

Ancient Monuments Laboratory
Report 43/86

ANALYSIS OF MEDIEVAL DRESS FITTINGS
FROM THE MUSEUM OF LONDON.

Paul Wilthew and Susan Wilthew

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Summary

Over 200 non-ferrous metal medieval dress fittings were analysed. A quantitative microanalysis system was used to analyse four gold rings, but qualitative X-ray fluorescence was used to analyse the other objects. No sample preparation was used in either case.

The compositions of the copper and lead/tin alloy objects are described in terms of broad alloy types and comments are made about the alloys used for particular groups of objects. Some groups were found to have fairly consistent compositions (within the limits of the method used). Among the copper alloy objects these included bells, headdresses and mounts all of which were consistently brass. Of the lead/tin objects, bells, studs and strap ends were generally tin, whereas mirror cases and brooches were pewter. Other groups were of variable composition and the interpretation of the results may be clearer when more archaeological and typological information is available.

Qualitative analysis (subject to the uncertainties introduced by lack of surface preparation) of the gold rings are given. In three cases the gold was heavily debased by silver and copper giving an alloy containing about 45%-55% gold. The mount on the fourth ring was of similar composition but the ring itself was less debased (about 75% gold).

Some suggestions for further work are also given.

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Analysis of Medieval Dress Fittings from the Museum of London

Introduction

The objects analysed were a selection of the medieval dress fittings from recent excavations carried out by the Department of Urban Archaeology of the Museum of London. The objects were from six sites, Baynard Castle (BC), Billingsgate (BIG), Billingsgate watching brief (BWB), Custom House (CUS), Swan Lane (SWA) and Trig Lane (TL). A catalogue of the dress fittings is currently being written and as part of the catalogue a substantial programme of analytical work was planned to determine the pattern of non-ferrous metal usage both chronologically and in different types of object. An investigation of the manufacturing techniques used in the objects was also planned.

The first stage of this work, which is reported here, involved an analytical survey of a large and representative selection of all the major groups of objects to be catalogued. The intention was to obtain basic information about the alloy types used and to identify which groups of objects would be likely to provide useful results if investigated in larger numbers and using quantitative techniques. The majority of the objects analysed were copper alloy, some were lead/tin objects and a few were gold or silver.

The analytical results are presented in the appendices and are discussed below. Some suggestions for further work are also given.

Analytical Method

Apart from the gold rings, all the objects were analysed qualitatively using energy dispersive X-ray fluorescence (XRF). Many of the objects consisted of several parts and as far as possible each part was analysed separately. In many cases, however, this was not possible and consequently some results were ambiguous. Where inlays or surface coatings were present both the base metal and the inlay or coating was identified if possible but again the results were sometimes inconclusive.

The four gold rings were analysed using a Link Systems AN10000 quantitative energy dispersive X-ray analyser on a scanning electron microscope (SEM) using a 25keV accelerating voltage. Link Systems ZAF/PB software set up with pure element standards was used to process the spectra. Each part of each ring was analysed separately.

No surface preparation was carried out and so the results will have been affected by surface contamination, corrosion and depletion of elements from the surface. They should nevertheless give a reasonable indication of the relative fineness of the gold in each ring and of the alloys used in the copper and lead/tin objects.

Gold rings

Quantitative results were obtained for the concentrations of gold, silver and copper in the gold rings and these are given, normalised to 100%, in appendix 1. The values quoted in the following discussion are based on those results, but it should be remembered that the surfaces analysed were not prepared and that the figures are subject to the errors listed above.

The results suggest that two of the rings (TL Accession Number 2263 and BC 2035) were of similar composition, about 45% gold debased with about equal amounts of silver and copper.

TL 2266 was somewhat purer (about 55% gold) and had been mainly debased with silver although it still contained about 15% copper. Both TL 2263 and TL 2266 were in two parts and in both cases the analytical results were consistent with the two parts being of the same composition.

TL 1717 consisted of three parts, the main ring, the mount and a small ring soldered to the mount. The main ring was significantly purer (about 75% gold) than either the other rings or the rest of TL 1717 itself. The analyses of the mount and the ring on the mount were not significantly different (55-60% gold, debased with about equal amounts of copper and silver).

Qualitative analysis of the solder in TL 605 indicated that it was silver rich, but the solders in the other TL rings were not analysable. More detailed SEM examination with appropriate surface preparation should allow the composition of the solders to be determined.

Copper alloy objects

Over 150 copper alloy objects were analysed by XRF and the results are summarised in appendix 2. A large number of different sorts of object were included and the numbers of each sort analysed varied from a single object to over thirty. Most of the objects contained traces of lead but these are unlikely to represent deliberate additions and are not discussed below. Where analytical evidence for coatings or solders was obtained this is mentioned in appendix 2. It may be possible to draw further and more detailed conclusions when full phasing and typological information for the objects is available.

The bells, head dresses, wires and "prickers" were all consistently made from brass although the zinc levels did appear to vary. In some cases a small amount (up to a few percent) of tin was also present. The head dresses, "prickers" and the single needle examined (which was also brass) were all fairly thick wires formed from a folded sheet and the latter two groups could therefore have been reused head dresses but it would be impossible to prove this on analytical grounds, even with quantitative results.

Only single examples of badges (copper), combs (bronze plates), dress hooks (brass) and mirror cases (gunmetal with lead/tin deposit inside) were analysed and therefore no conclusions as to the typical composition of these objects could be reached. However other mirror cases analysed by Justine Bayley (Bayley et al. 1984) were also all gunmetal which suggests that this was the typical composition of the copper alloy mirror cases.

Small numbers of buttons, chapes, cloak fasteners, pendants, pins brooches and tweezers were analysed but more than one alloy type was used in each of these groups. The buttons included the only examples of very high tin bronzes (probably above 25% tin), BIG 5734 and SWA 2167. These two buttons were solid but the others, which included both brasses and gunmetals were generally made from sheet metal. The only silver object analysed was a pin, BWS 5294, but other pins were both brass and bronze. The brass pins were of the wound wire headed type which are normally brass (Caple and Warren 1983). Two of the copper pendants were gilded and, as with the other gilded objects, the mercury gilding technique was almost certainly used. Three of the other pendants were also copper but no evidence of gilding survived. Of the other two pendants, one was brass and one gunmetal. Given the variable nature of the other groups, both analytically and stylistically, it is not possible to comment sensibly on the analytical results at this stage. More analyses of similar objects and more dating and typological information would be required before conclusions could be drawn.

Five larger groups of objects were analysed, buckles, finger rings, mounts, strap ends and studs.

The buckles comprised the largest group of objects, although they were crudely divided into two groups, those with single loops and those with double loops. Many of the buckles had several components and in some cases there was evidence for the use of lead/tin solder. Brass was the most common alloy used but gunmetal and, more rarely, bronze components were also present. A few copper buckles were noted, one of which was gilded. In many cases different components of a single object were made from different alloys, perhaps to improve the appearance by using alloys of different colour. There was no clear cut compositional difference between the two single and double looped buckles but a more refined typology might give better correlations.

The same comments can be made about the strap-ends where there

was rather more evidence for the use of solders. XRF analysis could only indicate the presence of lead/tin rich solders, but SEM examination of suitable prepared objects should give substantially more information.

The majority of the studs, including all the studs attached to straps, were brass although a few copper ones were present. Only one gunmetal, and no bronze, stud was found. The mounts were also typically brass (10 out of 12) although the rivets on them were of variable composition. Of the other two mounts, one was copper and one bronze.

The finger rings were another group which appeared to normally be brass (7 out of 11) but bronze and gunmetal examples were also found. The rings were rather individual objects with solders and various materials in the mounts and more information could be obtained by a more detailed examination than was possible during the work reported here.

Lead/tin objects

The analytical results for the 53 lead/tin objects are given in appendix 3. Copper and, occasionally, zinc were detected on some objects. It was clear that a copper (and perhaps zinc) rich layer had deposited on many of the objects. These layers probably consisted mainly of copper sulphides and/or copper-iron sulphides (iron was also often present but was not regarded as significant as it is unlikely to be a constituent of the lead/tin alloy itself). Copper can be added to a lead/tin alloy to harden it and may therefore have been present in the original metal of some of the objects. It was not possible to distinguish between surface deposits and copper in the original alloy with the method used and therefore the question as to whether copper was used to harden the alloys is not discussed.

With two exceptions, the lead/tin alloy objects fell into one of three compositional categories, essentially pure tin, impure tin containing several percent of lead and pewter, a lead/tin alloy probably containing between one-half and two-thirds tin. A more quantitative analysis might divide the pewter objects into more than one category. The exceptions were a mount (essentially pure lead) and a finger ring (possibly a test piece) which was lead rich but also contained significant amounts of tin.

Most groups of objects were fairly consistent in composition. The tin objects included all the bells, all but one strap-end (the exception being impure tin) and 14 out of 15 studs (the exception being pewter). The pewter objects included all the mirror cases (the only remaining foil in a case was tin), all the broches and 6 out of 7 badges (the other being tin).

The most varied group was the buckles which included about equal numbers of tin and pewter examples. The variation may be found to correlate with differences in typology or date when this information is available.

Several groups were only represented by a few objects and so no conclusions could be drawn concerning them. They included the beads (2 examples, both tin), the single pewter belt chape, the buttons (3 tin, 1 pewter), the rings (1 impure lead, 2 pewter) and the mounts (3 impure tin, 1 lead).

Suggestions for further work

As stated above, this work was intended as a preliminary study intended both to answer basic questions about the types of alloys used for different objects and to indicate what further qualitative or quantitative analysis would be likely to provide valuable information. It was clear that many of the results could not be fully evaluated until more detailed phasing and typological information was available and therefore it would seem sensible to postpone any further major programme of analytical work until that information is available. However several suggestions for further work can be made in the light of the analyses already carried out. They vary considerably in the amount of work required and some suggestions overlap.

1) Where only very few examples of a group of copper alloy or lead/tin alloy objects were analysed XRF analyses of more examples, if available, would be useful. The appropriate groups should be clear from the discussion above.

2) The opportunity could be taken to analyse the gold rings fully quantitatively to determine the fineness of gold being used and how much it varies from ring to ring. Too few examples are available to draw major conclusions but analytical data is not often obtained from this type of object.

3) A quantitative analytical programme on a particular group or groups of copper alloy objects would be valuable in investigating the pattern of alloy usage during the Medieval period. Small copper alloy objects from this period have not been analysed extensively in the past. The obvious large group to choose would be the buckles. There are large numbers of them and they vary considerably in date, composition and typology.

4) A selection of the copper alloy objects which had different components made from more different alloys, such as many of the strap ends, could be examined using quantitative analysis to determine what combinations of metals were used.

5) A compositional study of the solders used both on the gold rings and the copper alloys (particularly strap ends) could be carried out using the SEM.

6) A selection of pewter objects of various types and dates could be analysed quantitatively to investigate the variation in composition of pewter during the Medieval period.

7) Quantitative analysis of lead/tin objects suspected of containing copper could answer questions concerning the use of copper as a hardening agent in the lead/tin alloys.

8) A study of the manufacturing techniques used to produce the copper alloy objects could be made.

Glossary of terms as used in this report

Bronze - an alloy of copper and tin with at most relatively low levels of zinc.

Brass - an alloy of copper and zinc with at most relatively low levels of tin.

Gunmetal - a copper alloy containing both zinc and tin at significant levels.

Pewter - an alloy of tin and lead generally containing between about one-half and two-thirds tin. Other elements may be present at relatively low levels.

Lead/tin - a metal or object consisting essentially of tin and lead in any proportion.

References

J.Bayley, P.Drury and B.Spencer (1984) A Medieval Mirror from Heybridge, Essex. Antiquaries Journal LXIV-(II), 399-402

C.Caple and S.E.Warren (1983) Technical Observations on the Method of Production and the Alloy Composition of Late- and Post-Medieval Wound Wire Headed Pins. Proceedings of the 22nd Symposium on Archaeometry ed. A.Aspinall and S.E.Warren, 273-283

Appendix 1 - Analytical results for the gold rings

Note : These results were obtained by analysis of unprepared surfaces and may be subject to errors due to corrosion or contamination of the surface. These effects will, if anything, have enhanced the apparent gold content of the metal.

Site Code	Context Number	Accession Number	Area Analysed	Gold %	Silver %	Copper %
BC	79	2035	Ring	44.0	28.8	27.2
TL	429	605	Main Ring	74.7	14.4	10.9
			Mount	55.3	32.8	21.9
			Ring on mount	59.6	18.7	21.7
TL	1717	2263	Ring	45.7	27.6	26.7
			Mount	45.6	28.5	25.9
TL	2656	2266	Ring	54.2	31.3	14.5
			Mount	54.6	32.5	12.9

Appendix 2 - Analytical results for the copper alloy objects

Key : +++ = Detected at high levels
 ++ = Detected at moderate levels
 + = Detected at low levels
 tr = Just detectable
 nd = Not detected

Notes : Buckle 1 = Buckle with single loop

Buckle 2 = Buckle with double loop

Copper, which is not listed below, was the major element detected in all analyses of copper, bronze, brass and gunmetal.

Elements in parentheses in 'Composition' column were detected at low levels

Site code	Cont. No.	Acc. No.	Object type	Area analysed	Zn	Pb	Sn	Composition
BIG	3135	2436	Badge	Front	nd	tr	nd	Copper
				Back	nd	tr	nd	Copper
BC	88	4150	?Bell	Exterior	+++	tr	tr	Brass
				Interior	+++	tr	+	Brass
				Loop	+++	tr	nd	Brass
FWB	326	5306	Bell	Left side	+++	tr	tr	Brass
				Right side	+++	nd	nd	Brass
SWA	2055	580	Bell	Bottom	+++	nd	tr	Brass
				Top & ring	+++	nd	+	Brass
				Clapper				Iron
BIG	5400	3068	Brooch	Brooch	++	tr	++	Gunmetal
				Pin	+++	nd	+++	Gunmetal
FWB	389	1442	Brooch	Brooch	++	tr	+	Brass
				Pin	++	tr	+	Brass
SWA	2072	682	Brooch	Brooch	+++	+	++	Brass
				Pin	++	+	+	Brass
SWA	2050	2141	Brooch	Brooch	+++	tr	++	Brass
				Pin	++	tr	++	Gunmetal
BIG		? 2827	Buckle	Plate	nd	tr	tr	Copper
				Ring	nd	tr	tr	Copper
				Pin	nd	tr	nd	Copper
BC	88	4138	Buckle 1	Loop	++	+	++	Gunmetal
				Pin	++	+	+	Gunmetal
BC	250	4174	Buckle 1	Plate	++	tr	+	Brass
				Loop	++	tr	+	Gunmetal
				End plate	++	tr	+	Brass
BIG	2171	2302	Buckle 1		++	+	++	Gunmetal
BIG	2516	2313	Buckle 1		++	tr	++	Gunmetal
BIG	2591	2321	Buckle 1		++	tr	+	Brass

Site code	Cont. No.	Acc. No.	Object type	Area analysed	Zn	Pb	Sn	Compos- ition
BIG	2591	2336	Buckle 1	Loop	++	tr	+	Brass
				Roller	++	tr	+	Brass
				Pin	++	tr	+	Brass
BIG	5364	3077	Buckle 1	Loop	nd	nd	nd	Copper Gilded
				Roller	nd	nd	nd	Copper
				Back	++	nd	nd	Brass
BWB	259	335	Buckle 1	Loop	+++	tr	++	Brass
				Pin	++	tr	++	Gunmetal
BWB	333	528	Buckle 1	Plate	++	tr	+	Brass
				Loop	++	tr	+	Brass
BWB	108	1263	Buckle 1	Top plate	+++	tr	tr	Brass
				Bottom plate	+++	tr	tr	Brass
				Loop	++	+	++	Gunmetal
BWB	317	1650	Buckle 1	Plate	++	tr	+	Brass
				Loop	++	+	++	Gunmetal
BWB	313	1926	Buckle 1	Loop	++	tr	+	Brass
BWB	308	1938	Buckle 1	Plate	++	tr	+	Brass
				Loop	++	tr	+	Brass
BWB	354	3544	Buckle 1	Loop	nd	tr	nd	Copper
				Pin				Iron
BWB	395	3629	Buckle 1	Top plate	+++	tr	tr	Brass
				Bottom plate	+++	tr	+	Brass
				Middle plate	++	+	++	Gunmetal
				Loop	++	+	++	Gunmetal
BWB	?	4023	Buckle 1	Roller	+	+	++	Bronze
				Loop	+	tr	++	Bronze
BWB	317	4425	Buckle 1	Plate	++	tr	+	Brass
				Loop	++	+	+	Brass
BWB	274	4531	Buckle 1	Plate	+++	tr	+	Brass
				Loop	++	tr	+	Brass
				Bar on plate	+++	tr	+	Brass
SWA	2113	1493	Buckle 1	Body	+++	tr	+	Brass
				Pin	+++	tr	+	Brass
SWA	2031	2091	Buckle 1	Plate	++	tr	++	Gunmetal
				Loop	+++	tr	++	Brass
				Barrel	+++	tr	+	Brass
SWA	2063	2113	Buckle 1	Plate	nd	tr	nd	Copper
				Loop	nd	tr	tr	Copper
SWA	2061	2200	Buckle 1	Loop	++	+	++	Gunmetal
				Pin	+	tr	++	Bronze
SWA	2070	2874	Buckle 1	Plate+top of rivets	+	+	+++	Bronze
				Bottom of rivets	+	tr	+++	Bronze

Site code	Cont. No.	Acc. No.	Object type	Area analysed	Zn	Pb	Sn	Composition
SWA	2054	3886	Buckle 1	Top plate	+++	tr	+	Brass
				Bottom plate	+	tr	++	Bronze
				Middle plate	++	+	++	Gunmetal
SWA	2270	3935	Buckle 1	Loop	nd	tr	nd	Copper
				Pin	tr	tr	tr	Copper
BC	55	1511	Buckle 2	Loop	+++	tr	++	Brass
				Studs/rivets				Iron
BC	150	4304	Buckle 2	Loop	++	+	+++	?Gunmetal
								Tin coating
				Pin				Iron
EC	55	5323	Buckle 2		++	tr	++	Gunmetal
BWB	309	339	Buckle 2	Plate	++	+	++	Gunmetal
				Loop+bar : non-coated	++	tr	++	Gunmetal
				coated	++	+	+++	Tin coating
				Loop	++	+	++	Gunmetal
ENB	290	1916	Buckle 2	Loop	+++	tr	+	Brass
BWB	286	2308	Buckle 2	Loop	++	tr	+	Brass
				Bar	+++	+	+++	Brass
BWB	317	4431	Buckle 2	Loop	++	+	++	Gunmetal
				Sheet on end	++	+	++	Gunmetal
BWB	274	4557	Buckle 2	Plate	+	tr	+++	Bronze
				Loop	++	++	+++	Tin
SWA	2030	2129	Buckle 2	Loop	+++	+	+++	Brass or gunmetal
								?Tinned
				Plate	++	+	+	Brass
SWA	2055	581	Button	Top	++	tr	++	Gunmetal
				Bottom	++	+	++	Gunmetal
SWA	2072	685	Button	Button/ring	+++	tr	+	Brass
SWA	2018	1312	Button	Button/(bell)	+++	+	+	Brass
SWA	2030	3073	Button		++	+	+	Brass
BIG	2591	5734	Button	Button	tr	+	+++	Bronze
SWA	2030	2167	Buttons	Hollow	++	tr	+	Gunmetal
				Solid	nd	tr	+++	Bronze
SWA	1280	1684	Chape		+	tr	++	Bronze
SWA	+	1741	Chape		++	tr	+	Gunmetal
SWA	2103	3025	Chape		+++	tr	+	Brass
SWA	2083	788	Cloak fastener	Top	+++	tr	tr	Brass
				Bottom	+++	tr	nd	Brass
SWA	2109	2070	Cloak fastener	Top	nd	nd	tr	Copper
				Bottom	nd	tr	tr	Copper
SWA	2109	2071	Cloak fastener	Top	nd	nd	nd	Copper
				Bottom	nd	nd	nd	Copper

Site code	Cont. No.	Acc. No.	Object type	Area analysed	Zn	Pb	Sn	Composition
BIG	4449	2729	Comb	End plate	+	tr	++	Bronze
				Middle plate	+	tr	++	Bronze
SWA	2113	1492	Dress hook		+++	tr	tr	Brass
BWB	330	2664	Finger ring	Ring	+++	tr	tr	Brass
				Mount	+++	tr	+	Brass
				Inside mount	++	+++	+++	Lead/tin 'solder'
BWB	256	4433	Finger ring	Ring	+	+	+++	Bronze
				Blue inlay	+	+++	+++	Lead rich
SWA	935	383	Finger ring	Ring	+++	nd	+	Brass
				Mount	+++	+	+	Brass
				Green 'stone' (+ metal)	+++	+++	++	Glass
SWA	2108	1997	Finger ring		+++	tr	+	Brass
SWA	2106/2107	2025	Finger ring		++	+	+	Brass
SWA	2020	2092	Finger ring	Ring	+++	tr	+	Brass
				Back of mount	++	+++	+++	Lead/tin solder
				Blue inlay				Analysis same as metal
SWA	+	2500	Finger ring	Ring + mount	tr	tr	+	Bronze
				Yellow deposit inside mount				Analysis same as metal
SWA	+	2661	Finger ring	Ring	++	tr	++	Gunmetal
				Inlay	++	+	+++	Bronze
SWA	2106	2037	Finger ring		++	+	++	Gunmetal
SWA	2108	2926	Finger ring		++	+	+	Brass
BIG	6507	3284	Finger ring	Mount + ring	++	tr	+	Brass
				Inside mount				Analysis same as metal
SWA	2027	512	Finger ring	Back of mount	tr	+	++	Bronze
				Inside mount				Analysis same as metal
SWA	2081	1696	Head-dress		++	tr	nd	Brass
EC	55	1866	Head-dress		+++	nd	+	Brass
SWA	2102	2166	Head-dress		+++	nd	nd	Brass
SWA	2069	4998	Head-dress		++	tr	tr	Brass
SWA	2115	2236	Lace chape		++	tr	nd	Brass

Site code	Cont. No.	Acc. no.	Object type	Area analysed	Zn	Pb	Sn	Composition
SWA	2084	2209	Mirror-case	Bottom : Outside Interior	+ +	tr +++	+ +++	Gunmetal Lead/tin 'solder'
				Left side Hook	++ ++	tr tr	+ +	Gunmetal Gunmetal
BIG	2636	2445	Mount	Rivet	tr	tr	++	Bronze
BIG	5113	2826	Mount		nd	tr	nd	Copper
BIG	4064	2842	Mount	Rivet	nd	tr	nd	Copper
				Rivet	++	tr	+	Brass
BWB	119	1453	Mount	Top	+++	nd	+	Brass
				Bottom	+++	tr	+	Brass
BWB	307	2102	Mount	Top	+++	tr	+	Brass
				Bottom	+++	tr	+	Brass
BWB	131	2238	Mount	Top	+++	tr	+	Brass
BWB	147	2341	Mount	Top	+++	tr	tr	Brass
BWB	290	2362	Mount	Ring	++	tr	++	Gunmetal
				Plate	++	+	++	Gunmetal
BWB	368	3605	Mount		+++	tr	++	Brass
BWB	286	4588	Mount	Top	+++	tr	+	Brass
				Bottom	+++	tr	+	Brass
BWB	247	4711	Mount		+++	tr	+	Brass
CUS	12	225	Mount/belt	Mount- top	+++	tr	+	Brass
				-bottom	+++	+	+	Brass
CUS	12	859	Mounts on strap	Mount 1 top	+++	tr	+	Brass
				- bottom	+++	+	++	Brass
				Mount 9 top	++	tr	+	Brass
				- bottom	+++	tr	++	Brass
BIG	4368	2733	Needle		++	tr	+	Brass
SWA	2055	585	Pendant		nd	nd	nd	Copper Gilded
SWA	2079	693	Pendant		nd	tr	tr	Copper
SWA	2112	1679	Pendant	Pendant Chain	+++	tr	+	Brass
					+++	tr	tr	Brass
BIG	2596	2496	Pendant		nd	tr	tr	Copper
BIG	3343	3047	Pendant	Top	nd	nd	nd	Copper Gilded
				Back	nd	tr	tr	Copper
				Claw/rivet	nd	tr	nd	Copper
BIG	5364	3078	Pendant	Front	++	tr	++	Gunmetal
				Back	++	+++	+++	Lead/tin solder
SWA	2270	3934	Pendant		nd	tr	nd	Copper

Site ccde	Cont. No.	Acc. no.	Object type	Area analysed	Zn	Pb	Sn	Compos- ition
BWB	279	4568	Pin	Shaft	++	+	+++	Bronze
BWB	341	5294	Pins	Large pin	nd	tr	nd	Silver (Cu)
				Small pins :				
				Straight	+++	tr	+	Brass
				Bent	+++	tr	+	Brass
				Very bent	++	tr	+	Brass
BC	?	1762	"Pricker"		+++	nd	tr	Brass
BC	77	2090	"Pricker"		+++	nd	+	Brass
BC	119	4517	"Pricker"		+++	tr	+	Brass
BC	83	2391	Strap-end	Plate -top	tr	tr	++	Bronze
				- bottom	tr	tr	++	Bronze
				- middle	+	+	++	?Gunmetal ?solder
BC	250	4172	Strap-end	Plate -top	+++	tr	+	Brass
				- bottom	+++	tr	+	Brass
				- middle	++	tr	++	Gunmetal
BIG	?	2305	Strap-end	Plate - top	+++	tr	tr	Brass
				- bottom	+++	tr	+	Brass
				-mid, front	+++	tr	+	Brass
				-mid, end	+++	+	+	Brass
BWB	377	377	Strap-end	Top plate	++	nd	++	Gunmetal
				Bottom plate	++	tr	++	Gunmetal
				Left edge	++	+	++	Gunmetal
				Middle plate	++	tr	++	Gunmetal
BWB	366	1139	Strap-end	Top plate	++	tr	+	Brass
				Bottom plate	+++	tr	+	Brass
				Middle plate	+++	tr	++	Brass
BWB	286	2288	Strap-end	Top plate	tr	+	+++	Bronze
				Bottom plate	tr	+	++	Bronze
				Right edge	tr	++	+++	?Solder
BWB	290	2370	Strap-end	Top Plate	++	tr	++	Gunmetal
				Bottom Plate	++	tr	++	Gunmetal
				Right edge	++	tr	++	Gunmetal
BWB	328	2733	Strap-end	Top plate	++	+	+	Brass
				Bottom plate	++	tr	+	Brass
				Left edge	++	+	++	?Solder
BWB	292	3994	Strap-end	Top plate	+++	tr	tr	Brass
				Bottom plate	+++	tr	+	Brass
				Left rivet	tr	tr	nd	Copper
				Right rivet	tr	nd	nd	Copper
BWB	292	3997	Strap-end	Loop	+++	tr	tr	Brass
				Top plate	+++	tr	+	Brass
				Bottom plate	+++	tr	+	Brass
BWB	292	4001	Strap-end	Top	+++	tr	+	Brass
				Bottom	+++	tr	+	Brass

Site code	Cont. No.	Acc. no.	Object type	Area analysed	Zn	Pb	Sn	Composition
BWB	361	4113	Strap-end	Top	+++	tr	tr	Brass
				Bottom	+++	tr	+	Brass
				Washer	+++	tr	tr	Brass
BWB	309	4726	Strap-end	Top plate	+++	tr	+	Brass
				Bottom plate	++	tr	+	Brass
				Left edge	++	+	++	Gunmetal ?Solder
BWB	309	4731	Strap-end	Top plate	++	tr	+	Brass
				Bottom plate	++	tr	+	Gunmetal
				Left edge	++	++	+++	Gunmetal ?Solder
BWB	399	4991	Strap-end	Loop	+++	tr	+	Brass
				Plate	+++	tr	+	Brass
BWB	346	5124	Strap-end	Top	++	tr	+	Brass
BWB	306	5197	Strap-end	Plate	+++	tr	+	Brass
SWA	2100	1202	Strap-end	Top plate	+	+	+++	Bronze
				-bottom	+	+	+++	Bronze
				Middle plate	tr	tr	+++	Bronze
SWA	2105	1445	Strap-end	Bottom plate	++	nd	+	Brass
				Top of plate	++	tr	+	Brass
				Handle	+++	+	++	Brass
				-Right edge	+++	+	++	Lead/tin solder
SWA	2025	2106	Strap-end	Hook	nd	tr	nd	Copper
				Rivets/ washers	++	tr	+	Brass
SWA	2031	2971	Strap-end		++	tr	+	Gunmetal
SWA	2103	3023	Strap-end		+++	+	tr	Brass
SWA	2134	3308	Strap-end		+++	++	+++	Gunmetal
SWA	2134	3373	Strap-end	Top plate	++	tr	+	Brass
				Bottom plate	+++	+	+	Brass
SWA	2139	3380	Strap-end		nd	tr	tr	Copper
SWA	2023	3769	Strap-end	Top plate	++	tr	++	Gunmetal
				Bottom plate	++	+	+++	Bronze
TL	368	2398	Strap	Strap-end	+++	tr	tr	Brass
				Studs	+++	tr	tr	Brass
CUS	55	300	Strap	Stud 1 top	++	tr	+	Brass
				Stud 3 top	+++	tr	+	Brass
				Stud 6 top	++	tr	+	Brass
				Stud 1 btm	+++	tr	++	Brass
				Stud 3 btm	+++	tr	+	Brass
				Stud 6 btm	+++	tr	++	Brass
BWB	307	2127	Stud	Top	nd	tr	tr	Copper
				Bottom	nd	tr	tr	Copper
BWB	330	2682	Stud	Top	nd	tr	nd	Copper
BWB	330	2685	Stud	Top	+++	tr	+	Brass
				Bottom	++	tr	+	Brass

Site code	Cont. No.	Acc. no.	Object type	Area analysed	Zn	Pb	Sn	Composition
BWB	328	2725	Stud	Top	++	tr	+	Brass
				Bottom	++	tr	+	Brass
BWB	338	3772	Stud	Top	+++	tr	nd	Brass
				Bottom	+++	tr	tr	Brass
BWB	401	4202	Stud	Top	++	tr	++	Gunmetal
				Bottom	++	tr	++	Gunmetal
BWB	318	4580	Stud	Top	nd	tr	tr	Copper
				Bottom	nd	tr	nd	Copper
TL	?	153	Stud		nd	nd	tr	Copper
TL	415	559	Stud		nd	tr	nd	Copper
TL	414	562	Stud	Head	+++	+	+	Brass
TL	?	1725	Stud	Head	+++	tr	+	Brass
				Back of head + pin	+++	+++	+++	Lead/tin 'solder'
TL	368	1874	Stud		++	tr	tr	Brass
TL	275	2703	Stud	Head	+++	tr	tr	Brass
				Back of head	+++	+++	+++	Lead/tin 'solder'
				Pin				Iron
BC	9	2716	?Stud		+++	nd	nd	Brass
BIG	3212	2446	Tweezers		+	tr	+	Gunmetal
BWB	334	2675	Tweezers	Tweezer	++	tr	+	Brass
				Collar	+++	+	++	Brass
BWB	355	3551	Tweezers		++	tr	+	Brass
EC	55	1866	Wire obj		+++	nd	+	Brass
EC	89	3851	Wires	Twisted	+++	tr	tr	Brass (Ag)
				Straight	+++	tr	nd	Brass (?Ag)
EC	150	4468	Wire object		+++	tr	+	Brass
EC	150	4922	Wire		++	tr	nd	Brass
EC	150	4280	Unknown	Handle	+	+	+++	Bronze
				Top plate	+	++	+++	Bronze
				Bottom plate	+	+	+++	Bronze
				Interior	+	++	+++	Bronze
				Left edge	+	+	+++	Bronze

Appendix 3 - Analytical results for the lead/tin objects

Key : +++ = detected at high levels
 ++ = detected at moderate levels
 + = detected at low levels
 nd = not detected

Site code	Cont. No.	Acc. No.	Object type	Area analysed	Cu	Zn	Pb	Sn	Composition
BWB	136	14	Badge		+	nd	++	+++	Pewter
BWB	292	206	Badge	Back	++	nd	++	+++	Pewter
SWA	2012	542	Badge		+	nd	++	+++	Pewter
SWA	2113	1486	Badge	Back	+	nd	nd	+++	Tin
				Front	+	nd	nd	+++	Tin
SWA	2113	1494	Badge		++	nd	++	+++	Pewter
SWA	2106/ 2107	2033	Badge		nd	nd	++	+++	Pewter
SWA	-	2075	Badge		+	nd	++	+++	Pewter
SWA	2108	2788	Bead		nd	nd	nd	+++	Tin
SWA	2112	3294	Bead		nd	nd	nd	+++	Tin
SWA	2018	396	Bell	Ring	+	+	nd	+++	Tin
				Bell	nd	nd	nd	+++	Tin
SWA	2112	1682	Bell	Top	+	nd	nd	+++	Tin
				Bottom/ Clapper	nd	nd	nd	+++	Tin
BWB	290	2118	Bell		nd	nd	nd	+++	Tin
BIG	5722	3070	Bell	Ring	nd	nd	nd	+++	Tin
				Bell	nd	nd	nd	+++	Tin
TL	2184	1394	Belt chape	Plate	+	nd	++	+++	Pewter
				Cup	+	nd	++	+++	Pewter
SWA	2055	582	Brooch		nd	nd	++	+++	Pewter
SWA	2150	1265	Brooch		nd	nd	++	++	Pewter
SWA	2266	2354	Brooch		+	nd	++	+++	Pewter
SWA	2100	1094	Buckle		+	nd	nd	+++	Tin
TL	274	2159	Buckle		+	nd	++	+++	Pewter
SWA	-	3612	Buckle	Plate	++	nd	nd	+++	Tin
				Loop/pin	++	nd	nd	+++	Tin
BWB	330	2689	Buckle	Loop	++	+	++	+++	Pewter
BWB	256	4417	Buckle	Pin	+	nd	++	+++	Pewter
				Loop	+	nd	++	+++	Pewter
BWB	306	740	Buckle		+	nd	++	+++	Pewter
SWA	2101	2038	Buckle	Loop	+	nd	nd	+++	Tin
				Pin	nd	+	nd	+++	Tin
BWB	292	4006	Buckle	Loop	++	+	+	+++	Pewter

Site code	Cont. No.	Acc. No.	Object type	Area analysed	Cu	Zn	Pb	Sn	Compos- ition
SWA	2103	1782	Button		nd	nd	nd	+++	Tin
BWB	290	2121	Button		nd	nd	nd	+++	Tin
BIG	2745	2338	Button		nd	nd	nd	+++	Tin
BIG	2853	2508	Button		nd	nd	++	+++	Pewter
BWB	361	2769	Finger ring		+	nd	+++	++	Lead
SH	386	134	Mirror case	Front	+	nd	++	+++	Pewter
				Back	+	nd	++	+++	Pewter
BWB	130	257	Mirror case	Solid top	nd	nd	++	+++	Pewter
				Foil	nd	nd	+	+++	Tin
				Open-top	nd	nd	++	++	Pewter
				-bottom	+	nd	++	++	Pewter
SWA	2057	2123	Mirror case	Back	nd	nd	++	+++	Pewter
				Front	nd	nd	++	+++	Pewter
BWB	108	23	Mount	Top	++	nd	+	+++	Tin
				Rivet	++	nd	+	+++	Tin
SWA	2097	814	Mount		++	nd	+	+++	Tin
SWA	2112	2122	Mount		+	nd	+++	nd	Lead
BIG	2591	2301	Ring	Ring	nd	nd	++	+++	Pewter
				Inlay	+	nd	++	++	Pewter
BIG	5277	3037	Ring		++	nd	++	+++	Pewter
BWB	293	4042	Strap- end	Top	++	+	nd	+++	Tin
							nd	nd	
SWA	2084	653	Strap-end		++	nd	nd	+++	Tin
SWA	2082	3404	Strap-end		++	nd	+	+++	Tin
BWB	391	3602	Stud	Top	++	nd	nd	+++	Tin
BWB	352	4021	Stud	Top	++	nd	nd	+++	Tin
BWB	293	4044	Stud	Top	++	nd	nd	+++	Tin
BWB	380	5027	Stud	Top	+	nd	nd	+++	Tin
				Bottom	+	nd	nd	+++	Tin
SWA	2100	1078	Stud		nd	nd	nd	+++	Tin
BWB	110	1397	Stud		+	nd	nd	+++	Tin
BWB	136	1474	Stud	Top	nd	nd	nd	+++	Tin
				Back	nd	nd	nd	+++	Tin
BWB	157	5157	Stud		+	nd	nd	+++	Tin
BWB	206	5417	Stud		+	nd	nd	+++	Tin
BWB	328	2724	Stud	Top	++	nd	++	+++	Pewter
BC	150	3501	Strap	Strap-end	nd	nd	nd	+++	Tin
				Studs	nd	nd	nd	+++	Tin
BC	250	3620	Strap	Stud	nd	nd	nd	+++	Tin