Ancient Monuments Laboratory
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LATE ROMAN SPOON MOULDS FROM CASTLEFORD, WEST YORKSHIRE.

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Summary

About 800 fragments from a minimum of 52 clay moulds for casting purse-shaped spoons were examined. The moulds were of two piece construction and were assembled into composites so that about 16 spoons were cast at once in a cone-shaped assembly. Surviving metal traces suggest that the spoons were made of leaded gunmetal.

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LATE ROMAN SPOON MOULDS FROM CASTLEFORD, WEST YORKSHIRE

Introduction

A total of some 800 fragments of clay moulds for casting spoons with purse-shaped bowls were found. Most came from a pit 2.0 x 1.0 x 0.6m deep that was cut from levels above those of the third century forts and more or less immediately below the modern and Victorian overburden. The mould fragments came from the upper 0.2m of the fill apart from a small number which came from the surrounding area rather than from the pit itself. Sherds of pottery from the pit's fill have been provisionally dated to the third century. There was no other obvious evidence of metalworking (eg slag, ingots, or crucibles) and sieving failed to produce material of this nature.

After their initial recognition the moulds were brought to the Ancient Monuments Laboratory for detailed examination and analysis. A preliminary description has already been published (Bayley & Sherlock 1986) but the conclusions presented there have been expanded in this report.

It has not been possible to reconstruct a complete mould so only an estimate of the overall length of the spoons can be made; they are likely to have been around 152mm long. The spoons have purse-shaped bowls 26mm wide and 46mm long which have medial ribs running along their undersides. The handle makes a 10-15^{o} angle with the plane of the bowl and a crest projects upward from the point where the handle and bowl meet. The part of the handle nearest to the bowl is rectangular in cross section and extends 21mm from the edge of the bowl to where a raised collar or knop projects from it. From this point the handle is circular in cross section and tapers slightly. These features are illustrated in the reconsruction drawing Fig.1. The angled handle is clearly illustrated in Fig.2. It is estimated that the mould capacity would have been about 2ml and the finished spoon would have weighed around 20g.

The vast majority of the moulds were made from one original model or possibly from several which were intended to be identical. A few moulds for a second design of spoon have been identified; their only significant difference is the lack of a medial rib running from the handle along the back of the bowl (see Fig.4).

The mould fragments

Each spoon was cast in a two piece mould, the two valves being luted together with clay to keep them correctly aligned. The presence on many of the mould fragments of extra clay, which has clearly been added to the moulds after they were luted together, indicates that a number of these pairs were then assembled together into a composite mould (the form of which is discussed below). A sprue cup was then added to the composite mould and a

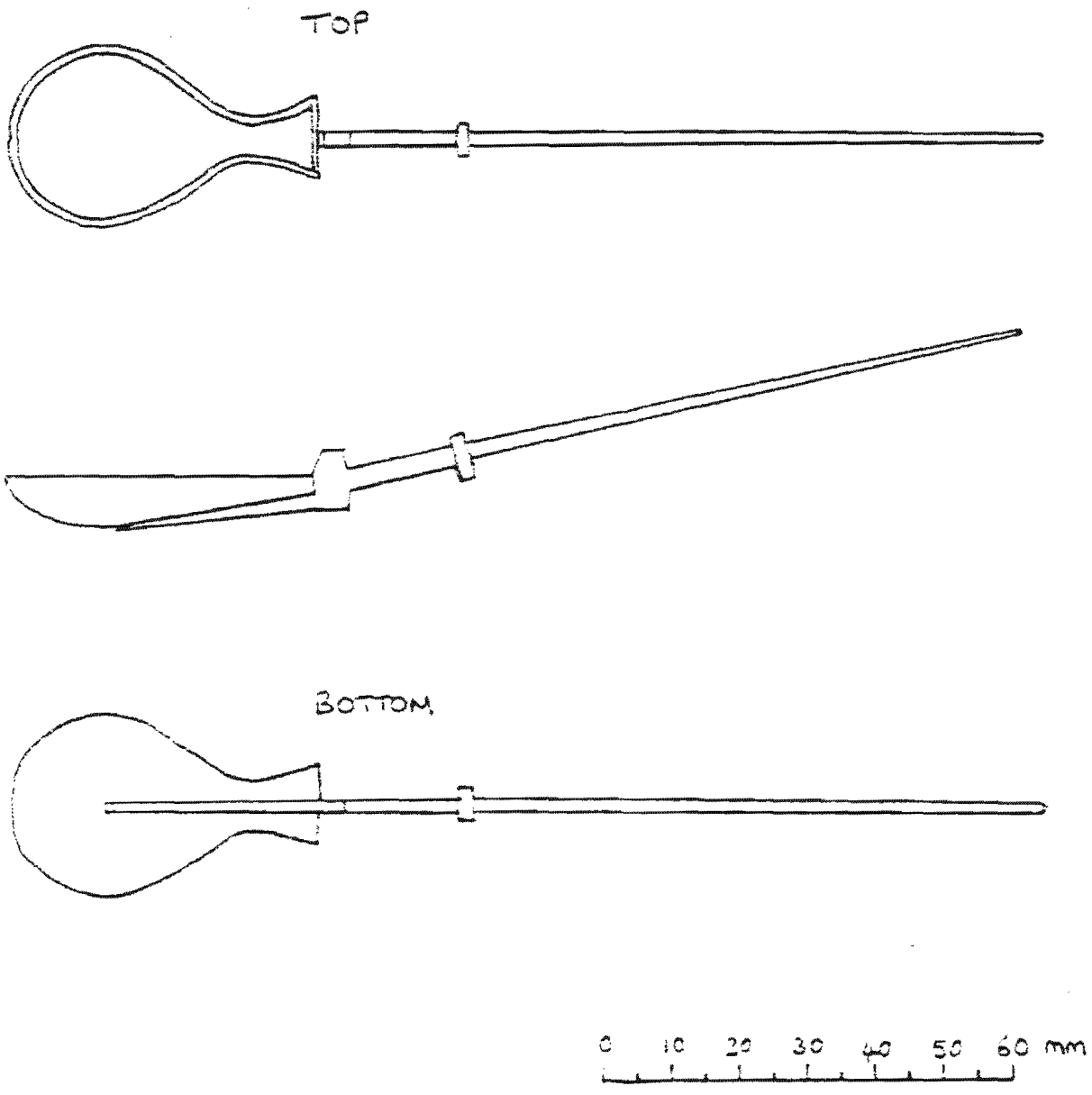

Fig.1. Reconstruction sketch of one of the spoons which would have been cast in the Castleford moulds.

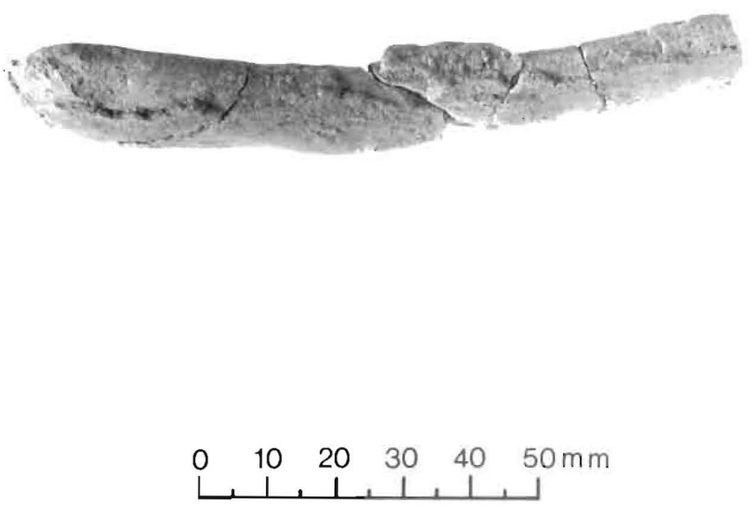

Fig.2. A partly reconstructed spoon mould back valve clearly showing the angle between the handle and the plane of the bowl.

number of spoons were cast at once. Some of the more crudely shaped clay fragments which are obviously not pieces of mould have been interpreted as "packing pieces", the clay which held the moulds together in the composite. Their presence is further evidence for the assembly of the moulds into composites.

The mould fragments were sorted into four classes; fronts, backs, packing pieces, and miscellaneous fragments. A representative selection of fronts are illustrated in Fig.3, backs in Fig.4, and other pieces in Figs.5 & 6. The total numbers of fragments in each class are given in Table 1.

Fronts	264
Backs	354
Packing Pieces	106
Miscellaneous	73
TOTAL	797

Table 1 : Total numbers of mould fragments.

Despite considerable effort to reconstruct the moulds fewer than 10% of the fragments have been rejoined. This suggests that what survives is only a fraction of the original mould material. It has been possible to estimate the minimum numbers of moulds represented based on a number of different uniquely identifiable portions of the surviving fragments. This information is summarized in Table 2. Although there are variations in these totals these are not considered particularly significant given the obviously partial nature of the sample. The variation is a futher indicator of partial survival and random loss.

There is no reconstruction of a complete valve, but it is suggested that the length of the handle (from end to bowl) was approximately 106mm. This supplies a further minimum number based on the calculation of the total lenth of all of the handle fragments present. The total of 4607mm for the mould fronts gave a minimum number of 43 moulds, whereas the 4110mm total length of the handle back fragments gave a minimum number of 39. These figures are included in Table 2.

	Mould Fronts	Mould Backs
Bowl/handle junctions	35	52*
Rib Terminations	--	35
Collars	38	24
Handle Ends	19	2
Handle Lengths	43	39

* The 52 Bowl/handle junctions include 4 of the "non-ribbed" type.

Table 2 : Minimum numbers of spoon moulds estimated from different portions of the moulds.

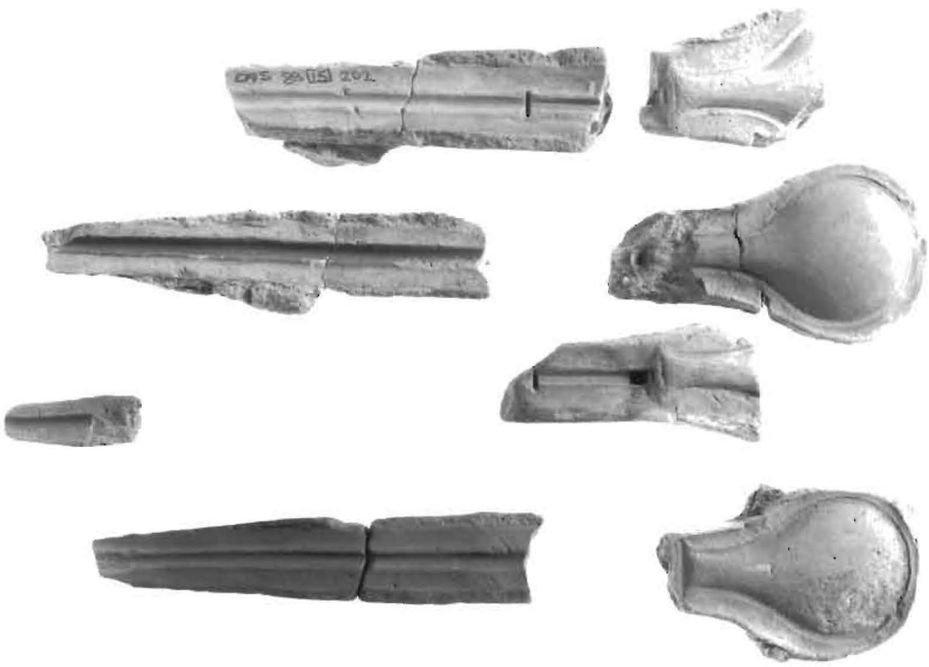

Fig.3. A selection of fragments of spoon mould front valves.

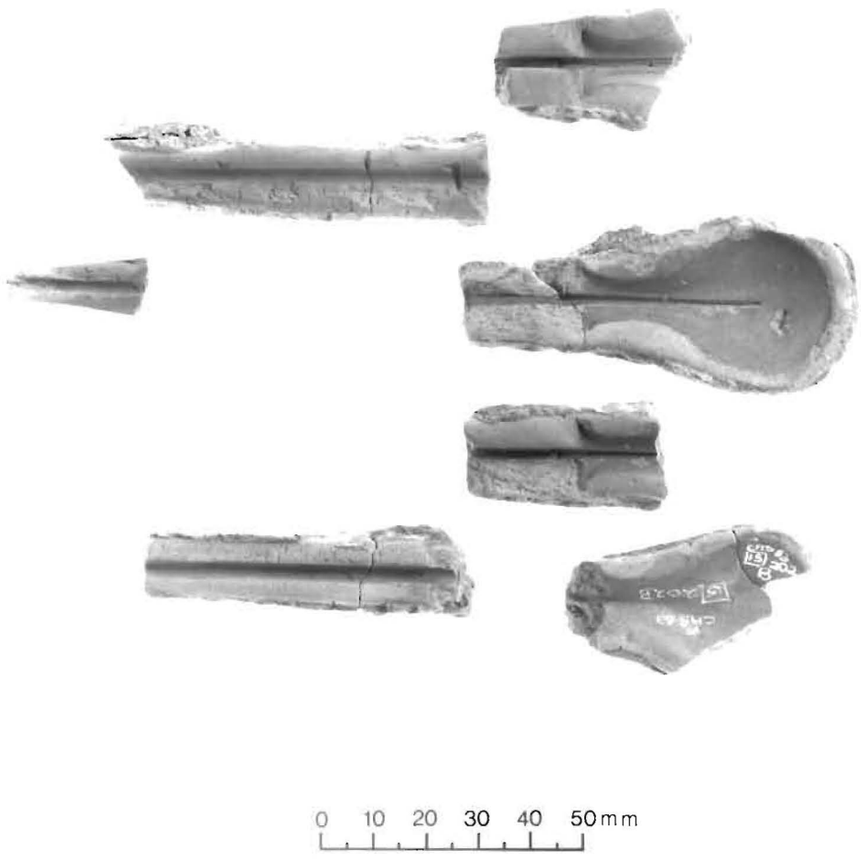

Fig.4. A selection of fragments of spoon mould back valves. Note the bowl fragment in the bottom right corner of the plate which is an example of the "non-ribbed" type.

The fabric of the moulds is tempered with abundant fine quartz grains (approximately 0.1mm in diameter with occasional larger inclusions of up to 0.5mm) and some mica. It fires pale pink to pale grey. The modelled surfaces and the adjacent areas of the moulds are always reduced fired from contact with the molten metal but the bulk of the mould fabric is often oxidized, as is the case with most clay moulds. Some of the modelled surfaces have a fine clay coating which fires a darker grey. The luting clay which joined the valves together, and the packing clay which held several moulds together for casting, is similar to that of the moulds themselves although it contains some rather larger quartz grains.

How the moulds were made and used

The moulds were made by taking a lump of clay, roughly shaping it, and pressing into it the back of a model spoon. A second piece of clay was then pressed over the front and down into the bowl. The two valves were then taken apart, the model carefully removed, the mould reassembled and the join sealed (luted) with a small amount of extra clay, traces of which survive on many of the fragments. Only fronts and backs which were made together could have been used together since random fronts and backs do not fit well enough.

Detailed examination of the mould fragments showed that the great majority were made either from one model or a number of models intended to be identical. However some variation was noted in the collars where a slight ridge or step could be seen on a number of examples. Similarly on the rectangular-section part of the handle, between the bowl and the collar, a slight bevel was apparent on some of the fragments rather than the expected vertical sides. These features were not related to one another and it is likely that they result from variations in the care with which the model was pushed into, and removed from, the soft clay during manufacture of the mould. These slight variations in mould form would have produced a less perfect casting, requiring more work to finish the object.

No vents or runners were provided and the casting would have been made by pouring the molten metal into the sprue cup and letting it run down the spoon handles into the bowls. The porosity of the fabric must have been sufficient to prevent any gases being trapped.

Before the moulds were used they were assembled into multiples for casting. Virtually all of the fragments have some evidence of a thick layer of coarser clay having been added to their sides, often over the thin luting clay layer (see Fig.7). There are no examples of this thick packing clay layer having been added to the mould backs or fronts. From this it seems clear that the moulds must have been assembled side-to-side rather than back-to-back. Also there are a number of surviving pieces which remain attached to one another in this way (see Fig.8). Further evidence comes from the packing pieces, many of which still have luting clay attached to them giving them a profile clearly matching that

Fig.5. Pieces of the packing clay which held a number of the moulds together into larger composites for casting. Remains of luting clay can be distinguished as a separate layer attached to the surfaces of the packing pieces giving them a cross-sectional profile matching the sides of the moulds where the two valves join.

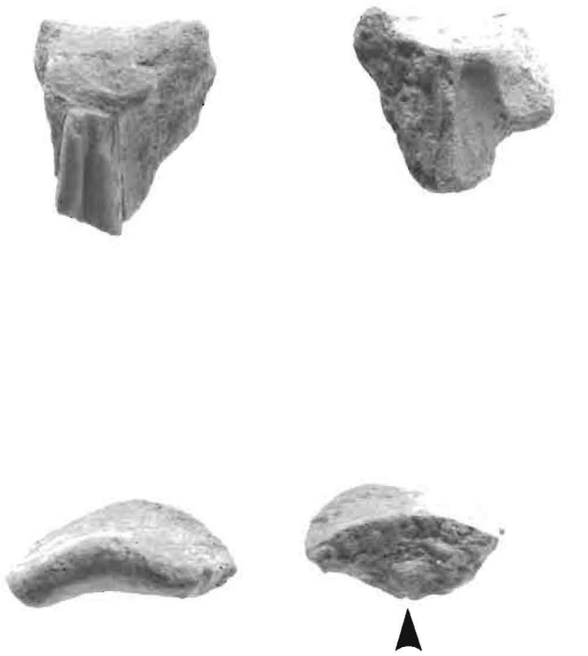

Fig.6. Fragments of sprue cup. The top two show that the cup was attached to the ends of the handles. Other pieces, below, viewed from above the cup show its circular form. The bottom right fragment still has a piece of handle mould attached. The groove of the handle can just be made out and is indicated by the arrow.

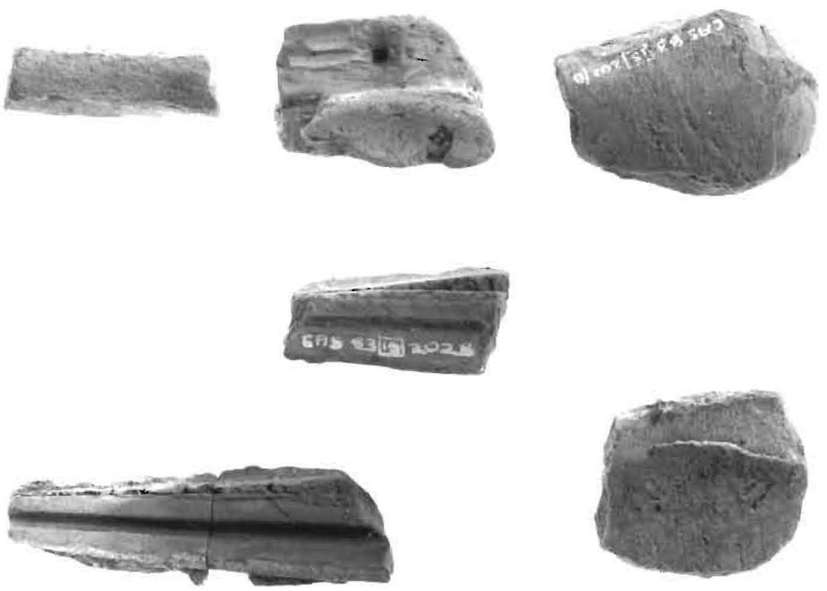

Fig.7. Various mould fragments showing the thin layers of extra clay that have been added to their outer surfaces. Fragments of thicker packing pieces remain attached to their sides.

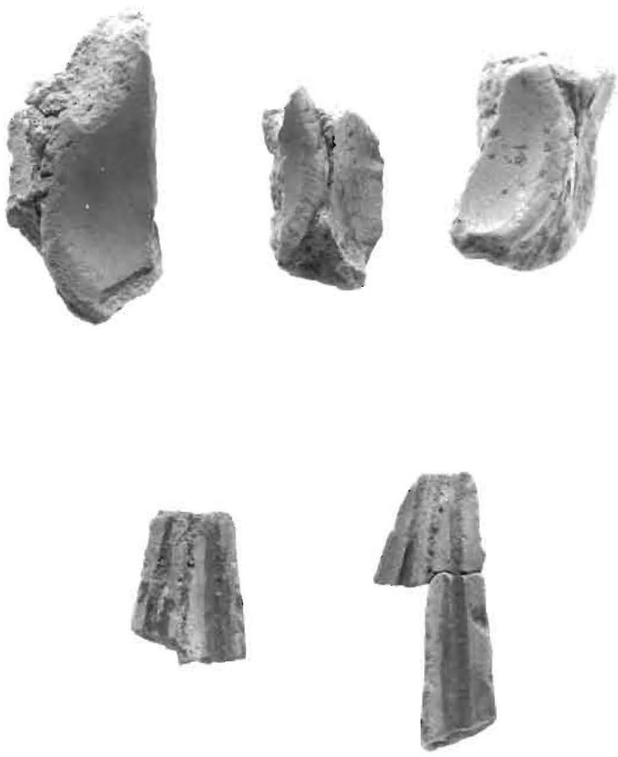

Fig.8. Mould fragments showing how the moulds were arranged into composites for casting. The top three fragments show that the bowls were arranged side-by-side. The bottom two show how the handle ends were grouped together.

of the sides of the moulds (see Fig.5).

From some of the mould fragments illustrated in Fig.8 it is apparent that the moulds were arranged in the composite so that the handle ends were close together. Other fragments, also illustrated in Fig.8, show that the bowls of the moulds were also virtually touching. The clay attached to some of the handle ends (see Fig.6) is shaped to form a sprue cup and it follows that having held the moulds together by extra, packing, clay a sprue cup was added to the apex of the array to receive the molten metal.

There is some debate over the form of the composite mould. One possibility is that the individual moulds were laid out in a "fan" with both the handle ends and the widest parts of the bowls touching (see Fig.10). Up to about six moulds could have been assembled in this way, but beyond this number the handles of the outermost moulds would have been off-set from vertical by angles greater than 30° and problems associated with the flow of the molten metal and the development of airlocks might be expected. Another problem with the fan construction would be the poor stability of the finished structure which would need to be supported during the casting operation.

An alternative arrangement would be to assemble the moulds in a similar way, with handles and bowls touching, but to angle them in a cone (see Fig.11) rather than laying them out flat. This would have advantages in terms of stability as well as allowing a larger number of moulds to be assembled into the composite.

A number of features noted in the mould fragments suggest that the cone-shaped composite is more likely to be the correct interpretation. Firstly there are the two surviving examples illustrated in Fig.8 (both from front valves) where the handle ends still remain joined to one another. In each case the mating surfaces of adjacent moulds meet at angles of $20\text{-}30^{\circ}$ (see Fig.9) and would have formed a circle (with the front valves innermost) to which a sprue cup was added. Given that other fragments (also illustrated in Fig.8) indicate that the spoon bowls were touching too, the overall shape of the composite mould would have been conical. Secondly it is notable that the remaining pieces of sprue cup (some of which are illustrated in Fig.6) indicate that it was roughly circular in form and not rectangular or oval, which would have been the case if the fan-shaped arrangement had been used. Thirdly the surface of the clay added to the handle tops on the back valves, presumably to support the sprue cup, indicates the composite was circular in shape (see Fig.6) and this too supports the idea that the handle tops were arranged in a circle. Finally no definite "end" spoons, where packing clay extended from one side of the spoon only, could be found.

Estimates of the number of moulds which were arranged into the cone-shaped composite have been made, based on calculations of the diameter of the supposed circle of handle ends. These calculations were made on the back valves by measurement of the curvatures of the surviving pieces of added clay and on the front valves by measurement of the angle at which mating surfaces met. Having determined the circumference of the circle of handle ends in this way the numbers of moulds in a composite could be

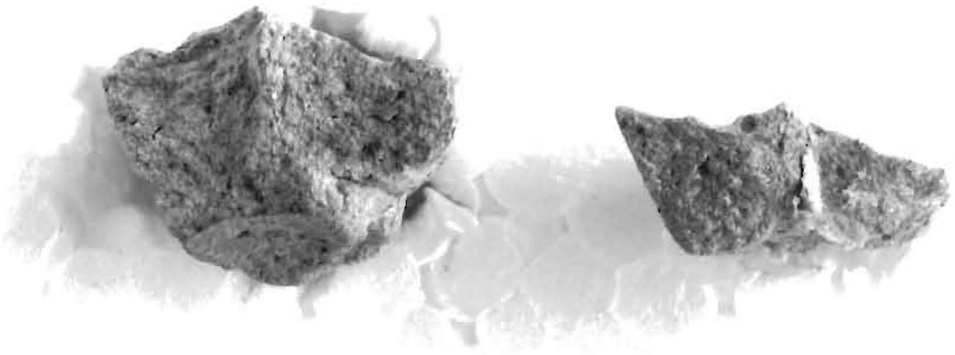

Fig.9. A cross-sectional view of the two fragments illustrated in Fig.8 showing that the mating surfaces of the moulds were angled at 20-30^{o} to one another.

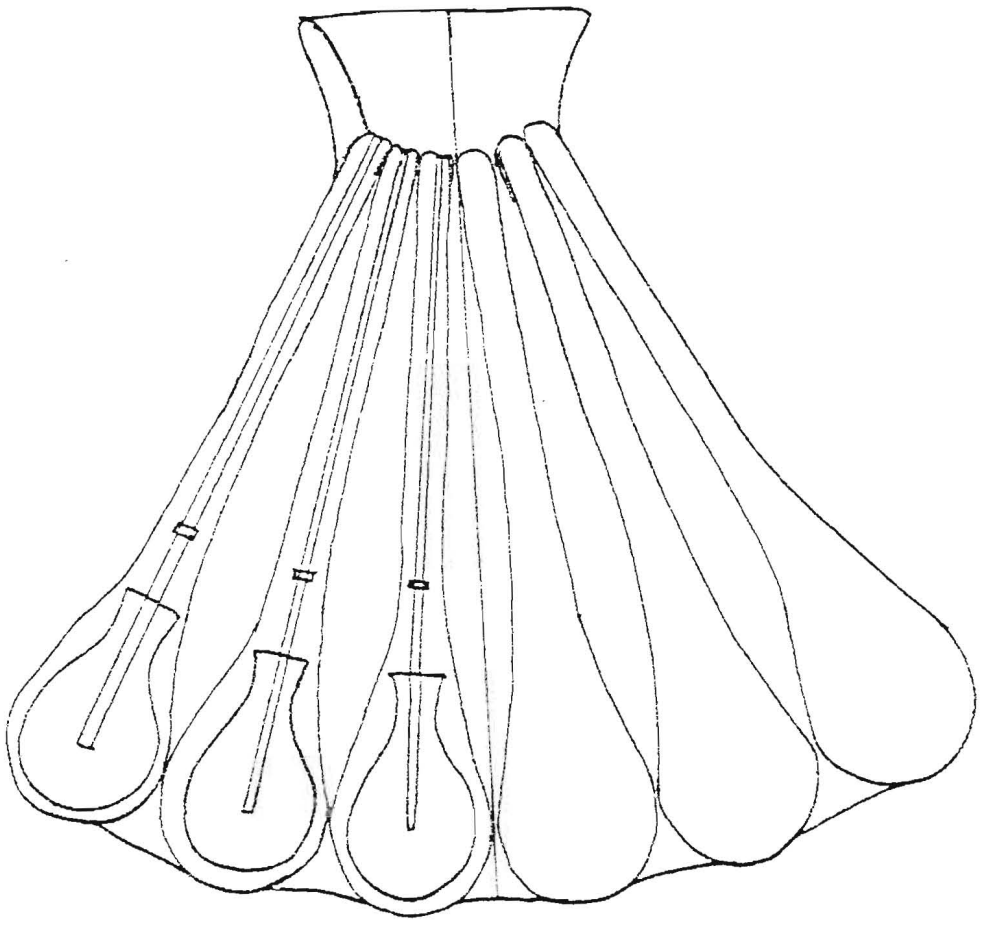

Fig.10. Reconstruction sketch of a fan-shaped composite mould incorporating six individual spoon moulds.

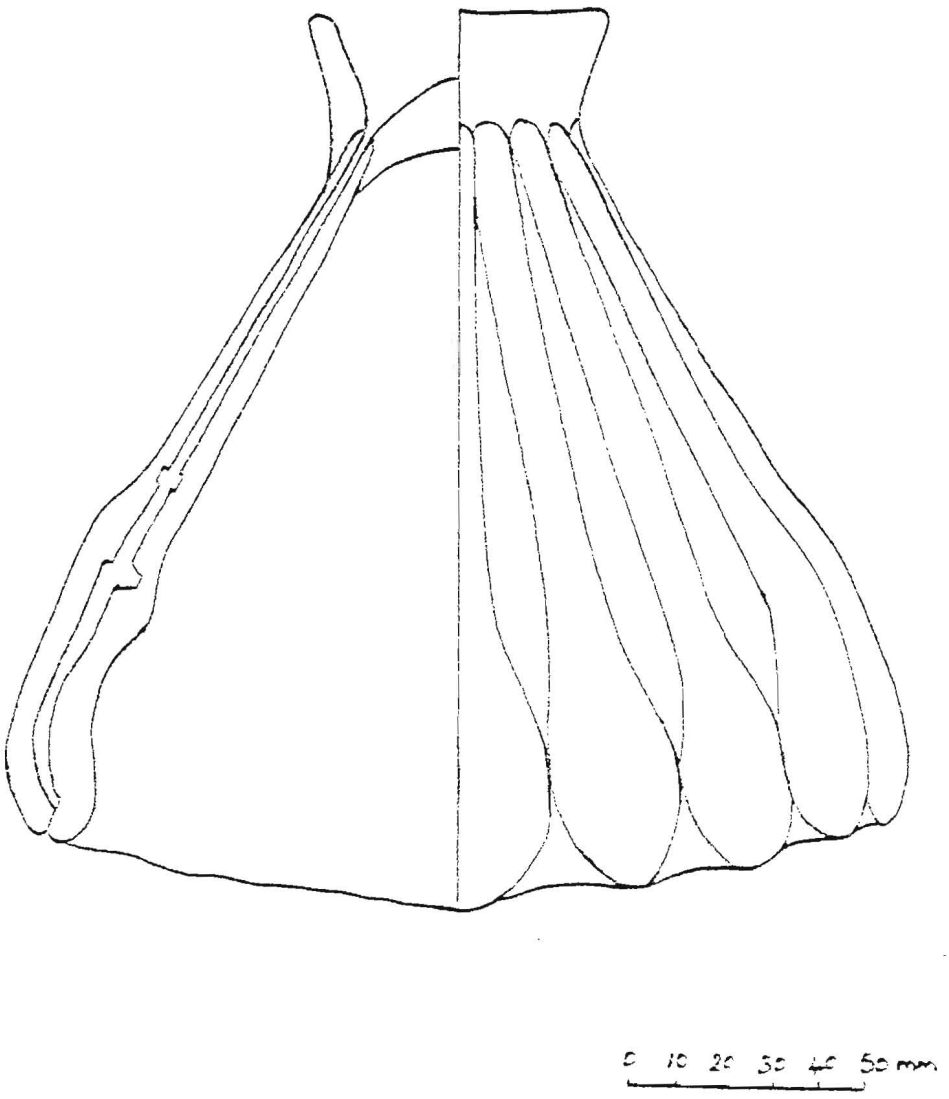

Fig.11. Reconstruction sketch of a cone-shaped composite mould incorporating 16 individual spoon moulds.

calculated from the known width of the moulds at the handle ends.

Estimates made in this way indicated that the number of moulds assembled in a composite lay between 8 and 18, the lowest estimate being made from the curvature of the clay attached to the back valve handle-end fragment illustrated in Fig.6 (bottom right) and the highest from the angle at which two of the front valve mating surfaces met. One estimate based on a combination of some of the most reliable measurements would put the total at 16, giving the composite mould a diameter of around 60mm at the sprue cup, 36mm for the circle of handle ends, and about 170mm at the bowls. This would present a maximum angle of about 30° from vertical for the molten metal during casting. The reconstruction illustrated in Fig.11 is based on these figures.

It must be stressed that these figures are no more than a rough guide to the numbers of moulds which may have been arranged in this way. There were only a few diagnostic fragments which displayed the features mentioned and these were too small for accurate measurement to be possible. In any case the calculations assume that all of the handles actually touched, that mating surfaces would always meet at exactly the same angle and that the composite was truly circular. In practice there would have been some variation and this was noted even in the few examples which had survived. It is these variations which produce the variations in estimated numbers of moulds in the composite; Fig.11 represents what is considered to be the most likely number.

Two mould fragments had traces of corroded metal on fractured edges, presumably where metal had run into cracks in the moulds. These were analysed qualitatively by energy dispersive X-ray fluorescence (XRF) and copper, tin, zinc, and lead were detected in significant amounts. The relative proportions of these elements indicate that the metal being cast was a leaded gunmetal, a quaternary alloy suitable for casting. Apart from these two fragments only very slight traces of metals were detected by XRF, enough to prove that the moulds had been used to cast non-ferrous metals, but too little to allow the sort of alloy in use to be determined. It is assumed that the two metal samples were representative of the alloy of which all the spoons were made.

Comparative material

Only one Roman spoon has been recovered from Castleford, a small circular-bowled cocleare (an early Roman type). This is a completely different form to the spoons which would have been produced from the Castleford moulds and is not connected with them.

As far as the moulds themselves go, they are so far unparalleled in the western Roman Empire. There is however some evidence for the manufacture of spoons at Augst in Switzerland where the back part of a two-part marble mould was found, as were four unfinished cast spoons (Riha & Stern 1982). Other unfinished metal spoons have been found in France (ibid) and recent excavations at Wroxeter have produced a failed casting made in a

two piece mould for a spoon with a leaf-shaped bowl (AM Lab No 786992). Aside from this there is some evidence for the production of bone spoons at Winchester and Woodcuts Common (Crummy, forthcoming).

Clay piece moulds were the normal type of moulds used for small objects in Roman Britain (Bayley, forthcoming) and in the 1st to 3rd centuries AD in the Roman provinces north of the Alps (Drescher 1973). What is unusual however is the assembly of these mould into composites. This is a facet of Roman mass production which has not previously been recorded in this country, perhaps because most of the finds of clay moulds have been restricted to small groups of fragments so that the evidence was not available.

Although no other examples of composite Roman spoon moulds are known, one composite mould intended for casting fibulae has recently been identified among the finds from a first century BC context at Bibracte, France (Beck et al 1982/3). The mould was unused and so remains almost complete. In this example the individual moulds were investment moulds, ie they were made by the lost wax technique. However there are similarities to the proposed Castleford arrangement in that the moulds (twelve in all) were assembled in a roughly conical shape with molten metal to be fed to each from a common sprue cup at the apex of the cone. Also, as with the Castleford moulds, no vents were provided. There are some differences in that the points of the moulds, where the molten metal entered, do not point towards one another but are connected to one another by means of a circular channel running around the top of the cone, a variant dictated by the dimensions of the individual moulds. Also, the brooches are not aligned with one another, however this is quite understandable since their orientation within the investment moulds was invisible and would in any case have been immaterial.

Conclusions

The spoon moulds from Castleford are, for the moment, unique but it should be borne in mind that it is not their manufacture, but their survival, which is unusual. Although around one hundred purse-shaped Roman spoons have been found in Britain (Bayley & Sherlock 1986), most of which were cast, none exactly match those from the Castleford moulds. Given the large numbers of small Roman cast metal objects which do survive one might expect large quantities of moulds of all sorts to be found. That they are not is due in part to the sorts of sites chosen for excavation but more to the inate fragility of clay moulds. They are not normally as well fired as pottery so their soft fabric combined with their odd shapes makes them liable to breakage and disintegration.

There is no evidence that the moulds were used more than once. The saving of the small amount of effort required to shape a piece of soft clay around the model spoon would not have justified the increased danger of a re-used clay mould fracturing and spoiling the casting. The two part construction of the mould was simply to allow the removal of the model spoon. After use the moulds would have been broken open to remove the casting and the

fragments discarded. Even if the two valves had been carefully separated, the fine surface detail of the mould would probably have been damaged in removing the casting, making it impossible to re-use it.

The friable mould fragments would not have lasted long on the workshop floor so the survival of so much material on this site must have been due to the deliberate dumping of the fragments into the pit soon after their use. There is little sign of abrasion or weathering on the majority of the fragments.

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