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Summary

About 80 crucible sherds from two sites within the Roman legionary fortress were analysed qualitatively by XRF. One group, which included both hand made and wheel thrown vessels, had been used exclusively to melt copper alloys while the other comprised mainly hand made silver working crucibles; both silver refining and melting were being carried out.

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A total of about 80 sherds which were all thought to be from crucibles were submitted for examination and analysis. They come from two excavations, both on the southern side of the Via Principalis within the legionary fortress and only about 100 metres apart. The first (the British Telecom site) found a range of cubicles which were used as metal workshops in the period c.75-85 AD; most of the crucibles from this site come from this phase of occupation. The second (Museum Garden) site found the remains of a senior officer's house. The crucibles come from both the timber phase (c.75-85 AD) and from the stone phase (c.85-200 AD) when the building included an area that was clearly used for metal working.

All the sherds were examined under x10 magnification and the metal-rich slag deposits on them were analysed qualitatively by energy dispersive X-ray fluorescence (XRF). The results of these analyses are presented in Tables 1 and 2.

There are a few pieces which are not crucibles. Some are just fragments of fired clay or daub, though the low levels of metals detected on some of them suggest they may have come from structures associated with metal working operations. There are four fragments of hearth lining, clay that has become vitrified on one side from contact with a fire at high temperatures. Three of these pieces have traces of non-ferrous metals in their vitrified surfaces and are thus likely to have come from hearths that were used for metal melting.

Site CBT produced one definite clay mould fragment and site CMG two possible pieces. The analytical results do not indicate clearly the nature of the alloy being cast, though the major element was almost certainly copper.

As far as the crucibles are concerned, the analytical results from the two sites are quite different, as are their forms and fabrics; the two groups are discussed separately below.

It should be noted that the XRF signal strength for each element is not directly related to its original concentration in the metal being worked. There are a number of reasons for this. The most important is that when an alloy is melted, some of the metals it contains are preferentially oxidised and are thus concentrated in the crucible slag that forms. It is this slag layer, sometimes plus corroded metal droplets, that has been analysed. A further distortion is introduced by the analytical method itself as different elements fluoresce more or less strongly and thus produce signals of different strengths, even when the metals themselves are present in equal concentrations. Zinc (Zn) is always over-represented as to a lesser extent is lead (Pb), while tin (Sn) and silver (Ag) are under-represented when compared with copper (Cu). These factors have been taken into account in the interpretation given below.

Table 1: The crucibles from the British Telecom site (CBT 138)

Context		Metals detected					sherd	Comments
		Cu	Zn	Pb	Ag	Sn		
207	1	++	+	++				hearth lining
	2	+	+	++				hearth lining
	3	+	++	+			ba	?W
	4	++	++					EOL
	5	+	+	+				
	6	+	++	+				
	7	+	++	+				
	8	+	++					
	9	+	++	+				
	10							fired clay, not crucible
	11	++		++				in-gate fragment from mould
209	1	+	++	+			r	EOL. non-circular form
	2	+	++	+		+	ba	EOL. W
226	1	+	++	+			ba	W)
	2	+	++	+				W) ? same vessel
263		+	++	+				
298	1	+	++	+			ba	EOL. W
	2	+	++	+		+		W
303		+	++	++			r	
306	1							hearth lining
	2	++	++	+			r	
313		+	++	+				
315	1	+	++	+				complete
	2	++	++	+		+		hearth lining
	3	++	++	++		+	ba	
	4	++	++	+		+	r	
	5	+	++	+				
	6	+	++	+				EOL. W. cf 226
	7	+	++	+				EOL. W. cf 226
	8							9 pieces of daub
334		+	++					EOL. W
375		+	++	+			r	
383		++	++	++			ba	EOL. W
406		+	++					EOL. W

Key to Tables:

+ = element present
++ = element detected strongly
r = rim sherd
r/1 = rim sherd with pulled out pouring lip
ba = base sherd
other crucible fragments are all body sherds
EOL = added extra outer layer
EIL = added extra inner layer of clay
W = wheel thrown
question marks denote uncertainty

Table 2: The crucibles from the Museum Garden site (CMG 83 etc)

No	Context	Metals detected					sherd	Use	Comments
		Cu	Zn	Pb	Ag	Sn			
1	171	+	+	++					mould?
2	232	+	+	++	+		r	HT	
3	266	++	++	+					mould?
4	269	+	+	+			r		? not crucible
5	166	+	+	++	++		r	HT?	
6	173	++		++		++	r	HT?	
7	173	+		+	+			Ag	
9	242								2 sherds without metals. ? not crucibles
10	-	+	+		++		r/1	Ag	
11	150	+	+	+	+			Ag	
12	225	+		++	+		r/1	HT	
13	228	+	++	+	+		r/1	Ag	
14	246	+		++	++	++	r	HT	
15	112	++	++				ba	brass	EOL. W
17	154	+	+	+	++		r	Ag	
18	40	++		++	++		r	HT	
19	95	+	++				r	Cu?	
20	95	++		+	++		r	Ag	
21	95								daub?
22	211				++			Ag	
23	212	+	+	+					? not crucible
24	170	+		++	+	+	r	HT	
25	170	+	+	+	++		r	Ag	
26	139	+	+	+	+		r	Ag	
27	217	+			+			Ag	
28	193	+	++	+				Cu	
29	93	++	++	+		+		Cu	EOL. EIL. W?
30	-	+	+		++		r	Ag	EOL. EIL. W
31	43	++		++	+		r	HT	
32	47	+	+	+	++			Ag	EOL. W?
33	-	++	+	++	++	+	r	HT	
X	25	+	++		++		r	Ag	W?
	72	+	+	++	+	+		Ag	W?
	72	+	+		+			Ag	EOL. W
	87	+	++		+			?Ag	W
	94								? not crucible
	139								overfired sherd, not crucible
	160	+			+			Ag	EOL. W
	177								EOL. W. not used
	181								EOL. W. not used
	193	+	++	+			r	Cu?	EOL now lost. W
	225	+	+	+	++			Ag	
	232	+		++		+		HT?	

Key to 'Use' column:
HT = 'heating tray' (see text)
Ag = silver melting
Cu = copper alloy melting

The British Telecom site

The crucibles were all used to melt copper alloys of one sort or another. In some cases there is positive evidence that the metal was brass (copper + zinc) while in other cases the presence of tin suggests gunmetals (copper + tin + zinc) or possible even bronzes (copper + tin) as even traces of zinc in an alloy can produce crucible slags with high levels of this metal detectable. There is no good evidence that any of the metals being melted contained significant amounts of lead. It appears that brass was the commonest of the alloys being melted and this is not surprising in a 1st century military context as the most widely used metal for military fittings at this period was brass (Bayley 1985A and forthcoming).

The crucibles were of a range of forms and fabrics, some better suited to their function than others (see Fig 1). There were some relatively thin-walled wheel thrown beakers which had an added extra outer layer of deeply vitrified less refractory clay, eg 226/1 and 383; these added outer layers are a common feature of crucibles of this type which are common in the later 1st and 2nd centuries (Bayley 1988A). Sherd 207/3 is from a thicker walled variant of this form without an added outer layer.

The other crucibles are all hand made, typically being thumb pots with forms comparable to that of the complete crucible 315/1. The exception is 315/3 which is of very varied wall thickness and appears to have traces of a small perforation high up in the wall. Pouring holes like this have been recognised in a few other crucibles which normally had applied lids (eg Tylecote 1986, Fig 50,27). The fabrics used for the hand made crucibles are apparently reasonably refractory and some contain vegetable temper as well as or instead of the more normal mineral temper.

The Museum Garden site

A few of these crucibles were used to melt copper alloys and are similar to those from the British Telecom site but the deposits on the majority of the sherds contain significant amounts of silver and thus indicate the working of this metal. Some were used to melt silver but others were sherds from small shallow dishes which are often known as 'heating trays' and were used as cupels, to refine small quantities of silver (Bayley 1988A). The important diagnostic features are a thick, vitreous layer on the upper/inner surface which is rich in lead and often contains trapped droplets of silver. Heating trays also usually have a circular central depression made by the button of refined silver as it collected.

The typical shape for the silver melting crucibles is a shallow hemisphere with a distinct pinched out pouring lip. This form is known on other 1st century sites, eg Sheepen, Colchester (Bayley 1985B) and St Sepulchre gate, Doncaster (Bayley 1986); the latter example also contained silver as did a similar crucible from Walton-le-Dale (Bayley 1988B).

Some of the heating trays are purpose made discs, eg No 2, 6 and 14, but others, eg No 18, appear to be silver melting crucibles that were used or re-used as cupels (see Fig 2).

References

Bayley, J (1985A) The analysis of copper alloy objects. In: R Niblett Sheepen: an early Roman industrial site at Camulodunum. CBA Res Rep 57, 115.

Bayley, J (1985B) The technological finds. In: R Niblett Sheepen: an early Roman industrial site at Camulodunum. CBA Res Rep 57, fiche 3:D11-E13.

Bayley, J (1986) A crucible from St Sepulchre gate (Site DEH), Doncaster. In: P C Buckland and J R Magilton The Archaeology of Doncaster. 1, The Roman civil settlement. BAR Brit Ser 148, 196 and 199.

Bayley, J (1988A) Non-ferrous metal working: continuity and change. In: E A Slater and J O Tate (eds) Science and archaeology, Glasgow 1987. BAR Brit Ser 196, 193-208.

Bayley, J (1988B) Technological finds from Walton-le-Dale, Lancashire. Ancient Monuments Laboratory Report 93/88.

Bayley, J (forthcoming) The production and use of brass in antiquity - with particular reference to Britain. In: P Craddock (ed) 2000 years of zinc and brass. BM Occ Pap.

Tylecote, R F (1986) The prehistory of metallurgy. London: Institute of Metals.

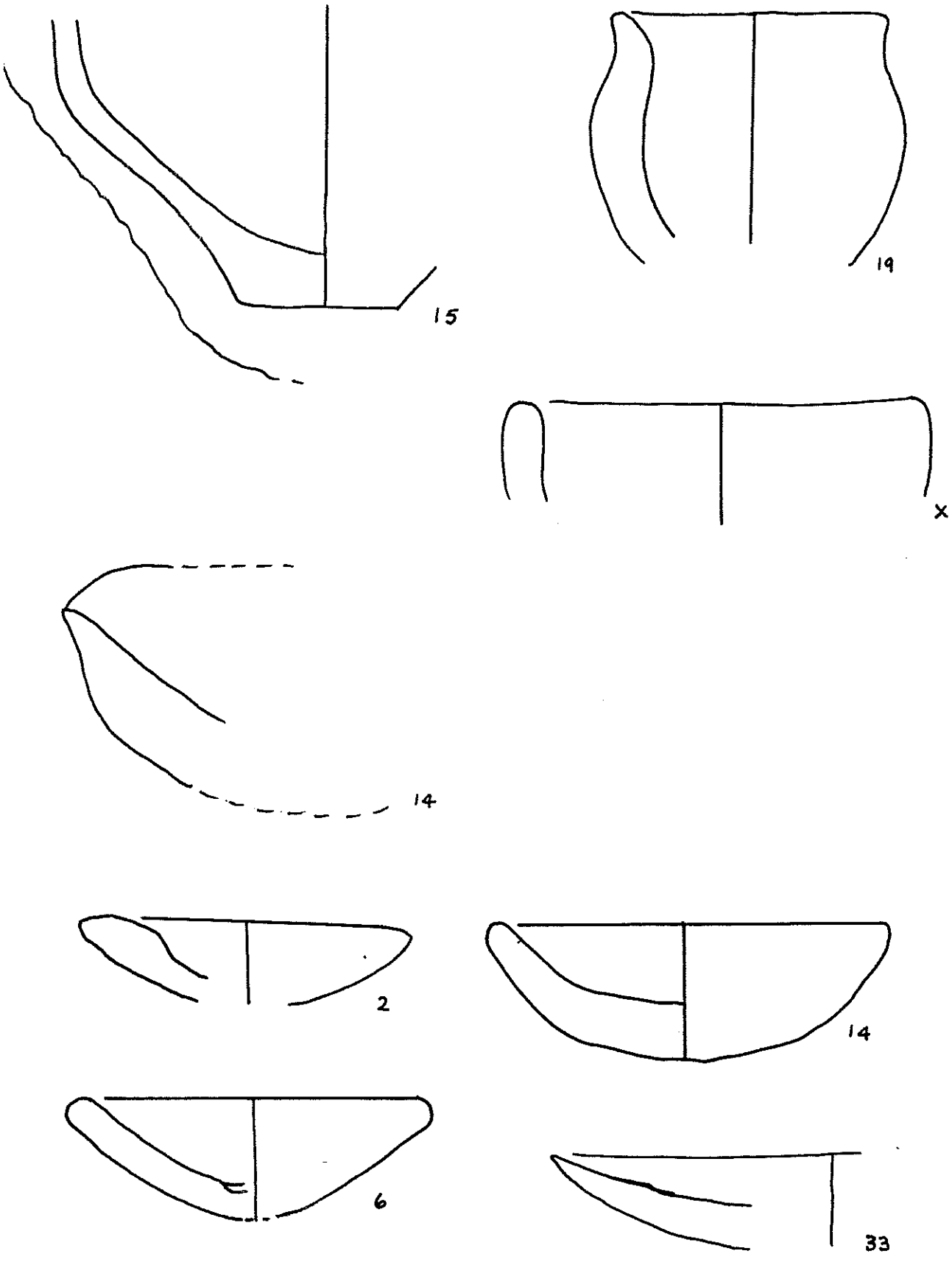

Figure 2: Sketch drawings of crucibles and heating trays from the Museum Garden site. Scale approx 1:1

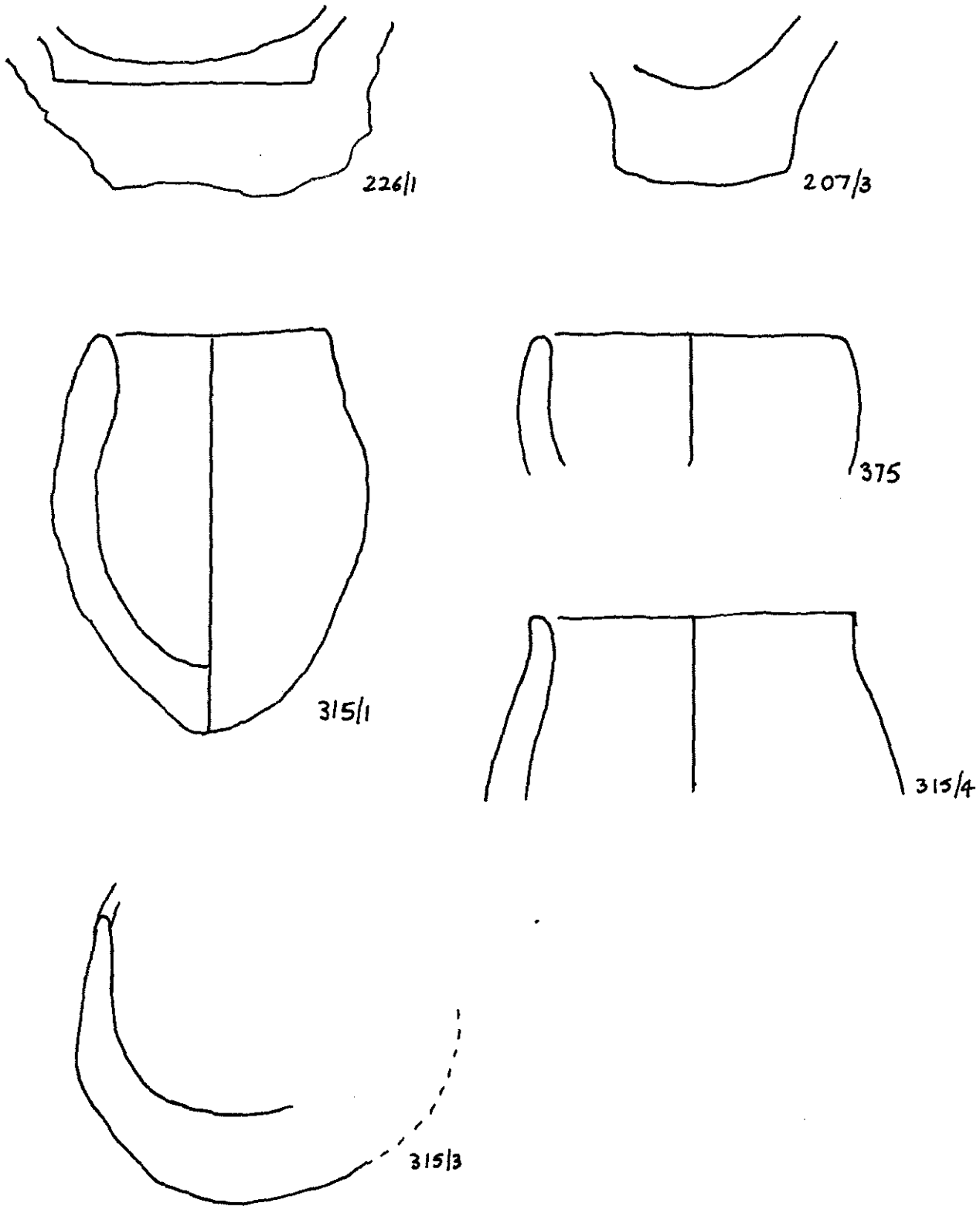

Figure 1: Sketch drawings of crucibles from the British Telecom site. Scale approx 1:1