

Ancient Monuments Laboratory  
Report 126/91

EVIDENCE FOR METALWORKING FROM  
PIT 157, SITE 25296, THETFORD,  
NORFOLK

Justine Bayley

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Summary

The contents of a late 12th/13th century pit included about 20 kg of fragments of litharge cakes, evidence for the refining of silver by cupellation, as well as a few pieces of slag. There were also 9 sherds of crucibles, some with traces of silver and copper alloy, 6 sherds re-used as cupeis and one sherd from a parting vessel.

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The main bulk of the finds were about 20 kg of fragments of litharge cakes, evidence for silver refining. In addition 18 'crucible' fragments, eight pieces of hearth lining and two lumps of smithing slag were also found. Two of the pieces of hearth lining carried traces of a tuyère hole, where the air from the bellows entered the hearth; their diameters were about 2 and 3 cm respectively.

The deposits on the 'crucibles' were analysed qualitatively by X-ray fluorescence (XRF). They included two lead-glazed potsherds, one fragment of a parting vessel (evidence for the separation of silver from gold (Bayley 1991A)), pieces of six sherds with thick, lead-rich vitreous deposits in them that had probably been used as cupels for assaying silver, and nine sherds from metal melting crucibles. One body sherd (from layer 150) was from a crucible that had been used to melt a lead-containing copper alloy and a rim sherd with a pouring lip (sf9, from layer 17) was from one that had been used to melt silver. The metal traces on the other crucibles were only slight and the nature of the metal melted could not be deduced from the analytical results. One crucible sherd (from layer 152) had extra clay added round the rim and built up into a bar across the pouring lip which would have held back any slag floating on the metal melt; similar features have only previously been recognised on Saxo-Norman crucibles from London (Bayley et al 1991, Nos 10, 19 and 20).

The litharge fragments are parts of roughly circular, concavo-convex 'cakes' which typically have diameters of around 15 cm. Many had a central depression in the upper, concave side, about 5-8 cm in diameter. Most of the cakes were about 2 cm thick near the rim and 1 cm thick in the centre. They were mid grey in colour and were noticeably heavier (denser) than slags normally are. XRF analysis detected large amounts of lead together with lesser amounts of copper and traces of silver, but the latter was only found around the edge of the central depression. Further analysis of a polished section through one cake using an XRF analyser attached to a scanning electron microscope also detected calcium and phosphorus in significant amounts.

Silver was refined by the process known as cupellation. The impure metal was melted with an excess of lead and heated under oxidising conditions. The lead was oxidised to litharge (PbO) which acted in two ways. It reacted with the base metals (eg copper) mixed with the silver, oxidising them, and also reacted with these other metal oxides, forming fusible compounds (Percy 1870) which then separated from the melt. Silver does not react with litharge and so is left behind when all the base metals have been oxidised and removed. Cupellation can be carried out on both large and small scales, depending on the quantities of metal involved. Where amounts are large a special hearth, lined with bone ash, was constructed. Bone ash (calcium phosphate) was used as it absorbs litharge; fired clay or other silica-rich materials react with the litharge to form a vitreous slag.

The litharge cakes are parts of these bone ash hearth linings that have absorbed copper-containing litharge. The central depressions on their upper surfaces are marks of where the purified silver solidified in the hearth which explains its presence round the edge of the depression where it may have been physically trapped in the solidifying litharge. On some cakes this rim area has been carefully cut away; presumably more silver than normal had been trapped and was reclaimed by re-cupelling these parts of the litharge cakes.

At the other end of the scale, small amounts of silver were tested for purity (assayed) on shallow dish or disc shaped vessels known as cupels. Sometimes, as here, potsherds were used as makeshift cupels; they can be recognised by the thick, lead-rich vitreous deposits on their upper (concave) surfaces.

Both litharge cakes and potsherds re-used as cupels are known in the late Saxon period (Bayley 1991B). The late 12th or 13th century date of this pit group suggests similar technologies continued in use beyond the end of the 11th century.

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