AML Report No. 3872

Crucibles and other metallurgical debris from Culver Street, Colchester

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The crucible sherds (AM822880) come from two distinct types of vessels. The first are crucibles used to melt copper alloys and are similar to those recently described from Lion Walk (AML Report No. 3817). The remains here are fragmentary but can be seen to be of the same general form. Sizes are also similar; the diameters given in table 1 are internal ones for rims but maximum external diameters for body sherds. The fabric, as in the example from Lion Walk, is pale grey in colour and quartz tempered. An extra outer layer of less refractory clay appears to be the norm. Most of the sherds bear visible signs of the metals they once contained, either red (copper coloured) patches in their vitreous layers or trapped droplets of metal, now corroded. The x-ray fluorescence (XRF) analyses of the crucible surfaces detected combinations of copper, tin, zinc and lead showing a variety of alloys were being melted though the majority seem to be bronzes (copper and tin). The two sherds from medieval or later contexts are very similar to the rest of the material and were most probably Roman residual.

The second group of sherds are quite diferent in both form and fabric; they seem to come mainly from a different area of the site and from earlier contexts than the majority of the crucibles described above. The elements detected by XRF were the same but the proportions and relative frequences were different. The fabric is somewhat variable but generally contains only a small amount of mineral temper together with considerable amounts of vegetable matter and is dark grey except near the outer surface where it is vitrified, vesicular and paler in

colour. The outer, vitrified surface is never coloured red and droplets of metal are not visible. Those crucibles appear to be handmade of a single layer of clay except near the rim where a sort of two layer of structure is visible (see illustrations) but the additions are in the same fabric as the main body and may be the remains of lids added to seal the crucibles. The fabric is very porous and friable and many of the sherds show fresh breaks. Most of the pieces are small but the few larger fragments suggest a pear-shaped body with a maximum internal diameter of about 4cm and a narrow mouth at the top which was sealed before the crucible was used. The largest sherd had a projecting knob on the side of the body which could have functioned as a handle.

These vessels are a problem as they are quite unlike ordinary Roman crucibles. Indeed their fabric does not appear to be very refractory and the deep vitrification noted suggests they may not have been strong enough to support the weight of molten metal they would have contained if they were to be lifted from the fire. The strongest evidence for their use however comes from the XRF data.

The outer surfaces contained almost no detectable metals while the inner surfaces gave very high readings for zinc together with traces of copper and occasionally lead. Zinc has a high vapour pressure (i.e. when a zinc-containing alloy is melted a lot of zinc vapour is given off) so all refractories used to melt brass (copper and zinc) tend to contain considerable amounts of zinc as it diffuses into the fabric and may even get trapped in a vitreous slag phase. The levels of zinc detected here however are far higher than is found even in crucibles used to melt brass. The most likely explanation for these high zinc levels is that the crucibles were used to make brass by the cementation process. Tylecote (1962, 53) describes the process as follows:

"...brass was made by mixing the ore calamine ($ZnCO_3$) with copper under

reducing conditions (i.e. charcoal). The calamine was ground, and mixed with charcoal and granulated copper. This was heated in a crucible at about 950-1000^{0}C to reduce the zinc in the calamine to zinc vapour which was absorbed by the solid copper granules. The temperature was then raised and the copper-zinc alloy melted."

This process would be most effective if carried out in a sealed crucible as the zinc vapour would then be unable to escape into the atmosphere.

No other ancient brass-making crucibles are known in this country or even in Europe (Craddock 1978,9) although a group of sherds of similar form and fabric to those described above have recently been found in Belgic contexts in Canterbury (Bayley, 1983). However, only a few of them have the diagnostic high zinc levels.

The non-crucible material (AM 822881) was also examined and a few pieces analysed. Details of these finds and the non-crucible material from AM 822880 are given in Table 3. The pieces marked with an asterisk are probably further debris from the copper alloy working industries described above. The rest of the pieces are accidentally overheated, the sort of material commonly found in destruction layers.

References

Bayley J. (1983) Crucibles and clay moulds from the Marlowes and Cakebread Robey sites in Canterbury, Kent. (AM Lab Report No. 3862).

Craddock P.T. (1978) The Composition of the Copper Alloys used by the Greek, Etruscan and Roman Civilizations. 3: The origins and early use of brass. J. Arch Sci 5 (1), 1-16.

Tylecote R.F. (1962) Metallurgy in Archaeology.

Table 1: Copper alloy melting crucibles.

SITE REFERENCE		DATE OF CONTEXT	VESSEL DESCRIPTION	METAL TRACES	XRF DETECTED
B200	1280	Med/Post-Med	R Ø=5		(Cu)
B200	1280	"	B+ Ø=8		
B293	1294	?2nd	B+	R	(Cu Pb)
B293	1294	"	+		"
B331	1448	2nd-3rd	B+	RM	Cu Zn Pb Sn
B331	1448	"	B+	M	"
B331	2652	"	R		(Cu Pb Zn)
B362	1370	late 1st/2nd	R+ Ø=6	R	(Cu Zn Pb)
B405	1353	2nd/3rd	B+		(Cu)
B405	1353	"	Ba+	RM	(Cu)
B428	1441	"	B+	M	Cu Zn Pb (Zn)
B448	1453	"	R+ Ø=5	RM	Cu (Sn Zn)
B448	1453	"	B+	RM	Cu Sn
B451	1444	"	R+ Ø=4	R	(Cu)
B455	1440	3rd?	B+ Ø=6	M	Cu Sn Pb (Zn)
B565	1520	2nd/3rd	B+	R	Cu
~~B455~~	~~1440~~	~~3rd?~~	~~B+ Ø=6~~	~~M~~	~~Cu Sn Pb (Zn)~~
~~B565~~	~~1520~~	~~2nd/3rd~~	~~B+~~	~~R~~	~~Cu~~
B701	1473	"	B+	R	Cu Pb Zn

Table 1: Copper alloy melting crucibles cont'd.

SITE REFERENCE		DATE OF CONTEXT	VESSEL DESCRIPTION	METAL TRACES	XRF DETECTED
B724	1475	2nd/3rd	R+		(Cu Pb)
B744	1479	late 1st/2nd	B+	R	Cu Sn Pb (Zn)
B744	1479	"	B+	R	"
B744	1479	"	B+	R	"
B748	1474	Mid 2nd	B+	M	Cu Sn Pb (Zn)
B2255	2463	2nd/3rd	B+ Ø=10	RM	

Key to Tables 1 and 2:-

Vessel descriptions

B = Body sherd

Ba = Base

R = Rim

+ = Extra outer layer

Ø = diameter (in cm)

Metal traces

R = red colour in vitreous later

M = Traces of corroded copper alloy

Cu = Copper
Pb = Lead
Sn = Tin
Zn = Zinc
} elements within brackets gave only weak signals

Table 2: ?Brass-making crucibles

SITE REFERENCE		DATE OF CONTEXT	METAL TRACES
A402	1544	43-9	Zn
B448	1453	2nd/3rd	Zn + Pb + Cu + Sn
B647	1446	Mid 2nd	
744	1479	Late 1st/2nd?	Zn + Pb + Cu
"	"	"	(Zn)
"	"	"	Zn + Cu
"	"	"	Zn + Cu
"	"	"	(Zn)
E494	2135	Roman	Zn + Cu
"	"	"	Zn + Cu
E750	2369	Late 1st-mid 2nd	Zn + Cu
E786	2367	"	Zn + Cu + Pb
"	"	"	
E786	2381	"	(Zn)
E791	2368	"	Zn
"	"	"	Zn
"	"	"	Zn
E1423	2560	43-9	(Zn)
"	"	"	Zn + Cu + Pb
"	"	"	(Cu + Pb + Zn)
E1436	2563	"	Zn + Cu
"	"	"	Zn + Cu
E1436	2563	"	Zn + Cu
E1436	2570	"	Zn

Table 3: Other material

SITE REFERENCE		DATE OF CONTEXT	DESCRIPTION	
AM 822880				
A402	1544	43-9	*?Hearth lining	XRF: Zn + Pb + Cu
A402	1544	43-9	?Daub	
A461	1629	Late 1st-mid 2nd	Over-heated sherd	
B448	1453	2nd/3rd	Calcined & vitrified flint	
B448	1453	"	Over-heated sherd	
C367	1549	later 1st	Molten glass & burnt clay on sherd	
C367	1549	"	Sherd with fluxed surface	
AM 822881				
A9	F4	Med/Post-Med	*Dribble of molten Cu alloy	
A15	F3	"	*Corroded lump of Cu alloy	
A20	F8	"	*Corroded lump of Cu alloy	
B345	F122	c.150-300	*Cu rich hearth lining?	
B1128	L250	Mid 1st-mid 2nd	Fragment of over-heated ceramic (?tile)	
B1232	L296	"	*Metal-rich fuel ash slag. XRF: Cu+Pb+Sn	
B1417	L319	"	*Spilt metal on fixed clay. XRF: Cu+Pb	
B1669	L400	"	*Metal-rich fuel ash slag.	
B1848		U/S	*Dribble of molten Cu alloy. XRF: Cu+Zn(+Sn+Pb)	

Table 3: Other material

SITE REFERENCE		DATE OF CONTEXT	VESSEL DESCRIPTION METAL TRACE
AM 822881 cont'd			
B2403	L678	49-60/1	3 lumps of dark brown fired clay
C376	L57	Mid 1st-mid 2nd	*Fuel/ash slag with traces of Cu
C417	L66	49-60/1	*?Corroded metal lumps
E302	F216	Med/Post-Med	Fuel/ash slag. Blue colour due to traces of iron
E421	L1	Saxon - 18th	Over-heated, vesicular ceramic with traces of copper corrosion products. Not a crucible.

MORE CRUCIBLES AND SCRAP METAL FROM CULVER STREET, COLCHESTER
(Addendum to AM Report 3872)

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The crucible sherds (AM 830764) can be divided into three groups. The metal melting crucibles (group A in the Table) are similar to those seen earlier; the metals include both brass and gunmetal. One crucible (B2502, △ d) had been used at least twice as it had two superimposed extra layers of clay on the outside. One sherd contained a few droplets of gold stuck in the vitreous layer on the inside of the crucible, showing it had been used to melt gold. This came from a post-mediaeval context but could be residual earlier material. It is not large enough for the form to be diagnostic.

There were two sherds and a number of tiny fragments of the same appearance as the ?brass-making crucibles previously described. However, these sherds lacked the high levels of zinc which were almost universally detected in the earlier brass-making crucibles.

A final sherd (C100, △ 2691) was of an oxidised fired, sandy fabric with a 3 mm thick vitreous deposit on the inside which contained corroded metal droplets. Visual examination suggested these metal droplets were silver or a silver-rich alloy which was confimed by XRF analysis which detected copper, zinc and silver. The thickness of the vitreous layer and the oxidising conditions under which the vessel had been heated indicated that it was not used for metal melting though the presence of significant amount of metals do indicate some metallurgical use. Further investigations will be carried out in an attempt to positively identify the process.

The scrap metal (AM 830765) was, with one exception, dribbles and flows of molten lead. These were probably all accidental spillages or metal within a building that got melted when it burnt down. The exception (B 1332, Δ 1688) was a few thick pieces of sheet tin-lead alloy. This could be considered as pewter which was commonly used for vessels in the third and fourth centuries or as a large mass of solder. The shape is not quite what is expected for either.

TABLE: CRUCIBLE SHERDS

Site Reference		Date of context	Vessel description	Metal traces
A: METAL MELTING				
B439	a	3rd/4th	B	-
B548	2688	late 1st - 3rd	B	R -
B565	2689	"	Ba	M Cu Zn Su Pb
B752	2690	"	B	R Zn Cu Pb
B2502	d	2nd	B++	RM Cu Zn Su Pb
C 27	2682	Post Med	B	Au (Cu Zn Pb)
B: ?BRASS MAKING				
E786	b	?	B	(Zn)
E784	c	?		-
C: OTHER				
C100	2691	late 1st - 3rd	B	Zn Cu Ag