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Summary

A total of 35 brooches and brooch fragments and 83 other copper alloy objects were analysed qualitatively by X-ray fluorescence. The applied decoration that survives on nine of the objects is described. The results are presented and compared with those of similar objects from other excavations.

.**Keywords**
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Introduction

The site was excavated in 1978-9 by Nicholas Palmer for Warwickshire Museums Service. The work described in this report was completed in the early 1980s as part of a wider project investigating the composition and decoration of Roman brooches and other metalwork. The site was occupied by an agricultural settlement until c.120 AD, and after that by a succession of timber and stone temples, the latest phase belonging to the 4th century. Many of the finds were not well stratified so it is not possible to discuss the variation of alloy use with date, except for objects which can be dated typologically.

Methods

The objects were all analysed by energy dispersive X-ray fluorescence (XRF). The results are presented in Table 1 for the brooches and Table 2 for the other objects. In most cases the copper alloy contained some tin, zinc and lead, though in widely varying proportions. Alloys that are mainly copper and tin are called bronzes, those containing mainly copper and zinc are brasses, and those with significant amounts of both tin and zinc added to the copper are known as gunmetals. All these alloys may have lead added; they are then known as eg, leaded bronze.

The detection limit for the elements being sought is probably in the range 0.1-0.5%. The composition of the corroded surface of the object (which is what was analysed) is not very directly related to the composition of the original metal, especially when the objects are as deeply corroded as they are at this site. The alloy name assigned to each object can therefore only be an approximate description of its composition, but objects with the same alloy name will have similar compositions. Roman brasses usually contain 10-20% zinc and bronzes have tin contents in the range 5-15%. Objects described as 'leaded' apparently contain more lead than those described as '(leaded)'. Lead contents can be in excess of 20% and only those objects not described as leaded will contain less than a percent or two of lead.

Brooch analyses

Previously reported analyses (eg Bayley and Butcher 1995) have demonstrated that there is a strong correlation between brooch type and the composition of the metal from which it is made. Typologically similar brooches are normally made from a single alloy, or from alloys of a limited range of compositions, no matter where they are found. The results for the brooches from Grimstock Hill can therefore be compared with data from other sites. Most of the types were of the compositions normally found for that type.

Nauheim derivative brooches are wrought rather than cast and so cannot be made from heavily leaded alloys. This is because these alloys cannot be hammered to shape without cracking, and they are not springy enough for making one-piece brooches with an integral spring. The two examples here are a gunmetal (No 1) and a bronze (No 2). Over 60% of all Nauheim derivative brooches are bronzes, with the remainder divided between brasses and gunmetals. There does not appear to be any correlation between composition and typological variants of Nauheim derivatives.

The vast majority of Aucissa brooches are brasses, though about 10% of them contain enough tin to be classified as gunmetals. The composition of the two examples here (Nos 3-4) are therefore not unexpected.

Table 1: Analytical results for the brooches

Report No	SF No	Brooch type	Decoration (see Appendix 1 for details)	Alloy
1	1018	Nauheim derivative		(leaded) gunmetal
2	1088	Nauheim derivative		bronze
3	595	Aucissa		brass
4	93	Aucissa		gunmetal
5	1086	Polden Hill		brass
6	110	Polden Hill		leaded bronze
7	850	Polden Hill		bronze
8	791	Polden Hill		leaded bronze
9	461	Polden Hill		leaded bronze
10	1087	Polden Hill		leaded bronze
11	1008	Polden Hill		leaded bronze
12	1085	Polden Hill		bronze/gunmetal
13	91	Polden Hill		leaded bronze
14	967	Polden Hill		leaded bronze
15	10	Polden Hill		bronze
16	2012	?		bronze
17	285	headstud		leaded bronze
18	860	headstud	enamel	leaded gunmetal
19	284	headstud	enamel rivetted-on studs at head and foot (lost)	gunmetal
20	64	headstud	enamel tinning rivetted-on studs at head and foot (lost)	brass/gunmetal
21	460	trumpet		leaded bronze
22	810	trumpet		bronze
23	120	trumpet		(leaded) bronze/gunmetal
24	303	trumpet		(leaded) bronze
25	2013	trumpet		leaded bronze/gunmetal
26	145	trumpet-headed	enamel	bronze/gunmetal
27	87	?		bronze
28	520	geometric plate	tinning rivetted-on decoration (lost)	bronze
29	771	penannular		bronze
30	395	penannular		bronze
31	1099	fragments		bronze
32	1048	fragments		bronze
33	702	fragments		bronze
34	84	fragments		(leaded) bronze
35	851	fragments		bronze

Note the Report Nos in Tables 1 and 2 are those used by Glenys Lloyd-Morgan in her catalogue of the finds, forthcoming in the excavation report.

The largest single group of brooches are the Polden Hill types (Nos 5-15), described by Glenys Lloyd-Morgan as dolphin brooches. These are all castings so any copper alloy can be used to make them. The pin/spring is a separate piece of metal held in place by an axis bar, the ends of which are held by the disc-shaped ends of the wings. In most cases the chord of the spring passes through a hole in the crest but in Nos 8 and 14 it is held in place by a hook. Seven of the ten brooches which were analysed were leaded bronze, a figure that compares well with the 65% leaded bronzes for other Polden Hill brooches. Nearly 20% of these other brooches are bronzes (cf Nos 7 and 12) while brasses (like No 5) are unusual but not unknown on other sites.

The headstud brooches (Nos 17-20) show some variety of form. No 17 has a fixed headloop and is made of leaded bronze; bronze and leaded bronze are the common alloys for this type of brooch (Bayley and Butcher 1995, Fig 8). For headstuds with loose headloops, over three quarters are zinc-rich alloys, the majority brasses and the remainder gunmetals or leaded gunmetals (*ibid*); nos 18-20 conform to this pattern. The bands of tinning on No 20 probably once held applied silver strips or wires which would have contrasted well with the golden colour of the brass, which was the usual alloy for brooches decorated in this way.

The six trumpet-headed brooches (Nos 21-26) also include a variety of forms. Bayley and Butcher (*ibid*) have shown that the type of headloop and whether the knop on the bow is flat on the back are the features that correlate best with alloy type. In this case most of the examples from Grimstock Hill do not fit with the expected pattern which predicts Nos 21-22 should be leaded bronzes, Nos 23-25 brasses and No 26 a brass or gunmetal.

Penannular brooches were made of any low-lead alloy so the compositions of Nos 29-30 are not unexpected.

Analyses of other objects

The results of these analyses are presented in Table 2.

In general, insufficient objects other than brooches have been analysed to see any clear patterns in the alloys used to make particular types. The assemblage from Grimstock Hill includes both cast and wrought objects, so it is not surprising to see a range of leaded and unleaded alloys used to make them. There are a few objects which appear to be made of unalloyed copper (Nos 36, 75 and 82) and it is possible that they are not Roman in date as the use of copper on its own is unusual at this period, except for thin sheet metal cladding.

The analytical results for the bracelets can be compared with those from Uley (Bayley 1993). The cable-twist bracelets (Nos 57-58) are both bronze while the eight Uley examples were half and half brass and bronze. The solid bracelets (Nos 59-60) are brass and bronze respectively but there are no close typological parallels for them among the bracelets from Uley.

The needle (No 74) is catalogued as brass and therefore interpreted as probably modern. It is in fact bronze and thus more likely to be of some antiquity.

The post medieval watch parts (Nos 76-77) are brass, as might be expected. The wire (No 108) is galvanised iron and therefore must be modern.

Table 2:Analytical results for the other objects

Report No	SF No	Object	Decoration (see Appendix 1 for details)	Alloy
-	467	strip		bronze
36	2002	buckle		copper
37	66	ligula		brass/gunmetal
38	629	earscoop		bronze
39	667	strip		brass
40	67	nail cleaner		bronze
41	605	nail cleaner		bronze
42	824	tweezers		bronze
43	2007	tweezers?		(leaded) bronze
44	521	tweezers		bronze
45	324	tweezers		bronze
46	2004	dress fastener	enamel	leaded bronze
47	352	stud	enamel	(leaded) bronze
48	1001	pin		bronze
49	588	pin		bronze
50	612	pin		gunmetal
51	679	pin		(leaded) bronze
52	114	pin		bronze
53	290	pin shaft		(leaded) bronze
54	637	pin		bronze
55	776	pin?		leaded bronze
56	195	ring: finger		gunmetal
57	558	bracelet		bronze
58	90	bracelet		bronze
59	487	bracelet		brass
60	872	bracelet		bronze
61	1003	seal box lid	enamel	leaded bronze
62	618	amulet?		bronze
63	95	attachment loop		bronze
64	1000	steelyard		leaded bronze
65	15	escutcheon		leaded bronze
66	318	vessel fragment?		brass
67	215	strip: decorated		gunmetal
68	2001	terret?		leaded gunmetal
69	113	fitting		bronze
70	161	nail?		leaded bronze
71	475	strip/ring		not analysed
72	1006	vessel?		(leaded) bronze
73	88	buckle	tinning	(leaded) bronze
74	92	needle		bronze
75	890	nail		copper
76	53	key		brass
77	212	watch part		brass

Table 2 (cont)

Report No	SF No	Object	Decoration	Alloy
78	7	strip (casting)		gunmetal
79	13	rod		leaded bronze
80	18	wire loop		brass
81	51	strip		bronze
82	60	strip		copper
83	70	wire		leaded bronze
84	81	strip		brass
85	96	wire		(leaded) bronze
86	1128	fragment		bronze
87	194	wire		copper/brass
88	196	finger ring		leaded bronze
89	247	lace tag ?		brass
90	251	pin		brass
91	304	sheet fragment		bronze
92	316	rod		brass
93	326	strip		bronze
94	334	tube		brass
95	336	wire loop		bronze/gunmetal
96	373	lump		leaded bronze
97	557	strip		(leaded) bronze
98	611	sheet		bronze
99	673	rod		(leaded) bronze
100	721	sheet		bronze
101	847	pin?		bronze
102	894	wire?		bronze
103	903	wire?		bronze
104	938	tweezer fragment		bronze
105	955	pin		bronze
106	966	pin		(leaded) bronze
107	986	wire		bronze
108	1032	wire		galvanised iron
109	2006	ring		bronze
110	1183	sheet		brass
111	58	spillage		leaded bronze
112	112	spillage		bronze
113	198	spillage		(leaded) bronze
114	1035	spillage		bronze
115	835	sheet		bronze
116	862	sheet		bronze
117	160	twisted loop		brass

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Appendix 1: Description of the decoration

Much of the enamel is deeply decayed so determining its original colour is difficult. Bayley (1987) describes the approach adopted here.

Report No	
18	The bow is decorated with 13 square fields of enamel, separated by reserved metal. They are deeply decayed and now appear alternately dark and light. The dark colour was probably originally red or dark green, while the light squares would have been white or pale green. The head stud has the same two colours, the dark ring being separated from a light central spot by reserved metal.
19	The bow has 13 lozenges flanked by triangular fields of enamel. The central lozenge now look pale green (which may not be its original colour) while the rest are blue. The triangles are now dark olive green and may originally have been red, dark green or black. The same dark colour is used on the arms and on the plate on the headloop where the enamelled field contains reserved metal lozenges. The hollow settings at head and foot would originally have contained an annular stud, probably of glass, held in place by a decorative rivet.
20	There are bands of tinning down the centre of the bow, at the ends of the crossbar, and on the ends of the plate on the headloop. These probably originally attached strips of silver, either beaded wire or repoussé-decorated foils. There are small fields of enamel on the arms and headloop plate; the small crescent-shaped fields are blue and the larger fields black. The hollow settings at head and foot would originally have contained an annular stud, probably of glass, held in place by a decorative rivet.
26	Some blue enamel has overflowed from the outer field into the inner orange one. They are separated by a ring of reserved metal and there is also a central metal spot.
28	Traces of tinning are visible. The area between the knobs was probably originally covered by a decorative plaque, rivetted into place.
46	The enamel is all turquoise-green.
47	The head of the stud has spots that new appear pale green, separated by reserved metal from a background that is too decayed to determine its original colour.

61 The lid is divided into 5x5 fields by reserved metal. The central three fields running horizontally (as drawn) are yellow. The four fields abutting two yellow fields have lost most of their enamel and its original colour cannot be determined. The remainder of the fields were possibly originally turquoise.