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Ancient Monuments Laboratory
Report 82/87

EXAMINATION OF SOME CRUCIBLE FRAGMENTS FROM TANNER ROW AND ROUGIER STREET, YORK.

Paul Budd BSc

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Summary

Ten fired clay fragments, thought to have originated from melting crucibles, were examined under a low-power microscope and analysed qualitatively by x-ray fluorescence. Eight of the fragments, four from Tanner Row and four from Rougier Street, probably derive from ceramic vessels associated with Roman non-ferrous metalworking. The crucible sherds examined suggest that Roman copper alloy working had been carried out at Rougier Street and that gold melting had taken place at the Tanner Row site during the Roman Period.

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EXAMINATION OF SOME CRUCIBLE FRAGMENTS FROM TANNER ROW AND ROUGIER STREET, YORK

Introduction

A total of ten fired clay fragments suspected of being sherds from metal melting crucibles were submitted to the Laboratory for examination. Five of these came from the Tanner Row site (1983/4.32) and five from Rougier Street (1981.12), all were from Roman contexts (with one exception which was unstratified). The sherds from Tanner Row should be considered in association with the examples already reported from the same site (see AML Report No.18/87). All of the fragments were examined under a low power microscope and their surfaces were analysed qualitatively for non-ferrous metal traces by energy dispersive x-ray fluoresence (XRF). Two of the fragments, one from each site, are not thought to have any demonstrable association with metal working. The remaining eight are probably sherds from ceramic vessels associated with non-ferrous metalworking.

Tanner Row

Of the four sherds recovered from this site which are thought to be from metal melting crucibles two were from beaker-shaped vessels and two from a dish-shaped vessel or vessels.

Context 4219, part of an irregular dump of late second century date, produced a crucible base fragment (SF 3203) from a beaker-shaped vessel with a base diameter of 30 to 40mm and a wall thickness of 7 to 9mm (see Fig 1). The fabric is highly refractory with a coarse mineral temper and is reduced fired to a light grey. XRF results suggest that the metal being melted was a copper alloy, possibly a brass.

The other sherd from a beaker-shaped crucible (from context 2455) is more complete, consisting of almost half of the vessel. It appears to have come from a smaller vessel, about 50mm tall with a maximum diameter of approximately 45mm (see Fig 2). The fabric is reasonably refractory and has been reduced fired to a dark grey or black colour. XRF analysis detected traces of gold on the internal surface of the sherd which were visible under a low power microscope as tiny droplets on the surface. Vessels of similar size and shape have been interpreted as crucibles used to melt precious metals (Bayley 1983). However in this case vitrification of the broken edges of the sherd and the presence of a small circular "tide" mark (about 15mm in diameter), which may have formed around a small globule of molten metal, suggest that the sherd may have been re-used after the vessel was broken as a "tray" on which to melt gold.

The two unstratified crucible fragments from Tanner Row may have originated from the same dish-shaped vessel, about 20mm high with a rim diameter of approximately 40mm (see Fig 3). The sherds were both of the same fabric, fairly refractory with a fine mineral temper and reduced fired to a light grey. Both were slightly

vitrified, predominantly on their internal surfaces. One of the sherds (sherd "a") displayed a circular "tide" mark similar to that mentioned on the sherd from context 2455. Tiny gold droplets were visible on the surface of this sherd when examined under the microscope and their presence was later confirmed by the XRF results. Sherds from very similar vessels, also used for gold melting have been recovered from Roman contexts at Copthall Street in London (Wilthew 1983). So these sherds, though unstratified, are likely to be Roman.

Also submitted for examination with the crucible material was a small piece of deeply vitrified ceramic material (SF 3071 from context 1364, an organic accumulation of late second or early third century date). It was not possible to determine whether this fragment originated from a vessel and, although XRF analysis detected the presence of low levels of copper and zinc, the results were not conclusive and no association with metal working could be demonstrated.

Traces of blue colouration were noted on all of the sherds from Tanner Row, these appeared on the surfaces of fractures as well as original surfaces and are thought to be due to the presence of iron phosphate and iron sulphides. These are secondary deposits which probably resulted from anaerobic burial conditions.

In general the evidence from the crucible fragments discussed above, as well as that from the Roman heating tray fragment which has already been reported*, indicate that the main metalworking activity in the Roman Period may have been small scale working in precious metals. This may have taken the form of the re-melting of filings or small fragments of gold into globules so that the metal could be more easily re-used or transported. The use of relatively open, shallow vessels or re-used sherds which show greater vitrification on internal surfaces suggest that this may have been achived by directing heat down onto the metal from the top of the vessel, probably by use of a blow-pipe. The available dating evidence suggests that these activities may have taken place around the later half of the second century. There is limited evidence from the crucible base fragment from context 4219 as well as from the mould fragment previously reported* that the working of copper alloys may also have been taking place at this time.

Rougier Street

Of the four crucible sherds examined from Rougier Street one (SF 457 from context 1205, a layer of burnt material of second century date, possibly associated with a burnt down warehouse) remains rather speculative. The "sherd" is a small piece of reduced fired clay broken into three fragments. It has a fine mineral temper and has been vitrified on one side. The three fragments are all very thin (only about 1.5mm) and this, as well as the irregular shape of the non-vitrified surface, suggests that the "sherd" may in fact be a thin layer which has flaked

* see AML Report No.18/87.

from the outer surface of a crucible. XRF results suggest an association with copper alloy working, but are non-diagnostic beyond this.

Two of the crucible sherds from Rougier Street are either from the same or very similar vessels; these are a rim sherd from context 1128 and a body sherd (sherd "a") from context 1106. Both of these contexts are dated to the Late Roman Period after the second quarter of the fourth century, however both contain large amounts of residual material. The rim sherd (see Fig 4) is from a crucible with an internal rim diameter of about 9cm with a wall thickness of 7 to 9mm. Both sherds are of the same highly refractory fabric with a dense quartz temper and both show slight traces of vitrification. Unusually the rim sherd displays some traces of oxidized firing (reducing conditions normally prevail in metalworking) although the bulk of the sherd is reduced fired to a light grey. The body sherd has a notable deposit of corroded copper alloy on its internal surface.

The final crucible sherd from Rougier Street, also from context 1106 (sherd "b"), is a large body sherd (about 5mm thick) which has been broken into three pieces. The original fabric is difficult to describe since, despite being fairly refractory, it has been altered by high temperatures and partly vitrified throughout its entire thickness. A layer of less refractory clay (about 3mm thick and deeply vitrified) has been added to the outside of the crucible.

The analytical results for all three of the crucible fragments from contexts 1106 and 1128 give the impression that the alloys being melted were probably leaded gunmetals. However two factors can combine in XRF analyses of crucibles to produce a distorted picture where zinc and lead tend to predominate whilst tin can be "invisible" even when originally present in significant quantities. One problem is that the more highly volatile metals such as lead and particularly zinc are preferentially retained in ceramic fabrics after they have been in contact with metal alloys at elevated temperatures. This phenomenon leads to the over emphasis of these elements in the analytical results. Adding to this the weak XRF signals produced by tin when compared with other metals often lead to its under representation in results.

The practical effect of these difficulties is well illustrated by the three sherds in question where the observed differences in analytical results probably reflect variations in the survival of metal traces as much as variations in the composition of the original alloy melted. Since all three sherds are fairly closely associated stratigraphically (two may indeed be from the same vessel), and since the XRF results are quite similar, it is quite possible that the same alloy was being melted in all three cases. It is notable that although tin was not detected on all three sherds it was represented where the corroded metal traces remained.

Also submitted with the crucible material was a piece of burnt reduced fired clay (SF 385), probably a fragment of tile, which originated from context 1205. Although XRF detected traces of lead on the fragment it is not thought likely that it had any direct association with metalworking.

In general the analysis of the crucible material from Rougier Street suggests that copper alloys were being worked in the Roman or Late Roman Periods.

References

Bayley, J. (1983) Some crucibles and "slags" from Hunter Street School, Chester. A.M.L.Report No.4043

Wilthew, P.T. (1983) Examination of some crucibles from Copthall Street, London. A.M.L.Report No.3949

Results of the XRF analyses of crucible fragments from Tanner Row and Rougier Street

Tanner Row

SF No.	Context	Part of crucible	Cu	Zn	Pb	Sn	Au
3203	4219	Base	+	++	+		
--	2455	Half Vessel		+			++
(a)	U/S	Base/Rim					++
(b)	U/S	Base/Rim					

Rougier Street

SF No.	Context	Part of crucible	Cu	Zn	Pb	Sn	Au
457	1205	Surface flake	+	++	+		
--	1128	Rim	++	++	+++		
(a)	1106	Body	+++	++	++	+	
(b)	1106	Body	++	++	+++	+	

Key

\+ - detected
++ - significant
+++ - major

Other material submitted

Rougier St.	1205	385	Burnt fired clay (?tile) fragment.
Tanner Row	1364	3071	Vitrified ceramic.

Sketch drawings of crucible sherds from Tanner Row and Rougier Street

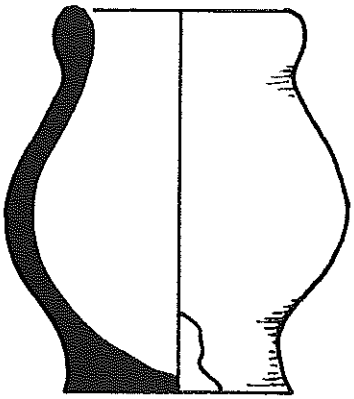


Fig 2.

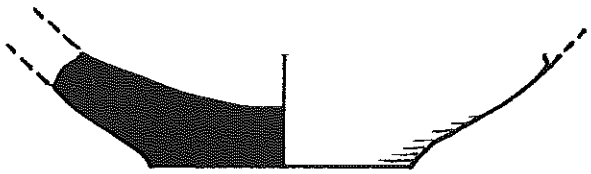


Fig 1.

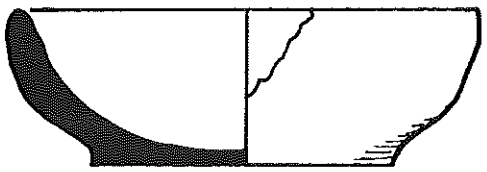


Fig 3.

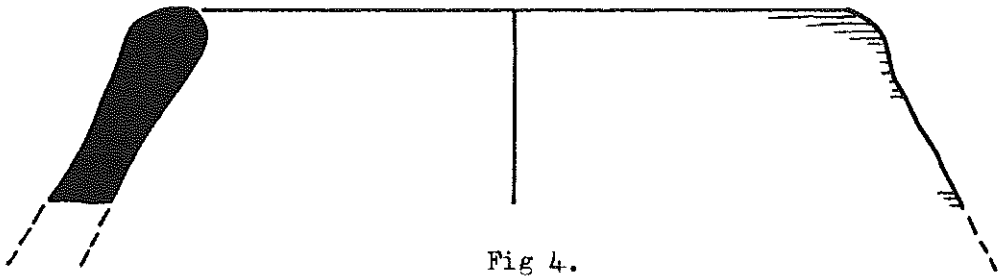
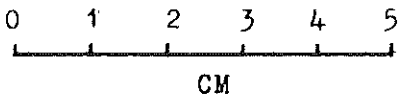


Fig 4.



Addendum to AML Report No. 82/87

THE EXAMINATION OF A FURTHER CRUCIBLE FRAGMENT FROM ROUGIER STREET, YORK

Paul Budd BSc

A further metal melting crucible fragment from the Rougier Street excavations (1981.12) was submitted to the Laboratory. The sherd (Δ 70) was recovered from a context (1133) overlying the latest Roman road surface and is probably of fourth century date. The sherd was examined under a low power microscope and the surface analysed qualitatively by energy dispersive x-ray fluoresence (XRF) for non-ferrous metal traces.

The sherd was from the base of a vessel perhaps transitional between the beaker and conical forms typical in the Roman Period (a comparable crucible base is illustrated in Garrod & Heighway; 1984,102). The fabric, which is reduced fired to a light grey, was probably quartz tempered. However it has been altered by high temperatures and has become partly vitrified throughout its structure (similar to the crucible sherd "b" from context 1106 already reported). The sherd varies in thickness between 3 and 7mm and an extra layer of deeply vitrified, less refractory clay (3 to 6mm thick) has been added to the outside.

Significant deposits of corroded copper alloy were present on the inner surface of the sherd. XRF analysis of these deposits suggests that the copper alloy melted was a leaded gunmetal. This supports the conclusion of the report that copper alloys were being worked in the area of the excavation in the Late Roman Period.

The table on page 5 of the report 82/87 should be amended by the addition of the following line:

SF No.	Context	Part of Crucible	Cu	Zn	Pb	Sn	Au
70	1133	Base	+++	+++	+++	++	

Reference:

Garrod,A.P. & C.Heighway (1984) Garrod's Gloucester Western Archaeological Trust, Gloucester.