THE BRITISH MUSEUM
RESEARCH LABORATORY
LONDON WC1

REPORT ON THE ANALYSIS OF A MEDIEVAL INGOT FROM THE EXCAVATIONS AT BRIDGE STREET, IPSWICH

(Archaeology Unit, Suffolk County Council, via M&LA)

INTRODUCTION

A gold-coloured metal bar from the excavations at Bridge Street, Ipswich was submitted to the Research Laboratory for analysis under the Treasure Trove procedure. Nondestructive X-ray fluorescence analysis indicated that the ingot was a brass rather than a gold alloy, and therefore it could not be considered as Treasure Trove.
However, as few copper-alloy ingots from this period are known (it was excavated from an infilled river deposit probably dating from the 11th or early 12th century), the ingot was clearly of some importance. It was therefore decided that a fully quantitative analysis should be carried out.

ANALYTICAL METHOD

The ingot was sampled for analysis using a 1mm diameter drill. The drillings were accurately weighed, dissolved in aqua regia and made up to volume. The resulting solution was then analysed using atomic absorption spectrophotometry following the procedure of Hughes et al (1976). The results have a precision of approximately ± 2% for copper, ± 5% for zinc and lead and up to ± 30% for the trace elements, the precision deteriorating as the detection limit for a particular element is approached. In addition, the following elements were also sought but were found to be lower than their respective detection limits: Sn 0.1%, As 0.03%, Sb 0.01%, Co 0.002%, Bi 0.01%, Au 0.003%, and Cd 0.001%.

DISCUSSION

The ingot is approximately 90 mm long by 9 to 10 mm wide, and is slightly "S"-shaped along its length and roughly "D"-shaped in cross-section. It exhibits some irregularities and porosity on its surface and appears to be "as cast". The ingot was found to have the following composition:

Cu 66.1%, Zn 27.1%, Pb 5.0%, Ag 0.024%, Fe 0.17%, Ni 0.007%, Mn 0.0015%

The analysis shows that the ingot is brass with a zinc content near to the normal maximum for brasses produced using the cementation process. Cementation involves mixing copper with zinc ore and charcoal in a closed crucible and heating, thus producing metallic zinc vapour which combines with the solid copper to produce brass. The reaction reaches an equilibrium when the zinc content rises to between 27% and 32% depending on the nature of the copper, after which no more zinc can be incorporated. This method was used to produce brass until metallic zinc became widely available in the West in the 18th century, when cementation was replaced by speltering (ie the direct mixing of copper and zinc metals, and brasses with virtually any zinc content could be produced. The high zinc content indicates that the ingot was formed from freshly produced metal rather than from the remelting of scrap, as the zinc content usually falls on remelting. Also, if the ingot had been formed from re-used metal, then one might expect some tin to be present from the inadvertent mixing of scrap bronze with brass. The lead content is higher than one would expect for it to have come from the copper or zinc ore, and is therefore likely to have been added separately to the melt prior to casting.
Analyses of Roman brass ingots and later medieval brasses are known (eg Tylecote 1988), but analyses of medieval ingots are limited to a few recently excavated finds which are as yet unpublished (Justine Bailey, pers.comm.). Qualitative X-ray fluorescence of an ingot found at Canterbury has shown it to be a brass with a few percent of lead, although this ingot is believed to be slightly later in date (13/14th

century) than that from Ipswich. An end piece of a bar some 46 mm in length, believed to be c.1050-1200 in date, was also excavated at Canterbury. Atomic absorption analysis has shown that it is a gunmetal and therefore it could merely be a remelted piece of scrap rather than a freshly produced alloy. The site at Coppergate, York has also produced a number of bars/ingots of brass, gunmetal and leaded bronze, some of which may be 10/11th century in date.

CONCLUSIONS

Little is known about the copper alloys used in the 11th/12th centuries, in particular how much fresh metal was being introduced into the system previously thought to have been dominated by the recycling of scrap. Analysis of the Ipswich ingot has clearly shown that fresh brass was available, and hopefully further analyses of ingots and the contents of crucibles etc. will allow us to build up a more complete picture of the metalworking practices being carried out at that time.

D.R.Hook
File 5578
16 September 1988

References

Hughes, M.J., Cowell, H.R. and Craddock, P.T. 1976 "Atomic absorption techniques in archaeology", Archaeometry XVIII, 19-36
Tylecote, R.F. 1988 The prehistory of metallurgy in the British Isles, The Institute of Metals, London.

KW/JMM 30.1
Mr K Wade
6520

27 September 1988

Mr D R Hook
Research Laboratory
The British Museum London
WC1I3 3DG

Dear Mr Hook

Analysis of Medieval ingot (File 5576)

I thank you for your report on the above ingot from our Bridge Street excavations, Ipswich. Any reference to your results in future publications will of course, be duly acknowledged.

Yours sincerely

for County Planning Officer

DF/3B
KV/KF 30.1
Mr K Wade
6520

Mr D R Hook,
Research Laboratory
The British Museum
London WC1B 3PC

Dear Mr Hook

Copier Alloy 'Ingot' from

Bridge Street Excavations (IAS62020257)

Thank you for the results of your analysis of the above and accompanying letter.

I am quite happy for further analysis to be carried out on the “ingot”. I should add, however, that the date of the object is more likely to be "early Medieval", that is 11th or early 12th century, and this might alter your judgment of its importance.

Yours sincerely,

for County Planning Officer

The British Museum

Research Laboratory
London WCI B 3DG Telephone 01-636 1555 ext
94013362 BMUS G.

Mr J A Newman
Archaeology Unit Planning
Department St Edmund
House
Rope Walk
Ipswich

Your reference

Our reference
DH/JB
10 July 1987

Dear Mr Newman

I recently examined and analysed a "gold" ingot from the excavations at Bridge Street (IAS 6202 0257) under the Potential Treasure Trove procedure. As the enclosed copy of my report shows, the ingot is in fact made of brass.

The Research Laboratory has carried out many thousands of analyses of copper-based metalwork, but very few of mid-late Saxon metalwork. The ingot is therefore an important example of such metalwork and is likely to be of great interest to archaeometallurgists in general.
I feel it would be of great benefit to the study of Saxon metalwork (and early brass making) if a full, quantitative analysis could be carried out on the ingot. This would enable the amount of zinc present to be measured accurately, thus providing technological information about the brass making processes being used at that time, and would also provide information1mm the amounts of trace elements present. To achieve this, a small sample (ca.10mg) would be removed by drilling a small hole (1mm in diameter by 2mm deep) into the ingot. This causes very little disfigurement and is acceptable to most archaeologists/museum curators. The hole could be filled and disguised if necessary, though its presence would serve as a reminder that the object had in fact been analysed.

Please let me know if you feel that carrying out the analysis would be worthwhile. I would be pleased to provide you with any further information you require.

Yours sincerely

Duncan Hook

Enc.

Reference

To: Mrs S Youngs
Department of Medieval & Later Antiquities

From: Duncan Hook Research Laboratory

ANGLO—SAXON BRASS INGOT FROM SUFFOLK — POTENTIAL TREASURE TROVE

The ingot was analysed using X-ray fluorescence on uncleaned surface metal, and therefore the result quoted below is semi-quantitative only:

% Cu	71.7
% Zn	27
Pb	1
% Fe	0.3

The ingot contains no detectable gold and therefore should not be considered as part of a Treasure Trove enquiry. It is, however, an extremely interesting object in its own right, as few ingots of this period are known, especially with the theoretical maximum zinc contents (27%) of the cementation process. Ideally, a full quantitative analysis should be made (involving the removal of ca.10mg of metal by drilling), and attempts should be made to obtain the necessary permission to carry out the sampling. The ornamented copper alloy strip das also analysed using X-ray fluorescence and examined using a binocular microscope. The metal was found to be a 7lopper-zinc-tin-lead alloy. No traces of solder could be detected.

D R Hook
File 5578
6 July 1987