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CRUCIBLES AND MOULDS FROM CHURCH CLOSE, HARTLEPOOL, CLEVELAND

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Justine Bayley
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Summary

A few pieces of slag, 11 crucible fragments and some two dozen clay mould fragments all dating to c 700 AD were examined. The crucibles included at least one with a knobbed lid used for melting silver. Copper alloys were also worked. The moulds were piece moulds but were not made in the usual way. Instead, the patterned matrix had half an in-gate and a plain backing piece (second valve) added to form a complete mould.

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The material submitted for examination (A M Lab No 868120) included fragments or crucibles, clay piece-moulds and slag. It came mainly from two associated contexts, 58 and 91, but was apparently a single group of material; a join was found between two crucible sherds from different contexts. All the material was carefully examined under low magnification (x10-x30) and all the crucibles and a proportion of the mould fragments were analysed qualitatively by energy dispersive X-ray fluorescence (XRF) in an attempt to identify the metals or alloys being worked. A date of around 700 AD has been assigned to these finds by Prof Rosemary Cramp based on the designs on the moulds.

The slag

The identifications of the slag are given in Table 1. Some is definitely not associated with the metal casting while other pieces may be (see Bayley 1985 for details of the processes producing different types of slag). The smithing slag is evidence for small scale iron working but the odd piece, as here, is best interpreted as a normal 'background' scatter rather than indicating iron smithing was actually carried out in the area excavated. The fuel ash slag and iron-rich fuel ash slag could have been produced in any sufficiently hot fire. It is often, though not necessarily, associated with metalworking. Hearth lining is fragments of the clay lining of a hearth which has become vitrified on the surface in contact with the fire. Vitrification is not normally produced in domestic hearths as the temperatures are not high enough.

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Table 1: The slag

S F No	Context	Description
40	91	hearth lining and fuel ash slag, charcoal
98	91	fuel ash slag, smithing slag and 3 tiny copper alloy fragments
103	99	iron-rich fuel ash slag
114	58	hearth lining and smithing slag

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The crucibles

Crucible fragments were noted in both the main contexts. Most of the pieces are very small so it is difficult to suggest the forms the vessels may have had. The individual pieces and the analytical results obtained from them are given in Table 2. The largest fragment is XRF-6 and its irregular curvature indicates it comes from a triangular or half-pear shaped crucible similar to those from Dinas Powys (Alcock 1963). It has an added

Table 2: The crucibles

XRF No	S F No	Context	Elements detected	Metal melted
6(joins 11)	96	91	Br Zn Cu Ag Pb	silver
7	96	91	Zn Cu Pb (Sn Ag)	?
8	96	91	Zn Pb Cu Br Ag Sn	?
9	96	91	Zn Cu Pb Sn	? bronze
10	96	91	Br Ag Cu Pb Zn	silver
11(joins 6)	96	91	Cu Zn	silver
12(joins 14)	113	58	Zn Cu Pb Br Ag	silver
13	113	58	Cu Pb Sn	? bronze
14(joins 12)	97	91	Zn Ag Cu Pb Br	silver
15	97	91	Zn Cu Pb Sn	? gunmetal
22	40	91	Zn Cu Pb Sn	? gunmetal

See below for explanation and discussion of this data

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outer layer of clay which stands proud of the rim for most of its surviving length suggesting it was originally lidded. The part of the rim without this addition would have been the lip where the metal was poured out. This crucible was used to melt silver. The only other large fragment is XRF-14 which has a fish-tail knob. It was also part of a crucible used to melt silver. The relatively small amount of vitrification on its outer surface suggests it was from a lid (which was less exposed to the fire) rather than from the body of a crucible. Again the best parallel in Britain for a knobbed lid is the crucibles from Dinas Powys so it may come from the same vessel as XRF-6 though the fragments do not actually join. The third fragment from a silver-melting crucible, XRF-10, may also have come from the base of the same of a similar vessel, though it also does not join.

The only other piece for which a form can even tentatively be suggested is XRF-7 which may be part of a small thumb pot crucible with a diameter of 3-4 cm and a height of under 3 cm. Its fabric is far more extensively vitrified than that of the vessel(s) previously described. The analytical results are ambiguous (see discussion below) but the metal being melted was probably a copper alloy containing tin.

XRF-9 and XRF-22 are tiny body sherds and XRF-8 a possible rim sherd from a crucible with an added outer clay layer like XRF-6. XRF-13 and XRF-15 are body sherds from rather thicker-walled crucibles. All these vessels appear to be hand-made.

The metals being worked

It can be seen from Table 2 that some of the crucibles were definitely used to melt silver. This statement is based not only on the XRF results but on the appearance of the metal deposits on the sherds. The composition of the metal melted in the rest is far less certain as there are problems in interpreting the XRF results. The difficulties are due to the very different chemical behaviour of the various elements which affects not only their survival on the crucible but their sensitivity to XRF analysis too.

The required information is the composition of the metal that was put into the crucible to be melted but all that survives is corroded metal (at best) or a metal-rich slag. When a mixture of metals (an alloy) corrodes or reacts with other materials to form a slag not all the elements in the mixture behave in the same way so the proportions of some go up and others down. In slags relatively volatile, glass-forming elements such as lead and especially zinc are enhanced while corrosion favours the survival of less reactive metals such as silver and, particularly, gold.

XRF, as used in the A M Lab, is far more sensitive to some elements than others so the height of a peak in the spectrum is not an accurate guide to the proportion of the corresponding element in the object being analysed. Of the elements of interest here, the lead peak tends to be enhanced and those of siver and tin reduced. It can now be seen that although Table 2 lists the elements detected in order of decreasing XRF peak height this is not directly related to their relative proportions on the sherd and certainly not to their proportions in the metal originally being melted.

Table 2 also illustrates a further factor which has to be taken into account when interpreting XRF analyses. It can be seen that joining sherds do not necessarily have the same elements detected and, even when they do, they are not in the same order. This is because the deposits on the sherds are not homogeneous and their burial environments may also have been different.

Taking all these factors into consideration, the XRF results have been interpreted as indicating that a variety of copper alloys were melted as well as silver. This is supported by the analyses of the copper alloy fragments in S F 98. One of them was bronze (copper + tin), one bronze with a minor amount of lead and one a gunmetal (copper + tin + zinc) with a small amount of lead. The two crucible analyses that are most difficult to interpret are XRF-7 and XRF-8 as both silver and tin were detected, a most unusual combination. The metal could have been a copper alloy containing minor amounts of silver but it is more likely that it was silver debased with a tin-containing copper alloy. All the silver being worked here would have contained minor amounts of other metals which accounts for the other elements detected in the silver-melting crucibles. Bromine is often detected as a component of silver corrosion products (Hedges 1976).

The moulds

These are piece moulds made of clay and are of particular interest not only for the high quality of the objects being cast but also because most of them are not made in the ordinary way. Normally, moulds for small objects such as these are made in two halves. Each valve carries the matrix for the object and the in-gate. To make an ordinary 2-piece mould a lump of clay is roughly shaped and a pattern or model of the object to be cast complete with runner(s) and sprue is pressed into it, keying marks are made and a second piece of clay is added. The two valves of the mould are then taken apart, the pattern removed for re-use, the mould re-assembled, the valves luted together and the whole dried, fired and the casting made. Contemporary examples include those from Dunadd in Scotland (Craw 1929-30, Bayley 1984) and Helgö in Sweden (Lamm 1980).

The Hartlepool moulds were made by pressing the pattern into a block of clay which was trimmed to a regular shape, eg the straight-sided disc of SF 91. Extra clay was modelled to form one side of the in-gate and added to the clay block to form a complete front valve for the mould, eg SF 94 is the addition that fits onto SF 91. As the objects being cast were mounts with flat backs there was no need to get accurate registration of the front and back mould valves so the back was formed be taking a relatively thin sheet of clay and smoothing it into place on the composite front valve, eg SF 95. This completed the in-gate and produced a smooth back to the mount being cast. These moulds have no added luting clay as the back was formed and attached to the front valve in a single operation.

The main reasons for this unusual method of mould construction were most probably the form and decoration of the mounts being cast. Their intricate detail required great care in making the impression in the mould as any flaws would have been faithfully reproduced in the final casting. Perhaps by making the matrix on a block of clay there was more opportunity for re-touching or for trimming or trueing up the top surface of the mould to control the thickness of the casting being made. The runners appear to have been cut out of the clay blocks after the design had been impressed and the in-gate added. This suggests the pattern used to make the matrix may have been an existing object rather than a purpose-made pattern piece complete with runners and sprue.

Although the moulds were piece moulds rather than investment (lost wax) moulds it is most likely that the craftsman intended to use each mould only once. The piece mould construction enabled the pattern to be used to make as many moulds as were required. The act of removing a casting from the mould would probably have caused sufficient damage to make the mould unusable again, particularly where a fine finish was required.

A proportion of the moulds including all the larger pieces were analysed to see if the alloy cast in them could be determined. Although sufficient metal traces were detected to confirm that the moulds had indeed been used to cast non-ferrous metals, it was only the most volatile elements that were detected at significant levels so no conclusions could be reached about the intended composition of the castings. The analytical results would be consistent with the use of either the (base) silver or copper alloys that were detected on the crucibles.

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Table 3: The moulds

S F No	Description
91	Round matrix with square 'lamb of God' design. Note the runner level with the animal's chest
92	Round matrix with interlace-decorated cruciform motif
93	Trapezoid matrix with interlace and beast motif
94	In-gate (joins SF 91). The channel is continuous with that on the matrix
95	Backing valve, ? from a circular casting
97	3 fragments from near the in-gates of upper valves * and 2 unidentifiable fragments
111	In-gate with traces of luting clay *
49	In-gate with traces of luting clay *
40	2 bags containing a total of 12 identifiable fragments comprising: an in-gate from a round matrix, cf SF 94 7 fragments of backing valves, cf 95 a surround to hold a round matrix or possibly an alternative form of backing valve for pieces such as SF 92, ie to give a thicker casting than that obtainable using a flat backing valve 2 fragments from near the in-gates of upper valves * and a fragment from an upper valve *

Those pieces probably or certainly coming from a conventional 2-piece mould are marked *
SF 99, 112 and 116 were also mould fragments

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