AHK Report 378.

ANALYSES OF THE BROOCHES FROM BALDOCK, HERTS

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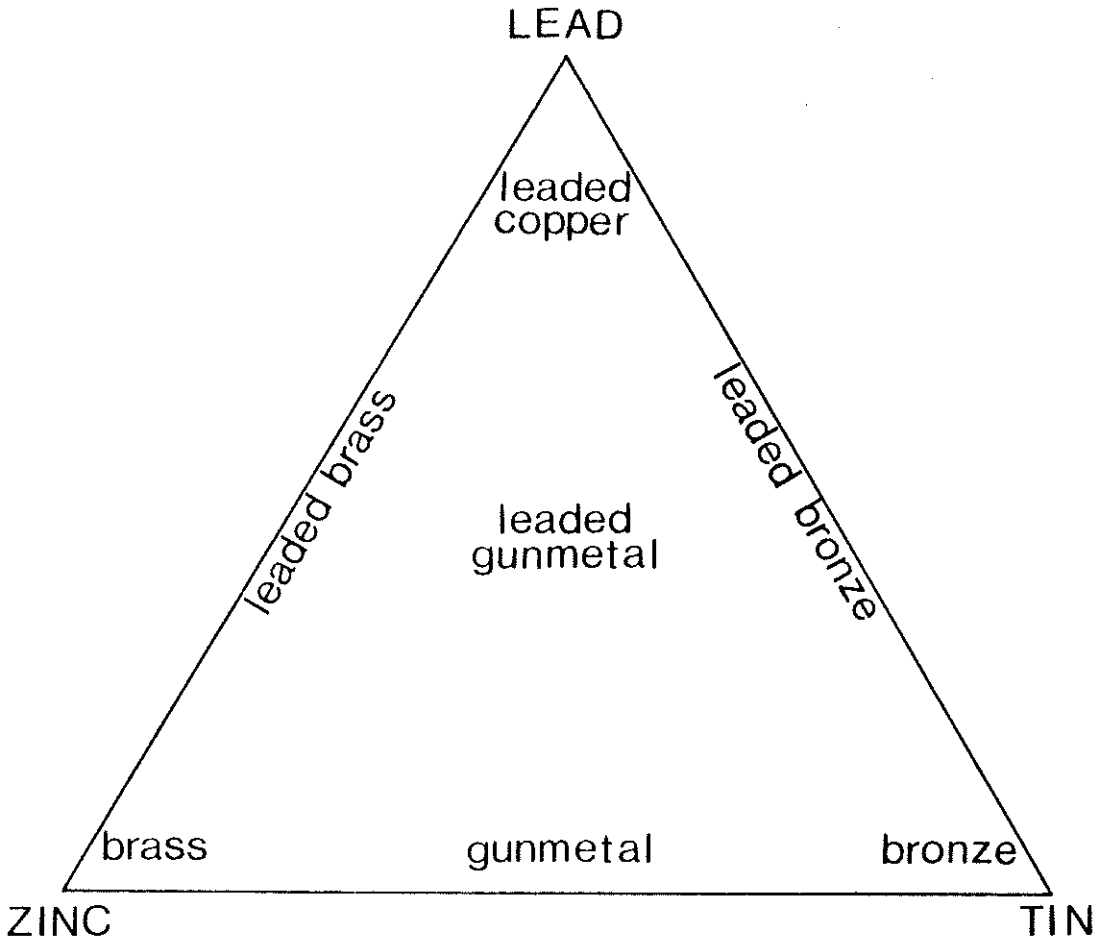
The site produced a total of 159 brooches and brooch pins of late Iron Age and Roman date. A few of these were made of iron but the bulk were of various copper alloys. They were analysed to see which alloys were being used for which brooch types to see if there were any patterns in the metal usage.

Small metal samples were taken from those brooches that were large and solid enough by drilling into them from the back with a no. 60 drill. The metal samples were then analysed quantitatively by atomic absorption (AAS). The results of those analyses are given in table 2.

All the brooches were then analysed non-destructively by x-ray fluorescence (XRF). This gives only semi-quantitative results but in this case they could be approximately calibrated by comparison with the AAS results.

By taking the two sets of data together it has been possible to assign an alloy description to each brooch (see table 1). In some cases this is quite clear cut; for instance an alloy containing only copper and zinc is a brass and one containing only copper and tin a bronze. However, most of the brooches contained detectable amounts of zinc, tin and lead so decisions have to be taken as to the level at which an element becomes significant in the alloy. Here, gunmetal is used as a descriptive term for copper alloys containing more than a percent or two of both tin and zinc. Eg. No 62 is described as a brass although it contains a little tin and a trace of lead. Only alloys containing over a few percent of lead are described as leaded as low lead contents have little effect on the mechanical properties of the metal. The relationship between the elements present and the alloy names is demonstrated

in the figure (below) which also shows the lack of sharp divisions between the various alloys.



Metal that is going to be wrought (as opposed to just cast) does not usually contain much lead as it would make it very difficult to work. Leaded alloys also lack the mechanical strength and springiness of lead-free metals and so are not used where these properties are important, eg the brooch pins (Nos 131-141) are all low lead or lead-free alloys. However, where complex castings are to be made, adding lead to the metal can be anadvantage as it is then more fluid and so it is easier to get a good flawless casting.

Discussion of Results

The La Tène III brooch fragments are catalogued as nos. 2-13. Most are bronzes but one (no 2) is brass. As yet I have no comparative data for these brooch types but will do when the Hayling Island brooches have been catalogued.

The composition of no 14 is somewhat unexpected as it seems to contain a significant amount of lead although it is of 1-piece construction.

Nos 15-22 and 23-44 are two groups of 1-piece brooches with 4-coil springs with internal chords and solid catch plates. Most of both groups are bronzes though a few contain enough zinc to be classed as "bronze/gunmetal" or even "gunmetal". Brass is used for most of those brooches that have rounded or humped bows (Nos 37, 39-41 and 43). Similar brooches from Richborough are fairly evenly split between bronzes and brasses with a few gunmetals (I cannot tell which of your sub-groups they correspond to, or whether they are a mixture). Two similar brooches with short bows and long feet (Nos 45-6) are both bronzes but a further example (No 47) is brass, as are the brooches with incipient wings with which it compares in other ways. These types (nos 48-50) can be roughly parallelled at Richborough where they are also all brasses.

The 1-piece Colchester brooches (Nos 51-3 and 54-66) are, with one exception, all brasses. This is not unexpected as all the comparable brooches from King Henry Lane, St Albans were brass as were just over half those from Richborough.

The later (2-piece) Colchester brooches (Nos 67-80) are all leaded alloys, either bronzes or gunmetals. This agrees with the range of compositions found for these types at Richborough. It is interesting to speculate on the change of alloy and design which obviously go hand in hand. Were leaded alloys introduced as an economy measure, necessitating the new design or was the design changed (it would be easier to repair) and the opportunity then taken to use leaded alloys?

'Dolphin' and 'Polden Hill' brooches are usually leaded alloys, most commonly leaded bronze, like the late Colchester brooches. The examples here are compositionally atypical. In the case of no 83 the reason may have been the colour of the metal; brass would be a golden colour and a nice contrast to the niello inlay.

The Langton Down brooches (Nos 87-95) are all brasses though one or two contain more than traces of tin. The one comparable brooch from Richborough and all those from King Harry Lane, St Albans are also brasses. The 'Nertomarus' brooch (No 86) which is made in a similar way is also brass.

The Kragenfibel (Nos 96-7), Thistle and Rosette brooches are all brass. The numerous Thistle and Rosette brooches from King Harry Lane, St Albans were also all brass. The fragment (No 101) is probably not from a Rosette brooch as it is a leaded bronze and not a brass.

The large group of hinged bow brooches (Nos 104-126) are also mainly brasses. For comparison, all the Aucissa brooches from Richborough that have been analysed are brass as are 80% of the Hod Hill variants from the site.

The plate brooches (Nos 143-152) are not a uniform group so the range of alloys found is not surprising. What is less expected is the fact that most of them contain virtually no lead.

The perannular brooches (Nos 153-9) are bronzes and brasses. They are found in a wide range of compositions, the only common factor being low lead levels.

Notes on individual brooches

15 The roughly shaped wire loop that holds the spring coils to the brooch is made of gunmetal (the brooch is bronze). It cannot have been a functional repair as the pin would not have been springy in this state.

62 The repair as well as the brooch is of brass.

67 The perforated lug may have broken, leaving the present arrangement.

69 This should be with the 1-piece Colchesters, not here. Analytically as well as typologically that is where it belongs.

83 The inlay on the bow near the head appears to be niello. I have not removed a bit to confirm this identification.

84 The "hollow" (1.2 of catalogue entry) is not deliberate but a blow hole in the casting. This is why it has broken where it has. Compositionally it could (though need not) be a 1-piece brooch.

91 There is definitely something extra on the front of this brooch. XRF gives enhanced signals for lead, and to a lesser extent tin, from the front as compared with the back of the brooch. The only thing that worries me is that a solder inlay wouldn't look very pretty - do you think it originally attached something else?

95 I doubt if the stuff in the centre groove is enamel; it looks very like the corrosion products overlying the incised decoration near the edges of the bow but I suppose it could be degraded enamel .. . (if it was, it would have been turquoise).

100 Traces of solder (lead-tin) on front.

101 Probably not a Rosette-brooch (see 'Discussion of Results' above).

102 The solder can be detected analytically - XRF gave enhanced lead and tin signals from the front of the brooch.

103 The head loop filling was just corrosion products. I can't see the bar through the spring coils coming out of the ends of the spring case. The tinning is a stripe down the bow and another across the spring case.

107-26 All tinned except 115, 117, 123, 126. This can be either a pure tin or a tin-lead alloy. It is usually applied to only parts of the brooch, not coating the whole thing. Those brooches where no tinning is visible may have been tinned and it has all worn off or is obscured by corrosion products.

143 The blue glass is a plano-convex (cabochon) shape, not a bead. It is held in place by a thin sheet of metal with a cut-out which is soldered to the brooch back. Cf. No 146.

144 The fronts of the knobs are tinned. The central rivet was iron with a copper alloy head. The 'bead' it held in place has gone; all that remains are iron corrosion products. The bead could have been eg bone.

145 I would say 'rivet' rather than 'pin' here as the latter can be confused with the brooch pin.

146 The glass cabochon is amber-coloured, not amber. As in No 143 it is held in place by the re‿poussé decorated sheet which is tinned ?brass soldered onto the back plate.

147 There were originally 6 projections from the plate.

148 The ring of enamel is made up of long and short blocks of alternating turquoise/green and purple translucent glass. Three of the projecting lugs contain opaque orange enamel, the fourth translucent amber/brown.

149 At least three enamel colours are visible on this brooch. The central band of rectangles are alternately yellow and unknown. The big fields to each side are blue and the triangles round the edge alternately blue and unknown. The enamel in the protruding discs is also of unknown colour. The 'unknowns' are most likely to have been red (or green) but are so decayed that no positive identification can be made.

151 The inset spots are hemispheres, probably originally spheres pressed into the blue field while it was soft and then polished. The inner parts of these hemispheres have fallen out. (The same 2-colour spot effect can be achieved by using slices of a rod with a contrasting core so it is worth differentiating between the two methods where this can be done).

152 Inlay (stripes and both eyes) is almost certainly niello though I have not sampled it to confirm the identification. You can't easily see if the grooves were tinned or not becuase they're full of niello.

Acknowledgements

I should like to thank Ruth Linton for sampling and analysing the brooches for me.

References

The AAS method used was essentially that described by Hughes, M J et al (1976) Atomic Absorption Techniques in Archaeology. Archaeometry 18(1), 19-37

The results of the analyses of the Richborough brooches have been summarised in Bayley, J et al (1980) The analysis of Roman brooches from Richborough Fort, Kent. in Proc. 16th Internat. Symposium on Archaeometry (ed E A Slater and J O Tate)

Bayley, J and Butcher S A (1981) Variations in alloy composition of Roman Brooches. Revue d'Archéométrie. Supplément, 29-36

Table 1: Analytical Results

Where more than one alloy name is given for a single object it indicates either an intermediate composition or some uncertainty as to its composition. The name that appears first is more likely to be correct.

Catalogue No	Quantitative Analysis		Metal alloy	Decoration
1			~~not analysed~~ BRONZE	
2			brass	
3			bronze	
4			"	
5			"	
6			"	
7			"	
8			"	
9			bronze/gunmetal	
10			bronze/gunmetal	
11			bronze	
12			"	
13			"	
14	X		leaded bronze	
15			bronze (and gunmetal)	
16			bronze/gunmetal	
17			bronze	
18			"	
19			bronze/gunmetal	
20			gunmetal	
21			~~not analysed~~ BRONZE	
22			bronze	
23	X		"	
24	X		"	
25			"	
26	X		"	
27	X		"	
28			"	
29			"	
30			"	
31	X		"	
32			"	
33			"	
34			"	
35	X		"	
36	X	LEADED	gunmetal	
37			brass	
38			bronze/gunmetal	
39	X		brass	
40			"	
41			brass	
42			bronze	
43			brass	
44			iron - not analysed	
45			bronze	
46			"	
47	X		brass	
48			"	
49	X		"	
50	X		brass	

51			brass	
52			"	
53			"	
54	X		"	
55	X		"	
56	X		"	
57			"	
58	X		bronze	
~~59~~			~~- not analysed~~ NO OBJECT	
60	X		brass	
61	X		"	
62	X		"	
63	X		"	
64			brass/gunmetal	
65			brass	
66		IRON	- not analysed	
67	X		leaded bronze	
68	X		leaded gunmetal	
69			brass	
70	X		leaded bronze	
71	X		leaded gunmetal	
72	X		" "	
73	X		leaded bronze	
74	X		" "	
75	X		leaded gunmetal	
76	X		leaded bronze	
77	X		" "	
78			" "	
79	X		" "	
80			" "	
81	X		~~- not analysed~~ GUNMETAL TINNED	
82	X		gunmetal	
83	X		brass	niello
84	X		bronze	
85			~~- not analysed~~ BRASS/GUNMETAL + BRASS CHAIN.	
86	X		brass	
87	X		"	
88			"	
89	X		brass/gunmetal	
90	X		brass	
91			"	"inlay" (see notes)
92			brass/gunmetal	
93			brass	tinned
94			"	
95			"	?? enamel (but see notes)
96			"	
97			"	
98			"	
99			~~- not analysed~~ BRASS	
100			brass	tinned (solder)
101			leaded bronze	tinned
102	X		leaded gunmetal	tinned (solder)
103			brass/gunmetal	tinned
104			" "	
105			brass	

106		brass/gunmetal	
107		brass	tinned
108		"	"
109		"	"
110		bronze	"
111		brass	"
112		"	"
113		gunmetal	"
114		bronze	"
115		brass/gunmetal	
116		brass	tinned
117		"	
118		"	tinned
119		"	"
120		"	"
121		"	"
122		"	"
123		"	
124		"	tinned
125		"	"
126		"	
127		iron - not analysed	
128		" " "	
129		iron - not analysed	
130		" " "	
131		bronze	
132		"	
133		gunmetal	
134		bronze	
135		gunmetal	
136		bronze	
137		brass	
138		"	
139		gunmetal	
140		brass	
141		bronze/gunmetal	
142		~~- not analysed~~ BRASS	
143		brass/gunmetal	tinned blue glass "stone"
144		brass	tinned
145		"	tinned
146		gunmetal/bronze	tinned amber glass "stone"
147		brass	
148		?bronze	enamelled
149		bronze	"
150	X	brass	
151		"	enamelled
152		"	niello tinned
153		bronze	
154		"	
155		brass/gunmetal	
156	X	brass	
157	X	bronze	
158	X	"	tinned
159		"	

Table 2: Quantitative (AAS) Analyses

Catalogue No.	AA Sample No	% Composition Cu	Zn	Sn	Pb
14	801	81.1	2.0	5.6	6.7
23	825	83.8	2.5	11.0	2.0
24	826	87.6	0.9	10.1	0.4
26	824	84.3	1.7	10.2	0.6
27	829	87.3	0.4	6.6	2.3
31	827	92.8	0	5.6	1.3
35	828	86.8	0.1	11.6	2.3
36	830	78.7	7.3	6.9	8.2
39	831	73.5	27.7	0.9	0.1
47	832	73.5	23.5	0.7	1.0
49	833	75.6	23.7	1.2	0.3
50	814	71.9	23.0	1.3	0.1
54	800	81.4	21.9	1.4	0.3
55	~~817~~ 859	80.3	18.9	0	0
56	808	71.1	20.5	0.6	0.1
58	834	82.5	0	9.7	0.2
60	~~813~~ 856	78.4	19.1	0	0
61	810	81.9	14.2	1.7	0.8
62	811	71.3	20.7	1.6	0.1
63	812	85.4	20.0	2.1	0.3
67	815	78.1	1.7	7.6	10.2
68	835	74.5	4.0	8.7	10.5
70	836	78.4	0.3	9.1	8.3
71	~~804~~ 855	80.9	4.2	4.9	12.3
72	837	74.5	7.5	5.4	11.5
73	~~797~~ 857	75.0	0.5	9.6	17.9
74	~~820~~ 860	61.3	0.3	7.5	30.0
75	838	78.1	6.0	6.8	9.4
76	841	77.3	1.8	8.0	12.2
77	321	78.5	0.8	6.4	11.2
79	~~805~~ 858	85.5	0.7	5.0	8.0
82	~~798~~ 854	84.5	6.0	7.5	0.8
83	807	81.8	19.6	1.8	2.0
84	876	90.3	0.4	14.6	0
86	802	74.8	17.9	1.8	0.9
87	809	71.2	17.1	1.9	0.2
89	840	72.9	21.8	3.5	0.4
90	839	73.5	24.5	0.5	2.4
104	842	73.5	24.1	3.1	0.1
116	~~822~~/844	70.8	28.3	0	1.7
117	845	68.2	26.8	1.4	0.6
118	848	71.1	28.4	1.2	0.2
119	843	73.7	28.3	0	0.1
120	819	75.3	21.1	0.8	0.1
124	806	75.0	23.9	1.1	0
125	846	73.1	25.5	0.6	0.2
150	847	73.7	21.4	2.7	0.7
156	803	81.7	17.3	1.8	1.2
157	818	81.2	1.5	11.8	0.7
158	849	82.5	0	10.9	1.3
81	853	84.6	5.0	5.7	1.1
102	852	78.5	15.7	2.7	6.1