiform object "} pair "}	ND	WM, pm
	110	Small-long brooch	D	-
U/S	78 79	Button Sheet strips	- -	- -

Codes: Analysis: ND = non-destructive analysis only; D = destructive samples possible; - no analysis recommended. Surface treatment: pm = punchmarks; WM = white metal; R+D = ring and dot design.

Table 2: Non-destructive XRF analysis

SF	Area, if not main part	Results
82	Ring (Pin similar, but perhaps more tin?)	Cu, Sn (Zn) (Pb)
84	Lots of tin	Sn Cu Pb Zn
85		Cu Sn Pb (Zn)
98	Very large tin peak, could be tinned	Sn Cu (Zn)
99	Main part; slightly more lead on soldered area and on strip.	Cu Sn Pb (Zn)
100	Main part; soldered areas and strips not significantly different	Cu Pb Sn (Zn)
101	Main part; more lead in soldered areas. Strips have traces of zinc but less tin present	Cu Sn Pb
104		Cu Sn Pb (Zn)
108	Main part; strips same as clasp. Soldered areas slightly richer in lead.	Cu Zn (Pb) (Sn)
109	Main part; no significant difference in soldered areas or in strips.	Cu Sn Pb Zn.
111 112 113	Main part; slightly more tin in white metal area?	Cu Sn Pb
192		Cu Sn Pb (Zn)

Results: Elements given in approximate order of quantity present. Elements in brackets are only present in minor quantities.