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Summary

Over 100 brooches from this early/mid 1st century AD site were analysed quantitatively by atomic absorption and a further 65 qualitatively by X-ray fluorescence. Almost all were brass.

Author's address:

Ancient Monuments Laboratory
Historic Buildings and Monuments Commission
23 Savile Row
London W1X 2HE

01-734-6010 x524

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Just over 100 of the brooches were sampled and analysed quantitatively by atomic absorption spectrometry (AAS) using essentially the method described by Hughes et al (1976). Most of the rest of the brooches were also analysed, but qualitatively by energy dispersive X-ray fluorescence (XRF). All the results are presented in Table 1 where those marked with an asterisk were obtained by XRF.

A few of the brooches had applied decoration of one sort or another. As noted in the typological report on the brooches, all the group G brooches would have had a glass 'stone' in the central cup; in G1 the opaque red glass survives. The silver sheet metal on L1 was soldered into position. On L3 the hook-shaped cut-outs were inlaid with copper, its pinkish colour providing a visual contrast to the yellow brass of the rest of the brooch. L6 and P3 both had applied copper alloy sheet decoration soldered in place.

Discussion of the analytical results

The copper used in Iron Age and Roman Britain contained deliberate additions of tin, zinc and/or lead giving a range of different alloys. The simplest way to present all three variables on a single graph is to use a ternary diagram where the position of the point representing a particular object is determined by the relative proportions of the three alloying elements. Fig 1 shows the names applied to each range of composition which can be considered as a specific alloy. It should be noted that there are no sharp dividing lines between the different alloys as any composition is possible. This means arbitrary decisions have to be made as to exactly where the boundaries for each alloy should be drawn when assigning alloy names to particular compositions. Where an object is of an intermediate composition this is indicated by applying a dual alloy name, eg brass/gunmetal. It should be noted that because of the arbitrariness of the

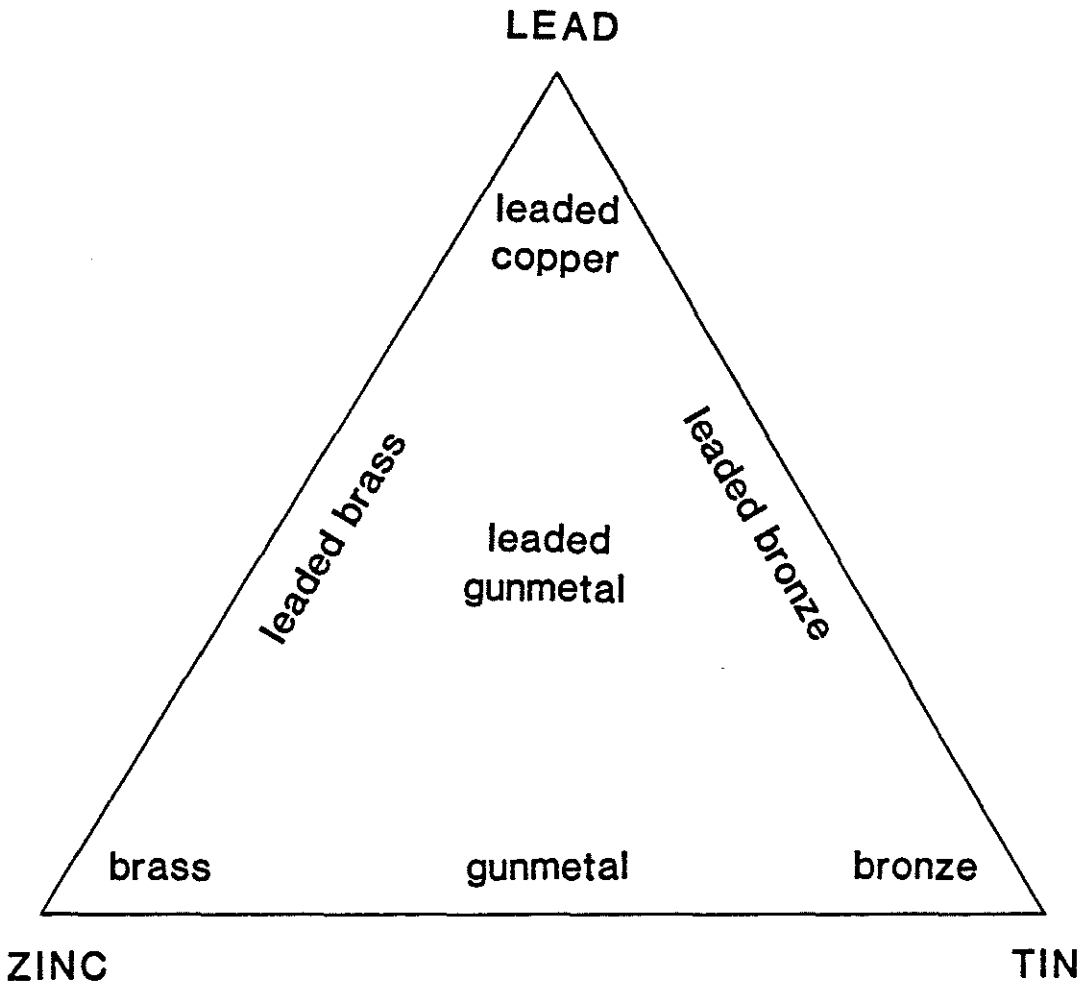

Figure 1: Ternary diagram showing the names applied to alloys of different compositions

divisions objects with similar compositions can be assigned different alloy names if they fall just one side or the other of a boundary.

In Iron Age times most copper alloys were bronzes with leaded bronze used for intricate castings and other objects which were not hammered to shape and where strength was not of prime importance. Brass was first produced on a large scale in the 1st century BC by the Romans (Bayley forthcoming) and used by them as a coinage metal. The metal's golden colour made it an attractive alloy for decorative metalwork and by early in the 1st century AD objects such as brooches were being made of it in Gaul (Rabeisen and Menu 1985).

Many of the brooch types in use on the continent in the early/mid 1st century AD are also found in Britain and the King Harry Lane brooches are typical examples. On typological grounds many of the British brooches are indistinguishable from continental examples and many authorities consider them to be imports (Stead 1984). Other types are variants of continental forms but are common in Britain though rare on the continent and therefore more likely to be of British manufacture. Some one-piece Colchester brooches (Group C here) were definitely made in Britain as the unfinished examples from Baldock show (Stead and Rigby 1987).

All the brooches here with the exception of the Group A ('Nauheim derivative') and Group D (Colchester derivative) examples are basically made of brass, though in some cases the amount of tin present is sufficient to just reclassify them as gunmetals. However consideration of the actual percentages indicates they are almost all part of the same distribution; see Table 1 and also Figs 2 and 3. Brass is the normal alloy used for British examples of the brooches with continental parallels and the few continental examples analysed so far are also brass. Recent analyses of 20 brooches from Mont-Beuvray (Pernot and Hurtel 1988) have shown that three of the four types sampled were brasses. These were described as a) having an uncovered spring with external chord and chord hook (equivalent to Groups B and C here), b) having a separate covered spring (like Groups E - L)

and c) being of Aucissa type (Group M).Though the continental sample is small, the results there mirror the pattern for the British brooches, suggesting the latter could indeed be imports. The source of the brass brooches found in Britain is part of the larger problem of the introduction of brass to Britain and has recently been considered in some detail (Bayley forthcoming).

It is noticable that although almost all the brooches are described as brass, different groups are of significantly different compositions. The AAS results show the Simple Gallic and Colchester brooches (Groups B and C) are fairly pure brass with only a percent or so of tin while the brooches with a separate encased spring mostly contain several percent of tin. The same trend is also apparent in the raw XRF data though it does not show in the alloy names assigned. This variation is not peculiar to this site but is the general pattern found throughout Britain (Bayley forthcoming). Note however that Fig 2 shows no significant differences between the Simple Gallic and Colchester brooches. In the same way Langton Down (Group E) and Thistle (Group F) brooches are compositionally indistinguishable, both from each other and from the other encased spring brooches (see Fig 3). At present no specific reason can be suggested for the variation in the purity of the brass used though different manufacturing traditions or source areas for either metal or brooches are possible explanations.

Although all the Group C brooches here are brass, some sites have produced examples made of bronze and as these sites are mainly or exclusively of post-conquest date it is tempting to see bronze as a transitional composition used briefly as the one-piece brooches gave way to the two-piece (Group D) ones. Over 80% of this later type are leaded bronzes although a few bronze examples (like that here) are known (Bayley 1985, Bayley forthcoming).

The Group A brooches show the whole range of unleaded compositions. This is not unexpected as of nearly 200 brooches of this type that have been analysed some 60% are bronzes, 25% brasses and the rest mainly gunmetals (Bayley forthcoming). There may be some correlation of alloy with typological sub-groups

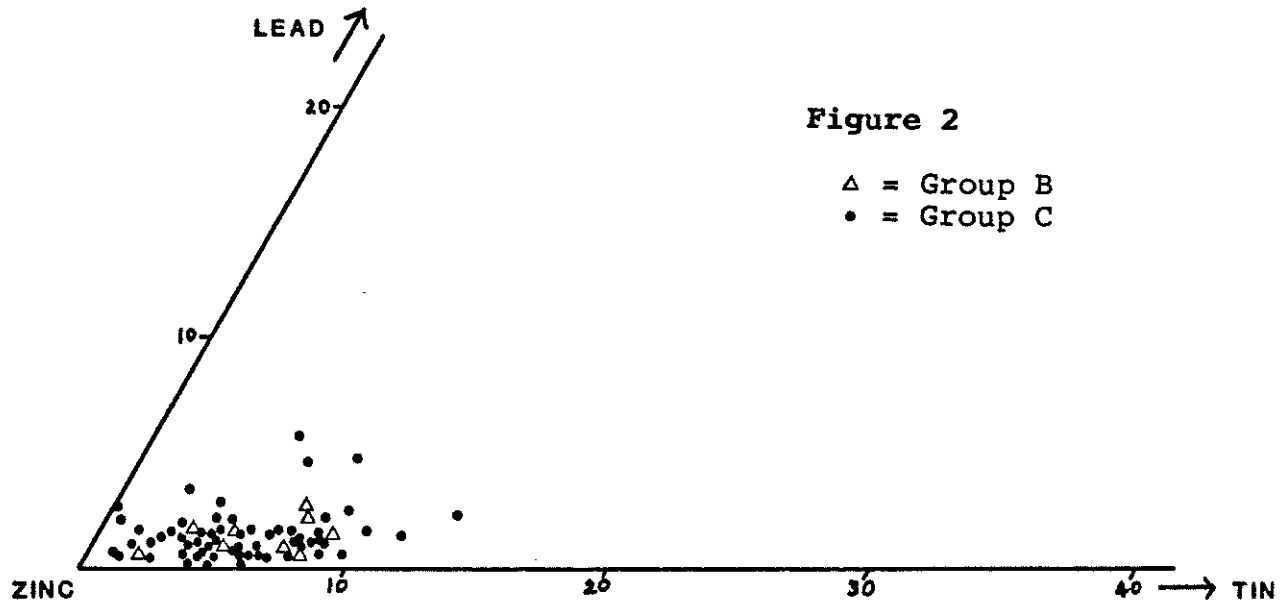

Figure 2

△ = Group B
• = Group C

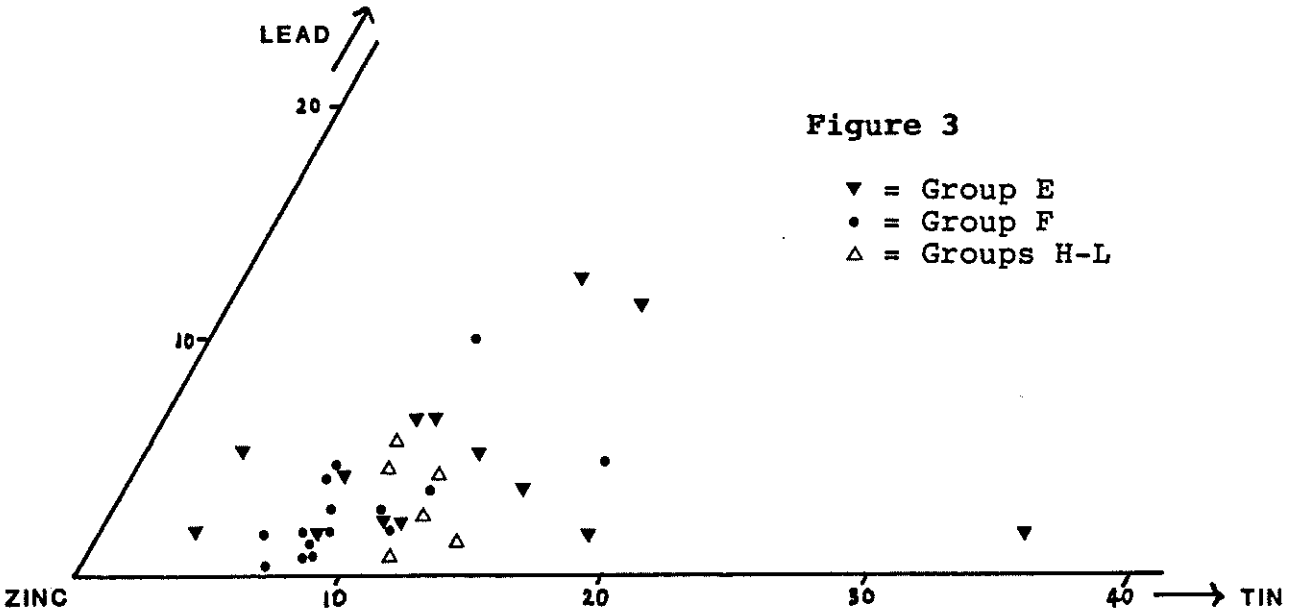

Figure 3

▼ = Group E
• = Group F
△ = Groups H-L

Figures 2 and 3: The bottom left hand part of ternary diagrams showing the compositions of some of the brooches analysed by AAS. The scales are relative proportions (expressed as percentages) for tin (along the bottom) and lead (up the side). Highest proportions of zinc are represented by points nearest the corner.

though further work is still needed to clarify this. The Group M (Aucissa) brooches are brasses like all the others that have been analysed (cf Bayley and Butcher 1981, Fig 3).

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Table 1: The analytical results

Cat No	AML No	Cu %	Zn %	Sn %	Pb %	Ag %		Alloy
A1	670417						*	bronze
A2	682695						*	gunmetal
A3	670523						*	bronze
A4	670468						*	brass
A5	670453						*	bronze
A6	670495						*	brass
B 1	670469	76.8	23.3	1.3	0.4	0.1		brass
B 2	682644	77.2	21.0	1.1	0.2	0.0		brass
B 3	682717	82.9	21.3	2.1	0.3	0.0		brass
B 4	670274	78.8	19.1	1.5	0.2	0.0		brass
B 5	4576	78.3	19.5	1.7	0.1	0.1		brass
B 6	4588						*	brass
B 7	670463	79.7	16.9	1.4	0.4	0.0		brass
B 8	670423	78.1	18.9	0.4	0.1	0.1		brass
B 9	682659	78.7	16.3	1.3	0.5	0.0		brass
B10	670294	76.7	18.2	0.7	0.3	0.0		brass
C 1	670449	79.9	19.5	0.6	0.4	0.1		brass
C 2	682687	81.0	17.5	1.6	0.4	0.1		brass
C 3	682685	82.0	17.8	1.8	0.5	0.1		brass
C 4	682686	79.8	15.8	2.5	0.4	0.3		brass
C 5	670443	78.9	19.3	1.2	0.1	0.1		brass
C 6	4533						*	brass
C 7	670504	78.9	17.6	1.3	0.3	0.1		brass
C 8	4567	79.8	19.3	1.3	0.1	0.0		brass
C 9	682642	76.2	24.1	0.6	0.3	0.0		brass
C10	4575	72.6	23.5	1.5	0.1	0.0		brass
C11	4574	77.8	23.2	1.0	0.1	0.0		brass
C12	682653	77.1	29.9	0.3	0.2	0.0		brass
C13	670486	80.0	20.2	1.0	0.1	0.0		brass
C14	682668	74.6	21.1	0.0	0.6	0.1		brass
C15	670451	77.9	20.6	0.6	0.3	0.0		brass
C16	4557	79.9	19.0	1.4	0.1	0.0		brass
C17	670447	77.2	16.9	1.6	0.2	0.0		brass
C18	670436	77.2	21.1	1.4	0.3	0.0		brass
C19	682662	78.2	18.0	0.2	0.1	0.0		brass
C20	670483						*	brass
C21 or C30	4524	81.2	18.5	1.6	0.2	0.1		brass
C21 or C30	4524	83.8	14.9	1.6	0.2	0.0		brass
C22	682712	72.2	23.9	0.9	0.1	0.1		brass
C23	682697	75.6	17.2	1.6	0.2	0.0		brass
C24	670275	84.3	15.1	0.9	1.0	0.0		brass
C25							*	brass
C26	670427	71.4	27.3	1.3	0.3	0.0		brass
C27	670435	81.3	17.5	0.7	0.2	0.0		brass
C28	4551	82.4	17.4	1.5	0.2	0.1		brass
C29	4544	80.5	17.5	1.6	0.2	0.0		brass
C31	670452	75.4	19.8	0.3	0.2	0.0		brass
C32	682654	79.1	17.8	1.0	0.3	0.0		brass
C33	670419						*	brass
C34	670440	81.3	16.8	0.7	0.5	0.0		brass
C35	670481						*	brass/gunmetal
C36	670466	70.7	21.3	1.0	0.3	0.0		brass

Cat No	AML No	Cu %	Zn %	Sn %	Pb %	Ag %		Alloy
C37	670467	76.2	20.7	1.9	0.3	0.3		brass
C38	682704	76.6	18.3	0.8	0.1	0.0		brass
C39	670444	78.2	18.6	1.3	0.9	0.1		brass
C40	4545	79.0	19.6	1.6	0.1	0.0		brass
C41	682702	79.2	18.8	1.5	0.3	0.0		brass
C42	670506	78.7	18.6	0.8	0.4	0.0		brass
C43	682660	80.2	18.2	0.1	0.2	0.1		brass
C44	682661	77.4	17.5	1.2	0.1	0.0		brass
C45	670437	81.0	19.6	1.8	1.1	0.0		brass
C46	682690	78.1	19.6	1.3	0.2	0.0		brass
C47	682675	78.7	18.5	0.3	0.3	0.1		brass
C48	670505	78.9	20.4	1.2	0.2	0.0		brass
C49	670507	71.9	16.8	1.9	0.3	0.0		brass
C50	4534	73.9	23.6	1.0	0.0	0.1		brass
C51	682727	78.2	18.2	0.4	0.2	0.0		brass
C52	682667	73.9	22.1	1.1	0.0	0.0		brass
C53	670649	74.3	23.1	1.1	0.2	0.1		brass
C54	670458	77.2	21.7	2.9	0.3	0.0		brass
C55	4527						*	brass
C55	4527						*	brass
C56	682666	76.0	21.3	0.5	0.1	0.0		brass
C57	670464	78.5	22.1	0.8	0.2	0.0		brass
C58	682700	80.8	20.5	1.2	0.2	0.0		brass
C59	670521	76.3	21.9	1.0	0.3	0.0		brass
C60	670438						*	brass
C61	670518	89.6	20.1	2.1	0.1	0.0		brass
C62	4538						*	brass
C63	682670	76.8	20.2	0.8	0.3	0.0		brass
C64	4539	84.0	17.1	1.2	0.3	0.2		brass
C65	4516	81.6	16.7	1.0	0.3	0.2		brass
C66	4562						*	brass
C68	4571						*	brass
C69	682731						*	brass
C70	682703	73.4	20.1	0.5	0.7	0.1		brass
C71	670650	78.6	18.3	0.6	0.2	0.0		brass
C72	4522						*	brass
C73	682652	76.6	17.6	1.7	0.1	0.1		brass
C74	670513						*	brass
C75	682729						*	brass
C77	670519	73.2	19.5	1.0	0.4	0.0		brass
D 1	670525						*	bronze
E 1	670420	81.9	16.6	3.1	0.7	0.1		brass
E 2	670296	82.6	12.4	1.7	0.3	0.0		brass
E 4	682684	89.7	10.2	2.4	0.2	0.0		brass
E 6	682724	78.1	19.7	2.4	0.5	0.0		brass
E 7	670426	79.3	19.7	2.3	1.6	0.1		brass
E 8 or E 9	4520	77.8	18.9	3.0	1.2	0.7		brass
E 8 or E 9	4520	77.0	16.3	2.8	2.8	0.1		brass
E10	4579						*	brass
E11	4535	76.1	20.7	1.9	0.4	0.0		brass
E12	670491	75.3	22.6	0.9	1.3	0.1		brass
E13	670490	79.6	16.1	2.0	1.3	0.1		brass
E14	670439	76.7	20.7	1.9	1.0	0.0		brass
E15	682671	77.9	16.4	3.5	2.6	0.0		brass
E16	682677						*	brass
E17	670487						*	brass

Cat No	AML No	Cu %	Zn %	Sn %	Pb %	Ag %		Alloy
E18	682718						*	brass
E19	670421	76.0	19.4	0.8	0.3	0.1		brass
E21	670484						*	brass
E23	682673-4						*	brass
E24	682682						*	brass
E25	682711						*	brass
E26	682688						*	brass
E27							*	brass/gunmetal
E28	682678						*	brass
E29	682676	85.6	11.0	6.1	0.3	0.0		gunmetal
F 1	4541	81.7	16.2	1.5	0.2	0.0		brass
F 2	670515						*	brass
F 3	670488						*	brass
F 6	682655	79.8	19.8	1.7	0.9	0.0		brass
F 7	682707	74.0	18.6	1.7	0.2	0.1		brass
F 8	670462	76.7	17.1	2.0	0.5	0.1		brass
F 9	682669	79.8	19.3	1.8	0.6	0.0		brass
F11	682698						*	brass
F12	4553						*	brass
F13	670653	80.7	21.0	4.8	1.3	0.0		brass
F14	4582						*	brass
F15	682714	75.9	21.8	1.5	0.4	0.0		brass
F16	4552						*	brass
F17	4554						*	brass
F19	670489	74.7	17.3	1.6	0.2	0.0		brass
F20	682696	78.5	16.5	2.1	2.1	0.1		brass
F21	682689	78.1	16.3	2.2	0.7	0.0		brass
F22	682680	77.1	18.9	1.8	0.4	0.0		brass
F23	682672	73.6	19.8	1.7	1.1	0.1		brass
F24	682713						*	brass
F25	670652	78.2	18.2	2.3	0.4	0.0		brass
F28	4556						*	brass
F29	682683						*	brass
F30	4561	77.5	18.6	1.6	0.4	0.1		brass
F31	4526	75.9	22.4	1.7	0.1	0.1		brass
F33	682664						*	brass
F4	4583						*	brass
F5	4581						*	brass
G1	4521						*	brass
G2	4521						*	brass
G3	682694						*	brass
G4	682693						*	brass
G5	670298						*	brass
H1	682705						*	brass
H2	682701						*	brass
H3	682706						*	brass
H4	670512						*	brass
H5	4532	79.0	16.4	2.2	0.5	0.1		brass
H6	670520	81.8	17.0	2.8	0.2	0.0		brass
H7	4530						*	brass
J1	4542	79.8	19.5	2.2	1.0	0.0		brass
J2	670637	80.4	16.0	1.7	1.1	0.1		brass
K1	670434						*	brass
K2	682708	75.6	19.2	2.4	0.1	0.0		brass
L1	4521						*	brass
L2	670514						*	brass

Cat No	AML No	Cu %	Zn %	Sn %	Pb %	Ag %		Alloy
L3	4518						*	brass
L4	670485						*	brass
L5	670461	78.4	15.8	2.2	0.8	0.0		brass
L6	4531						*	brass
M1	4540						*	brass
M2	4573						*	brass
M3	670457	77.7	18.6	2.0	0.1	0.0		brass
M4	670511						*	brass
N1	682648	71.6	24.9	1.5	0.1	0.0		brass
N2	682663						*	brass
P1	4563						*	brass
P3	682679						*	brass