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Qualitative analyses of some copper alloy objects from Blackfriars Street, Carlisle

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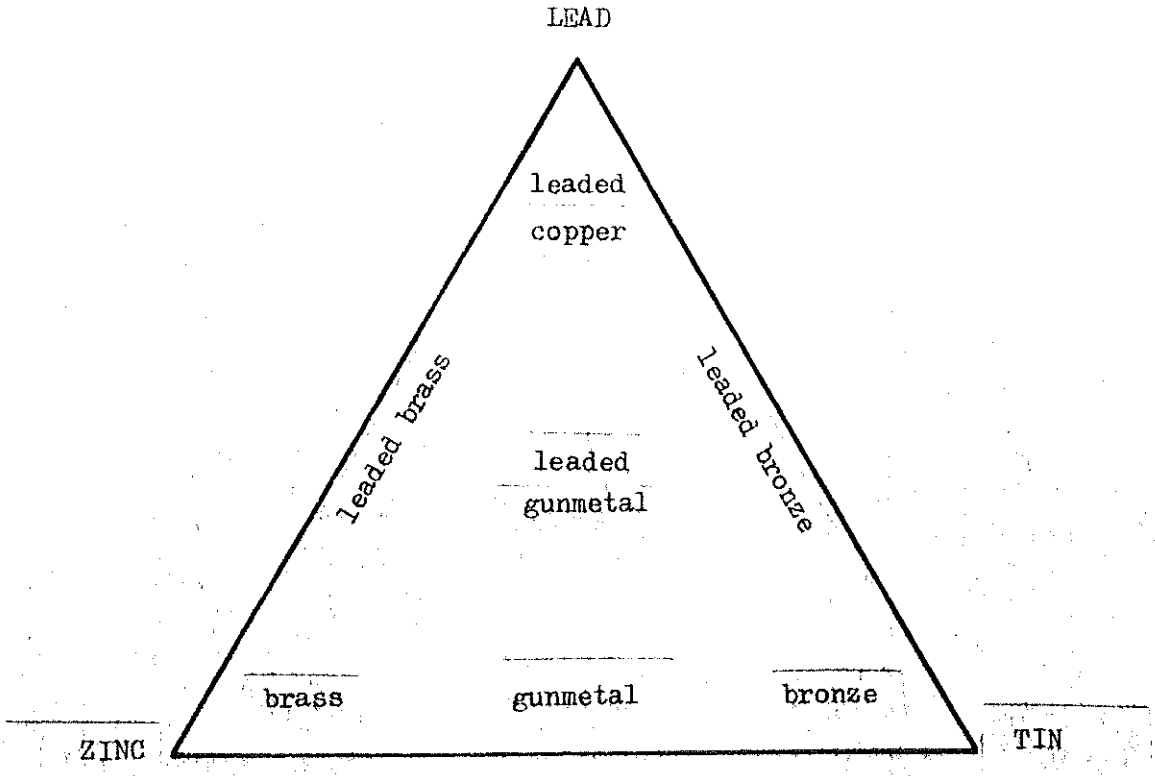
Introduction

The objects were all analysed non-destructively by an energy dispersive x-ray flurorescence(XRF) system. The analyses were performed on the corroded surfaces where the proportions of elements present are not the same as in the uncorroded core of the object. For this reason an absolute composition cannot be given but the relative signal strengths detected generally allow an alloy class to be suggested. The main elements alloyed with copper are zinc, tin and lead. The diagram (below)shows the names given to the various alloys and also shows that there are no hard and fast dividing lines between them.



Most objects contain small proportions of all three major alloying elements but when the amounts, although detectable, are not at high enough levels to have an effect of the properties of the metal, their presence can be ignored. Thus a brass may contain a small amount of tin but the alloy would only be reclassified as a gunmetal when the tin content rose to a few percent.

For these reasons the alloy names given in table 1 should be taken as indications of composition rather than as absolute labels. Where the alloy is not named it is because the figures obtained by XRF did not fit into any expected patterns so any label given would have been no more than an inspired guess. The deeply corroded nature of much of the metalwork means that the interpretations given are less certain than is often the case.

Table 1: Alloy composition of all objects analysed

Small Find no.	Alloy	Notes
AE 58	leaded gunmetal	
62	copper	
65	leaded gunmetal	B
68	?	
72	?	
79	gunmetal	
114	leaded bronze	
117	leaded bronze/gunmetal	
119	bronze	
121	?	
123	leaded gunmetal	E
124	leaded bronze	
127	bronze	B
128	brass	
132	gunmetal	B
135	? brass	
146	leaded bronze	BE
149	speculum metal	High tin bronze
153	leaded bronze	
13	leaded bronze	B
20	brass	
44	leaded brass	
52	brass	
58	leaded bronze	E
59	leaded bronze	B

Small Find no.	Alloy	Notes
66	leaded brass	
67	leaded gunmetal/brass	
82	leaded bronze	
86	?	B
103	bronze	
107	leaded gunmetal	
113	brass	
116	leaded ?	
118	leaded ?	
133	bronze	B
138	gunmetal	B
143	leaded bronze	
145	gunmetal	B
146	?	
148	?	BE
155	leaded bronze	E
156	leaded bronze	
160	bronze	
164	leaded bronze	E
165	leaded bronze	B
168	leaded bronze	E
176	?	B
178	leaded gunmetal	B
186	leaded bronze	
191	leaded gunmetal	E
192	leaded bronze	E
193	leaded bronze	E

Small Find no.	Alloy	Notes
195	leaded bronze	E
198	leaded gunmetal	
201	leaded bronze	E
202	bronze	B
205	leaded gunmetal	B
209	brass	B
166	brass	
217	gunmetal	B
218	leaded gunmetal	E
222	leaded gunmetal	B
226	gunmetal	B
227	leaded bronze	BE
231	brass	
235	leaded bronze	
237	brass	
238	leaded bronze	B
240	leaded gunmetal	
244	leaded bronze	E
245	leaded bronze	E
246	gunmetal	
247	leaded bronze	
249	leaded gunmetal	
250	copper	
252	leaded gunmetal	
253	brass	

Small Finds no.	Alloy	Notes
255	bronze	
256	leaded gunmetal	B
259	brass	
261	leaded bronze	
262	gunmetal	
264	brass	BE
265	?	B
266	gunmetal	B
267	leaded bronze	
268	bronze	BE
272	brass/gunmetal	
2	leaded bronze	

B = brooch

E = enamelled

Discussion of results

Most of the small finds come from dated contexts but, as expected, at least some of the finds are residual. Examples of this are the brooch fragment (AE 65), seal box (AE 58) and brooches (AE 165 and 205), all of which are definitely Roman objects but were found in Medieval contexts. In a similar way some of the finds from later Roman contexts may be assumed to be of earlier date though in most cases this cannot be demonstrated as typological variations are not sufficiently well documented to allow this.

An additional way of classifying the objects is on the basis of their composition. This is not a simply classification system as many different factors have to be considered. A particular alloy may have been chosen for any number of reasons. From a technical point of view different alloys have different properties making them more or less suitable for different manufacturing processes. High tin bronze is hard and brittle. It is however a fairly white alloy and takes a good polish and so was used for cast mirrors. Heavily leaded alloys are difficult to smith as they tend to crack so they are usually only used for castings which will not be put under too great a strain.

Availability and economics must also be considered. Some metals may not have been available to the craftsmen working in a certain area while others may have been cheap and plentiful. Lead fell into the latter category as it was produced in quantity as a by-product of silver minining. It was probably added to more expensive copper alloys as a diluent in all cases where its adverse effects on the

properties of the metal would not matter.

Fashion is a further factor in metal choice as different alloys have different colours; brass is golden yellow, while bronzes tend to be browner or whiter.

Some alloys are known to be used more commonly at one period than another and some are unknown before a certain date. As examples may be quoted the virtual absence of zinc in copper alloys in Britain before the Christian era and the appearance of leaded copper and leaded brass in the medieval period though they are not used earlier.

About half of the Roman objects are leaded bronzes on gunmetals, bronzes being twice as common as gunmetals though it should be remembered that the division between them is arbitrary and may not be totally consistent. The amount of lead is variable but in most cases is probably within the range 5-15%. The remaining objects (where an alloy was assigned) are almost equally divided between brasses, bronzes and gunmetals. The lead levels here are all below a few percent and in most cases under 1%. The only leaded brasses are among the objects said to be medieval in origin (i.e. AE 44, AE 66, AE 67).

The occurence of the different alloys in contexts of different date is summarized in table 2. Bearing in mind the small numbers involved, it can be seen that there is no very significant variation with date which suggests that fashion and availability of supplies were not the over-riding factors in alloy selection. (The brooches, which

can be dated more closely than the other objects because of their typological variation, are discussed in more detail below.)

Table 2: Variation of composition of Roman objects with context and date

Date of context (century)	Brass	Gunmetal	Bronze	Leaded Bronze	Leaded Gunmetal	Total
Late 1st/Early 2nd	3	3	-	5	3	14
2nd	1	2	3	4	3	13
3rd	1	-	1	6	2	10
4th	1	-	-	3	1	5
3rd or 4th	1	2	1	-	1	5
2nd to 4th	1	-	1	1	-	3
"Roman"	1	1	-	-	1	3
Unstratified, Saxon or Medieval	2	2	3	9	3	19
	11	10	9	28	14	72

It would appear then that the way a given object was made and the use it was to have were the major factors in selecting the alloy of which it was to be made.

The brooches

Analyses of Roman brooches from a number of sites in different parts of the country show correlation of alloy with brooch type and date (Bayley et al, 1980 and Bayley and Butcher, 1981). While it is true that

a variety of fabrication methods were used so a range of alloy types is to be expected, there do seem to be other factors involved. For example, brass is most commonly used for earlier 1st century types. This apparent chronological variation is supported by analyses of many of the small finds from the Sheepon site in Colchester which was destroyed in the Boudiccan uprising; the vast majority of them are also of brass (Bayley in Niblett, forthcoming).

A total of 27 of the objects analysed from Blackfriars Street were brooches. The breakdown by alloy types is similar to that of the metal work as a whole.

However, when individual brooch types are considered further comments can be made.

Table 3: Composition of Roman brooches analysed

	Plain	Enamelled	Total
Brass	1	1	2
Gunmetal	6	-	6
Bronze	3	1	4
Leaded bronze	4	2	6
Leaded gunmetal	5	-	5
"Copper alloy"	3	1	4
			27

Five of the six penannular brooches were unleaded bronzes and gunmetals, one a leaded gunmetal. For comparison only 4 out of about 30 penanular brooches from Richborough contained more than 2% lead; they were mostly bronzes and gunmetals though some were brass. The general use of

unleaded or low lead alloys suggest these brooches were wrought rather than cast; the only way to prove this is by making metallographic sections of the objects.

AE 217 (a gunmetal) is a 1-piece brooch. A group of similar brooches from Richborough are mainly brasses but also include bronzes and gunmetals.

AE 176 is a bronze and AE 205 a leaded gunmetal, I have no analyses of very similar types but a small collection of various knee brooches from Richborough were mostly lightly leaded bronzes and gunmetals.

AE 238, a Polden Hill brooch, is a leaded bronze as are most brooches in this class (Bayley and Butcher, 1981, Fig 6).

AE 59 and AE 165 are leaded bronzes, AE 65 a leaded gunmetal. All are from crossbow brooches, AE 59 being an earlier type than the other two fragments. These analyses fall within the range found for similar types from Richborough (Ibid, Fig. 9).

The trumpet brooches (AE 13 and AE 222) are leaded alloys, a bronze and a gunmetal respectively. As the small numbers of trumpet brooches analysed from both Richborough and Catsgore were of very variable composition no sensible comparisons can be drawn.

The headstud brooches (AE 264, AE 268 and ? AE 178) were of variable composition being respectively brass, bronze and leaded gunmetal. A similar range was noted among the headstud brooches from Richborough while those from Nornour (Hull, 1967, e.g. Fig. 17) have almost all been shown to be leaded bronzes.

The two enamelled plate brooches (AE 146 and AE 227) are both leaded bronzes. Similar brooches from both Nornour and Richborough are also leaded bronze.

The enamels

A total of 18 of the objects (including 5 brooches) were enamelled. Twelve of these were leaded bronzes and 2 leaded gunmetals. These are the sort of composition one would expect as these alloys are easy to enamel as their expansion coefficients match those of the enamel reasonably well so it does not flake off as the object cools down after manufacture. (Bateson and Hedges, 1975, 185-6). The vast majority of enamelled Roman objects that have been analysed in the Ancient Monuments Laboratory were also leaded bronzes.

AE 123: A stud with two fields of enamel divided by an anulus of reserved metal. The centre field was orange and the outer one contained both white and blue enamel.

AE 146: A plate brooch with two concentric circles of petal-shaped fields containing enamel. The colours were yellow and turquoise. The smaller depressions between the enamel fields in the outer ring may also once have contained enamel.

AE 58: A lozenge-shaped seal box with the lid divided into 5 x 5 fields. The centre one contained yellow enamel, the four fields adjoining it green and the remainder turquoise.

AE 148: A brooch with enamel decoration on the spring cover. The colours were blue and possibly white.

AE 155: A ? seal box lid or ? plate brooch with 3 concentric enamel fields divided by reserved metal. The centre field was white,

the colour in the next could not be determined and the outer ring was of alternating blocks, probably of red and white.

AE 164: A ? seal box lid. The enamel was green with a white centre spot.

AE 168: A large fitting, enamelled on both sides. The centre part of the repeating design on the front was in red enamel while the background was in blue. All the enamel on the reverse was blue.

AE 191: An equal-ended stud with an enamel field on the complete end (other end missing). The enamel was green with white spots set into it. The spots do not go through the whole thickness of the base enamel but were (hemi)spheres pressed into it while soft. The centre of the object contained a dark coloured deposit that may have been the remains of a further enamel field.

AE 192: A seal box lid with 3 concentric enamel fields divided by reserved metal. The colours of the two inner fields could not be determined. The outer field contained alternating blocks of turquoise with a dark centre spot and ? red.

AE 193: Part of a finger ring. The enamel was turquoise and the spots reserved metal.

AE 195: A stud with 3 concentric fields of enamel divided by reserved metal. The centre field was turquoise; the next contained both clear golden-brown and opaque orange (probably originally as alternating blocks) and the outer field was alternating blocks, probably originally 6 of each, of turquoise and red (or green).

AE 201: The stud had one enamel field which was red, with turquoise spots in a ring near the edge. The centre spot was very decayed and so was probably originally a third colour.

AE 218: A lozenge-shaped seal box. The centre field on the lid contained orange enamel. The four fields around it now appear off-white but were probably originally translucent green.

AE 227: A plate brooch with three concentrically arranged rings of triangular enamel fields. The fields of the middle ring were of blue enamel while those of the inner and outer rings now appear green but were probably originally red.

AE 244: A lozenge-shaped seal box lid. The four crescents were of white enamel; the colour of the surrounding enamel could not be determined.

AE 245: A lozenge-shaped seal box lid with 5 x 5 enamel fields, all blue.

AE 264: A head loop brooch with a panel of enamel along the bow. This was made up of alternating blocks of blue and red (blue nearest the foot), probably originally 4 blocks of each colour. There was no enamel on the boss near the head or on the foot.

AE 268: "Sawfish" head loop brooch with enamel in the stud and in the lozenge and triangular fields on the bow. No colours could be determined.

References

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