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Analysis of Copper Alloy, Gold and Silver objects from Coppergate, York

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The objects analysed (AM 841157-8) consisted of a large number of copper alloy, gold and silver small finds. Each part of each object was, as far as possible, analysed separately using qualitative energy dispersive x-ray fluorescence (X.R.F.). No preparation of the surface of the objects was carried out prior to analysis and therefore the results could be affected by alterations in the surface composition due to, for example, corrosion or contamination during burial or deliberate surface treatments such as tinning. However, the type of alloy used to produce each object could be determined with confidence in almost all cases. The analytical results are given in the appendix below, together with the results for objects from Coppergate analysed previously.

A large majority of the objects analysed were copper alloys. The important elements detected on analysing these objects were copper, zinc, lead and tin and the alloy types were defined by the relative amounts of zinc, lead and tin present. The composition of copper alloys is shown schematically in Figure 1, in which the further an area in the triangle is from the point labelled with an elements symbol, the less of that element is present.

It is clear from Figure 1 that there are no rigid boundaries between different alloy types, but general categories can be usefully applied:

Brass - An alloy containing copper and zinc with, at most, a small amount of tin.

Bronze - An alloy containing copper and tin with, at most, a small amount of zinc.

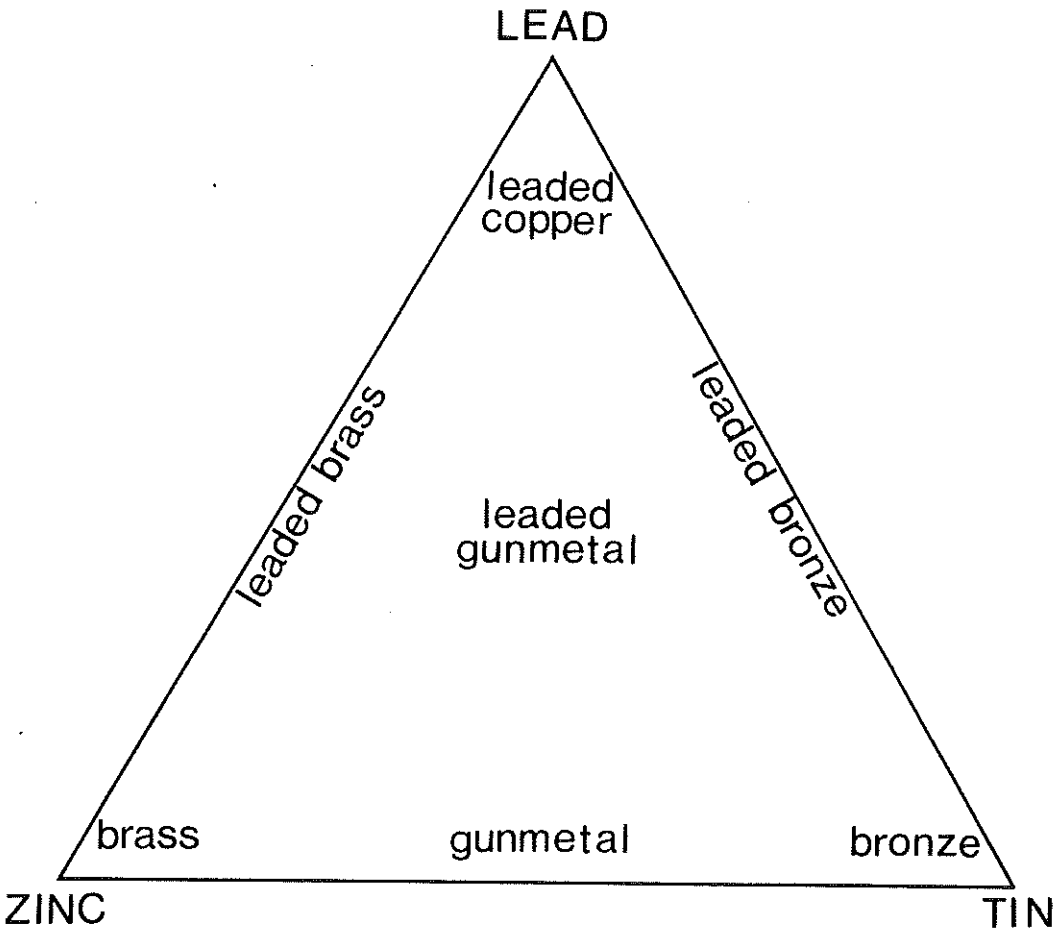

Figure 1: **Composition of copper alloys**

Gunmetal - An alloy containing significant amounts of copper, zinc and tin.

In addition any of the above alloys may contain significant amounts of lead, in which case they are described as leaded brass etc. The amount of lead present could not be determined with any accuracy by the method used and therefore objects described as 'leaded' may contain any amount of lead from a few per cent upwards. The presence of lead would improve the castability and the machinability of the alloys, but at high levels it would make them unsuitable for wrought objects.

The analytical method used enabled alloy types to be assigned to each object but it was not possible to obtain accurate quantitative values for the composition of the objects. It would be possible to carry out quantitative analysis on same objects using atomic absorption spectroscopy (A.A.S.), but this would involve taking a sample of about 10mg of metal from each object. The sample would, obviously, have to be of uncorroded bulk metal, the composition of which was representative of the original composition of the object. Several possible methods of sampling are listed below.

1) Drilling into the base metal of the object using (typically) a 1mm drill bit. A hole about 3mm deep would be necessary, although more than one shallower hole could be drilled.

2) Scraping a sample from the surface after removing corrosion products and any surface layer of metal which may have altered in composition.

3) Removing a piece of the object.

In the appendices the suitable techniques for use on each object are indicated in the final column. If no suitable sample could be obtained "X" has been entered in this column. The assessment is based solely on the possibility of obtaining a sample and not on the suitability of the technique from any other viewpoint. In some cases, particularly if method 1 is not possible, the effect of sampling on the appearance of the object may be unacceptable. Each of the methods described is destructive to a greater or lesser degree. In general method 1 is to be preferred when the object is thick enough to make it possible as the only visible sign of sampling would be a single 1mm diameter hole. Method 2 would have a much greater effect on the appearance of the object as it involves sampling from a much larger area. Method 3 would require the removal of part of the object, although the remainder would be relatively unaffected. In many cases where drilling is not possible both methods 2 and 3 would be feasible.

Results

A wide range of alloys were found on analysing the 'copper alloy' objects including two iron objects (I-2214 and U/S-1942) and two pewter (tin-lead alloy) brooches (I-324 and II-4067). The majority (about 59%) of the objects, however, were brass or leaded brass. About 20% of the objects were bronze, and of these just under half were leaded. The remaining objects were either gunmetals or leaded gunmetals (about 12%) or fairly pure copper (about 9%).

Only one or two examples of most of the types of object analysed were present and it is not possible to draw any conclusions on the basis of a sample as small as this. A few larger groups of similar objects were present and these showed some correlation between object type and composition, although in most cases there were exceptions. Some of these apparent exceptions might be explained if the results were considered in conjunction with a more detailed typology of the objects than was possible in the present work. Also, no

detailed archaeological information about the site was available and it might be possible to draw further conclusions if the results were considered in terms of (eg) the context dates.

Brass (or leaded brass) was the most commonly used alloy for the majority of types of objects. About two-thirds of the decorative fittings, mounts and terminals and of the sheets and strips analysed were brass. The exceptions did not tend to be of one particular composition but included gunmetals, bronzes and, in the case of the sheets, copper. The situation was similar for rings, brooches and tweezers, although a more detailed typology of these objects would be needed before drawing any firm conclusions. All of the balance parts analysed were brass. One brooch (V-3157) was enamelled and the enamelling originally consisted of concentric rings of blue, white and, in the centre, red enamel.

The compositions of the other large groups of objects, the pins and needles and the buckles, were less consistent, but again a more detailed typology might enable further conclusions to be drawn. The pins and needles were mainly either brass, or leaded brass, (15 out of 28) or bronze, or leaded bronze, (9 out of 28). Two gunmetal and two copper examples were also found. Brass, leaded brass, leaded gunmetal, bronze and copper buckles, or buckle components, were found with no apparent tendency towards any particular compositions.

Six bars, rods or, possibly, ingots were analysed. The results contrasted with the overall pattern of alloy usage as the alloys found were gunmetal, leaded gunmetal, leaded bronze and copper. No brass or leaded brass examples were found.

Five gold or silver objects were analysed, including one gilded pewter mount or terminal fragment (V-2742). Three of the other objects were silver, a ring

(I-8038), a decorated mount (II-5885) and a wire finger ring (IV-6445), although low levels of copper, zinc, lead, tin and in two cases gold were also present. The final object (V-2742), a buckle pin, was either debased gold or perhaps gilded silver.

Appendix - Analytical results and suitable methods of sampling the objects

Find No (Lab No)	Object type	Elements Detected* by XRF (Minor elements)	Alloy Type	Suitable Sampling Methods
Area I				
71	Belt mount	Cu Zn Pb (Sn)	Brass (?+ lead solder)	x
121	Pin	Cu Zn Sn Pb	Brass (? + tin or tin/lead coating)	x
163	Hinge mounts?	Cu Pb Sn	Leaded bronze	1
168	Tack or stud	Cu Zn (Pb)	Brass	1
292	Stud or boss	Cu Zn Pb	Leaded brass	1
324	Cross brooch	Pb Sn (Cu, Zn)	Pewter	2
425	Strip (? decorated mount)	Cu Zn (Pb)	Brass	2, 3
503	Twisted wire chain	Cu Zn (Pb, Sn)	Brass	3 (?)
519	Twisted wire fragment	Cu Zn Sn (Pb)	Gunmetal	3 (?)
578	Mount fragment	Cu Zn (Pb, Sn)	Brass	3
904	Strip	Cu Zn (Pb, Sn)	Brass	2, 3
961	Handle	Cu Zn (Pb)	Brass	1
1318	Buckle	Cu Pb Zn Sn	Leaded gunmetal	1
1359	Ring/annular brooch frag	Cu Zn (Pb, Sn)	Brass	3
1378	Pierced strip	Cu Zn (Pb, Sn)	Brass	3 (?)
1466	Tweezers	Cu Zn Sn (Pb)	Gunmetal	2, 3
2079	Strip	Cu Zn (Pb, Sn)	Brass	2, 3
2214	Strip	Fe (Mn, Cu, Pb)	Iron	x
2359	Washer	Cu Zn Pb	Leaded brass	x
3035	Pierced mount	Cu Zn (Pb)	Brass	3
3521	Strip	Cu Zn Pb (Sn)	Leaded brass	2, 3
3730	Strip	Cu Pb Sn	Leaded bronze	x
3853	Mount	Cu Zn Pb Sn	Leaded brass	1
4124	Tweezers	Cu Zn (Pb)	Brass	3
4356	-	Cu Zn (Pb)	Brass	-
5640	Brooch pin	Cu Zn (Pb)	Brass	2 (?1)
5657	Finger / ear ring	Cu Pb Sn (Zn)	Leaded bronze	3
6037	Ring	Cu Sn (Pb, Zn)	Bronze	x
6482	Bar ?Ingot	Cu Sn Pb	Leaded bronze	1
7119	-	Cu Zn (Pb)	Brass	-

Find No (Lab No)	Object type	Elements Detected* by XRF (Minor elements)	Alloy Type	Suitable Sampling Methods
7153	Finger ring	Cu Zn (Pb)	Brass	x
7442	Sheet fragments	Cu Zn (Pb)	Brass	3 (?)
7463	Tweezers	Cu Zn (Sn) Pb	Leaded brass	-
7501	Strap end	Cu Zn Pb	Brass	-
7516	Finger ring	Cu Zn Pb	Leaded brass	-
7537	Finger ring	Cu Zn (Pb)	Brass	-
7572	Spatulate object	Cu Zn (As)	Brass	-
7708	Wire/strip	Cu Zn Sn (Pb)	Gunmetal	2, 3
7736	Bossed/decorated strips	Cu Zn Pb	Leaded brass	3 (?)
7737	Bossed/decorated strip	Cu Zn Pb	Leaded brass	3 (?2)
7797	Finger ring	Cu Zn (Pb)	Brass	-
7806	Finger ring	Cu Zn (Pb, Sn)	Brass	-
7841	Folded strip	Cu Zn Pb Sn	Brass	2, 3
7848	Balance fragments - shaft	Cu Zn (Pb)	Brass	2, 3
	Balance fragments - ring	Cu Zn (Pb, Au)	Brass	-
7872	Pin	Cu Zn (Sn)	Brass	2
7890	Finger ring	Cu Zn Pb	Brass	-
8038	Band ring	Ag Cu Zn Au Pb Sn	Silver	?2, ?3
9234	Object with serrated edge	Cu Zn (Pb)	Brass	2, 3
9245	Clamp ring	Cu Zn Pb (Sn)	Leaded brass	1
10038	Wire	Cu (Zn)	Copper	x
11180	?Brooch fragment	Cu Zn Pb (Sn)	Leaded brass	1
11212	Dress hook	Cu (Pb, Sn)	Copper	-
11997	Decorated ring	Cu Zn Sn (Pb)	Bronze	2
12759	Buckle - ring - plate - pin	Cu Zn Pb Sn Cu Sn (Zn, Pb) Cu Sn (Zn, Pb)	Leaded gunmetal Bronze Bronze	- - -
12767	Sheet	Cu Sn (Zn, Pb)	Bronze	2
13933	Fibula	Cu Pb Sn Zn	Leaded bronze	1
25127	Ingot	Cu Zn Sn (Pb)	Gunmetal	-
Area II				
101	Rod	Cu Zn Pb Sn	Leaded gunmetal	x
774	Ring pin	Cu Zn (Pb)	Brass	-
1039	Holed strip	Cu Zn (Pb)	Brass	3
1701	?Clasp	Cu Pb Sn	Bronze	1

Find No (Lab No)	Object type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
2479	Strip	Cu Zn (Pb, Sn)	Brass	2, 3
2617	Tube	Cu Zn (Pb, Sn)	Brass	2, 3
2761	Lace tag	Cu Zn (Pb)	Brass	3
2875	Sheet	Cu Zn (Pb, Sn)	Brass	3 (?)
2844	Mount	Cu Zn Sn (Pb)	Brass	2, 3
2845	Casing mount	Cu Zn Sn (Pb)	Gunmetal	2, 3
3062	Holed wire with spoon end	Cu (Pb)	Copper	1
3195	Ferrule	Cu Sn (Zn Pb)	Bronze	3 (?)
3204	Strip	Cu Zn Pb Sn	Leaded gunmetal	3 (?)
3226	Strip	Cu Zn (Pb, Sn)	Brass	3 (?2)
3255	Ferrule	Cu Sn (Zn, Pb)	Bronze	3 (?2)
3352	Strip	Cu Zn (Pb, Sn)	Brass	2, 3 (?1)
3383	Annular brooch - ring	Cu Zn Pb Sn	Gunmetal	1
	" - pin	Cu Zn Pb Sn	Gunmetal	-
3456	Strip	Cu Zn (Pb, Sn)	Brass	3
3475	Mount fragments	Cu Sn (Pb)	Bronze	?3
3497	Ring	Cu (Pb)	Copper	3 (?2)
3900	Offcut triangular sheet	Cu Zn (Pb, Sn)	Brass	3 (?2)
4034	Balance arm	Cu Zn Pb Sn	Leaded gunmetal or tin/lead coated brass	1
4067	Annular brooch?	Pb Sn (Cu, Zn)	Pewter	2
4099	Ring	Cu Zn (Sn)	Brass	3 (?2)
4135	Twisted rod	Cu Zn Sn (Pb)	Bronze	x
4162	Strip	Cu Zn (Pb)	Brass	3 (?2)
4232	Earring	Cu Zn (Pb, Sn)	Brass	2, 3
4613	Intertwined wire ring	Cu Zn (Pb, Sn)	Brass	3 (?2)
4725	Three link chain	Cu Zn Sn (Pb)	Gunmetal	1
4770	Finger ring	Cu Zn (Pb, Sn)	Brass	3 (?2)
4821	Staple	Cu Zn (Sn)	Brass	3
4891	Strip with rivet holes	Cu Zn Pb Sn	Leaded gunmetal	?3
4911	Strip	Cu Zn Sn (Pb)	Brass	2, 3
4912	Pin?	Cu Zn Sn (Pb)	Brass	x
4916	Folded sheet	Cu Zn (Pb, Sn)	Brass	3
5180	Buckle	Cu (Pb)	Copper	1
5369	Decorated lace tag	Cu Zn (Pb, Sn)	Brass	3
5519	Wire	Cu Zn (Sn)	Brass	x
5572	Worked rod	Cu Zn Pb	Brass	1

Find No (Lab No)	Object Type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
5709	Finger ring	Cu Zn Sn (Pb)	Brass	1
5753	Perforated strip	Cu Zn (Pb)	Brass	3 (?2)
5791	Decorated terminal	Cu Zn Pb	Leaded brass	x
5885	Decorated mount	Ag Cu Zn Au Pb Sn	Silver	2
5923	Offcut triangular sheet	Cu (Pb)	Copper	2, 3
6145	Intertwined wire ring	Cu Zn (Pb)	Brass	3 (?2)
6294	Pin	Cu Zn (Pb)	Brass	-
6670	Finger ring	Cu (Pb)	Copper	x
6902	Finger ring	Cu Pb Sn	Leaded bronze	1
6956	Tweezers	Cu Zn (Pb)	Brass	-
7253	Finger ring	Cu Zn Pb	Leaded brass	2, 3
7389	Mount - bossed strip	Cu Zn Pb	Brass	3
7685	Fibula	Cu Pb Sn	Leaded bronze	1
7940	Ring & belt slide	Cu Zn Pb	Leaded brass	-
7971	Strip	Cu Zn Pb Sn	Leaded brass	x
8176	Brooch fragment	Cu Zn (Sn, Pb)	Brass	1
8295	Strapping fragment	Cu Zn Pb Sn	Leaded gunmetal	3
8653	Pin?	Cu Zn Sn (Pb)	Gunmetal	2
8728	Sheet	Cu Sn (Pb)	Bronze	3
8780	Strip & ring - strip	Cu Zn (Pb)	Brass	2, 3
	" - ring	Cu Zn (Pb)	Brass	1
8803	Brooch	Cu Zn Pb	Leaded brass	-
9557	Brooch - cylinder with large projection	Cu Sn (Pb)	Bronze	1
10064	Pin/needle fragment	Cu Sn (Pb)	Bronze	x
10131	Pin or wire	Cu Zn (Sn)	Brass	3
10300	Ring	Cu Pb Sn	Leaded bronze	1
10837	Strap end	Cu Sn (Pb)	Bronze	3
10874	Mount fragment	Cu Zn Pb Sn	Brass	x
10890	Rivetted and bossed sheet	Cu Zn Pb	Leaded brass	3
11080	Seal fragment - stud - disc	Cu Zn Pb Sn Cu Zn Pb Sn	Leaded gunmetal Leaded gunmetal	1 x
11178	Rod with two eyes	Cu Zn (Pb, Sn)	Brass	1
11959	Ring of twisted wire	Cu Sn (Pb)	Bronze	2 (?1)
11961	Pin fragment	Cu Zn (Pb, Sn)	Brass	3
12330	Tweezers	Cu Sn (Pb)	Bronze	2, 3
12526	Small ring	Cu Zn (Pb, Sn)	Brass	2

Find No (Lab No)	Object Type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
12836	Sheet	Cu Pb Sn	Leaded bronze	x
13036	Ring	Cu Zn Pb	Brass	2
13093	Ring	Cu Zn (Pb, Sn)	Brass	-
13654	Tongs - fragments	Cu Pb Sn	Leaded bronze	2, 3
13752	Perforated strapping	Cu Zn Sn (Pb)	Brass	3
13813	Strip	Cu Pb Sn	Leaded bronze	2, 3
13866	Two wires twisted together	Cu Zn Pb Sn	Leaded bronze	3
14154	Wire bracelet	Cu Zn Pb Sn	Brass	3
24119	Needle	Cu Zn (Pb)	Brass	-
(AG 64)	Needle	Cu Sn (Pb)	Bronze	-
(U 32)	Tweezers	Cu Zn (Pb, Sn)	Brass	-
Area III				
149	Plate fragment	Cu Zn Pb Sn	Gunmetal	x
806	Fitting	Cu Zn Pb Sn	Leaded gunmetal	1
1037	Belt end or buckle	Cu (Pb) Au	copper	1
	- rivet			
	- pin	Cu (Pb) Au?	(? gilded)	1
	- ring	Cu (Pb)	Copper	-
1082	Annular brooch - body	Cu Zn (Pb) Sn	Brass	3
	" - pin	Cu Zn (Pb) Sn	Brass	-
1206	Strip	Cu Zn Sn (Pb)	Brass	x
1255	Triangular sheet	Cu Sn (Pb)	Bronze	3 (?2)
4771	Perforated strip	Cu Zn Pb	Leaded brass	x
6941	Needle	Cu (Pb)	Copper	3
8368	Ring	Cu Sn (Pb)	Bronze	1
10247	Ring	Cu Zn Sn Au Hg	Mercury gilded gunmetal	1
Area IV				
133	Button	Cu Zn (Pb)	Brass	x
196	Chain link	Cu Zn (Pb)	Brass	x
269	Bell	Cu Zn (Pb) Sn	Gunmetal	x
524	-	Cu Zn Sn (Pb)	Gunmetal	-
541	Buckle	Cu Zn Pb Sn	Leaded brass	2, 3
573	Spur	Cu Zn (Pb, Sn)	Brass	1
750	Binder	Cu Zn (Pb, Sn)	Brass	3
928	Wire	Cu (Pb)	Copper	x
1501	Rod	Cu (Pb)	Copper	1

Find No (Lab No)	Object Type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
1669	Bar with eye	Cu (Pb)	Copper	1
1795	Strip	Cu (Pb)	Copper	x
1944	Needle	Cu Zn Sn (Pb)	Brass	-
2181	Flat ring	Cu Zn (Pb, Sn)	Brass	3
2200	Ring	Cu Zn (Pb, Sn)	Brass	2, 3
2306	Buckle loop - body	Cu Sn (Zn)	Bronze	1
	- rectangular part	Fe (Cu, Pb, Zn, Sn)	Iron-corrosion products	x
2477	Plate	Cu Zn Pb (Sn)	Leaded brass	3
2544	Ferrule	Cu Zn (Pb, Sn)	Brass	3
3059	Button/boss - front	Cu Zn Pb Sn	Brass	x
	- filled back	Cu Zn Pb Sn	Lead	?1
3220	Ring	Cu Zn Pb	Leaded brass	1
3290	-	Cu Zn Pb	Brass	-
5736	Strip	Cu Zn Pb	Leaded brass	3
6445	Wire finger ring	Ag Cu Zn Pb Sn	Silver	3
8711	Strip	Cu Zn Pb Sn	Brass	3
9909	-	Cu Zn (Pb)	Brass	-
9973	Strip	Cu Zn (Pb, Sn)	Brass	3
10577	Perforated strip	Cu Zn Pb (Sn)	Leaded brass	3
13195	Wire wound round rod - wire	Cu Zn Pb	Brass	3
	Wire wound round rod - rod	Cu Zn (Pb)	Brass	3
Area V				
2443	Wire	Cu Zn (Pb)	Brass	2, 3
2453	Buckle	Cu Zn Pb Sn	Leaded gunmetal	1
2457	Ring	Cu Zn (Pb, Sn)	Brass	x
2467	Binding ring	Cu Zn	Brass	2, 3
2515	Wire	Fe (Zn)	Iron	-
2516	Looped wire	Cu Zn Pb Sn	Gunmetal	x
2525	Binding on wood	Cu Zn (Pb, Sn)	Brass	3
2545	Ring	Cu Zn Pb Sn	Gunmetal	2
2567	?Vessel rim	Cu Pb Sn	Leaded bronze	1
2571	Buckle pin	Au Ag Cu Zn	Debased gold or gilded silver	?2
2578	Annular brooch or buckle - ring	Cu Zn Sn (Pb)	Gunmetal	1
	Annular brooch or buckle - pin	Cu Sn (Pb)	Bronze	1

Find No (Lab No)	Object type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
2625	Ring	Cu Zn Sn (Pb)	Gunmetal	1
2742	Decorated mount or terminal	Pb Sn Au (Cu, Zn)	Gilded pewter	1
2766	Ligula	Cu Zn Sn (Pb)	Brass	2
3157	Enamelled brooch	Cu (Pb)	Copper	x
3306	Buckle plate	Cu Zn Sn (Pb)	Brass	3
3329	Annular brooch	Cu Zn Sn (Pb)	Brass	2, 3
3355	Annular brooch - twisted ring	Cu Zn Sn (Pb)	Brass	2, 3
	Annular brooch - pin	Cu Zn Sn (Pb)	Brass	3
3677	Buckle	Cu Zn Pb Sn	Brass	1
3705	Tweezers	Cu Zn Sn (Pb)	Brass	2, 3
4068	?Brooch - beaded ring	Cu Zn (Pb, Sn)	Brass	2
4113	Key	Cu Zn Pb Sn	Leaded bronze	1
4336	Tweezers	Cu Zn Sn (Pb)	Brass	2,3
4399	Hollow pin	Cu Zn Sn (Pb)	Brass	3
4711	Plate	Cu Sn (Pb)	Bronze	3 (?2)
4896	Connected rings	Cu (Pb)	Copper	1
5176	Dress fastener	Cu Zn Pb Sn	Brass	-
5607	Finger ring	Cu Zn	Brass	3
6063	Perforated mount	Cu Zn Pb (Sn)	Brass	3
6623	Sheet	Cu Zn Pb (Sn)	Brass	3
6751	Buckle pin	Cu Sn (Pb)	Bronze	2, 3
6801	Chain	Cu Zn Pb (Sn)	Leaded brass	3
8759	Pin	Cu Pb Sn	Leaded bronze	3
8762	Triangular plate	Cu Pb Sn	Leaded bronze	3
8800	Disc	Cu Pb Sn	Leaded bronze	2
8908	Rod with eye	Cu Pb Sn	Leaded bronze	3 (?2)
8931	Pin/needle	Cu Pb Sn	Leaded bronze	3
8937	Double twisted wire pin and ring	Cu Zn Sn (Pb)	Bronze	3
8947	Curved strip	Cu (Pb, Sn)	Copper	x
8951	?Annular brooch - brooch	Cu Sn (Zn, Pb)	Bronze	3
	?Annular brooch - pin	Cu Sn (Pb)	Bronze	2, 3
9072	Strapping & back plate - strapping	Cu Zn Pb Sn	Leaded gunmetal	2, 3
	Strapping & back plate - plate	Cu Sn (Zn, Pb)	Bronze	x

Find No (Lab No)	Object type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
9082	Perforated plate	Cu Pb Sn	Leaded bronze	3
9316	Sheet	Cu Zn (Pb, Sn)	Brass	x
11446	Scalpel blade	Cu Zn (Pb)	Brass	3
12792	Bracelet (?) fragment	Cu Zn Sn (Pb)	Gunmetal	3
12808	Ring	Cu Pb Sn	Leaded bronze	1
15492	Wires	Cu Zn Pb Sn	Gunmetal	x
(Z92)	Dress pin	Cu Zn (Pb)	Brass	-
Unstratified				
23	Rivetted plate - plate	Cu Zn Pb (Sn)	Leaded brass	2, 3
45	Disc	Cu (Pb)	Copper	2
75	-	Cu Zn Pb Sn	Leaded gunmetal	x
109	Perforated disc	Cu Zn Pb (Sn)	Brass	2
148	Ring	Cu Zn Pb Sn	Leaded brass	1
225	Casting waste?	Cu Pb Sn	Leaded bronze	1
1822	Ring headed pin - ring	Cu Zn (Pb, Sn)	Brass	1
	Ring headed pin - pin	Cu Sn (Pb)	Bronze	1
1942	-	Fe (Zn)	Iron	-
2377	Pin	Cu Zn (Pb)	Brass	3
2512	Pin	Cu Zn (Pb, Sn)	Brass	x
2579	Pin	Cu Zn Sn	Brass	x
2983	Buckle	Cu (Pb)	Copper	2
3530	Pin	Cu Zn Pb Sn	Gunmetal	x
4095	Pin	Cu (Pb)	Copper	2
5197	Pin (wrapped sheet)	Cu Zn (Pb)	Brass	3
6257	Offcut strip	Cu Zn Pb	Leaded brass	x
11195	Door knob (18th C)	Cu Zn (Pb)	Brass	1
14148	Pin	Cu Zn Pb Sn	Bronze	1
Area Unknown				
763	Suspension chain	Cu Zn (Pb, Sn)	Brass	-
7388	Ring headed pin	Cu Zn Pb (Sn)	Leaded brass	-
7576	Balance arm	Cu Zn (Pb, Sn)	Brass	-
7590	Ring	Cu Pb Sn	Leaded bronze	-
8118	Ring	Cu Zn Pb (Sn)	Leaded brass	-
8372	Tripod suspension bracket	Cu Pb Sn	Leaded bronze	-

Find No (Lab No)	Object type	Elements Detected* by XRF (Minor elements)	Alloy type	Suitable Sampling Methods
9708	Pin and chain	Cu Sn (Pb)	Bronze	-
10059	Weight	Cu Zn (Pb, Sn)	Brass	-
10247	Ring	Cu Au Hg Ag Sn	Mercury gilded copper	-
13035	Ring and pin	Cu Zn Pb (Sn)	Brass	-
13149	Ring & pin - ring	Cu Zn Pb Sn	Brass	-
	- pin	Cu Sn Pb (Zn)	Bronze	-
13760	Garment hook	Cu Zn Sn (Pb)	Gunmetal	-
14060	-	Cu Zn Pb	Brass	-
(AD32)	Scale pan	Cu Zn (Pb, Sn)	Brass	-
(AL14)	Balance, arms & Pan	Cu Zn (Pb, Sn)	Brass	-

* Elements detected at particularly high levels are underlined (except for copper in copper alloys)