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Limoges painted enamels: evidence for specialist copper-smithing workshops

Susan La Niece, Stefan Röhrs, Dora Thornton and Antony Simpson

Summary French enamellers active in Limoges during the late fifteenth to the early seventeenth century were noted for their fine painted scenes taken from classical mythology and Christian traditions. The forms made in the Limoges workshops included plaques, plates of various sizes, ewers and ewer stands, salt cellars, candlesticks and footed bowls, all of which were intended to be decorative rather than functional.

Instead of the more obvious painted enamel surfaces, this study examines the metalwork of these vessels. The metal, entirely hidden beneath the enamel, is generally of sheet copper. While the study of damaged objects reveals constructional features, X-radiography of unaltered enamels, complemented by examination using a microscope and boroscope, has made it possible to understand the construction of the more complex shapes. The methods used to join the components are quite unlike those seen in sheet metalwork that was not intended for enamelling, and are partly explained by the need to avoid solder, which could not survive the temperatures of the multiple enamelling stages. The crudeness of the metalwork is in stark contrast to the quality of the enamelling and some very unusual and ingenious means were employed to conceal the mechanical joins in hollow feet. It is likely that the difficulties of the enamelling process led to many failures and rejects, making it uneconomical to invest time and effort in making the metal forms, although one common feature is that the metal was consistently kept as thin as practicable to minimize the adverse effects of differential expansion and contraction during firing and cooling. These observations lead to the conclusion that there were specialist metal workshops that were mass-producing copper forms specifically for enamelling.

INTRODUCTION

This study developed from a collaboration between the British Museum and the Wallace Collection. The important collection of Limoges painted enamels at the Wallace has recently been catalogued by Higgott [1], and scientific analysis and X-radiography of some objects from that collection were carried out by two of the authors (SLaN and SR) at the Department of Conservation and Scientific Research at the British Museum.[1] The results of these scientific studies raised some interesting questions about the metal substrate to the enamel and encouraged further work on objects selected from the extensive collection of these enamels at the British Museum.

It was in Limoges in central France that the traditional craft of enamelling on copper entered a new dimension from the late fifteenth century. Instead of being engraved or channelled out to take the enamel, the whole copper surface was carefully treated and painted like an artist's canvas. The first works were small plaques painted with religious subjects that were probably intended for private devotion, good examples being two plaques (1922,0707.1 and 1913,1220.28) in the British Museum, signed by Léonard Limosin and dated 1536, that show scenes from the life of St Anthony Abbott [2; p. 40 and Plates 16, 17 and 39]. Both plaques also bear the arms of Jean de Langeac, a powerful figure at the French court who had served as ambassador to Francis I and as councillor to Henry II of France; he was also Bishop of Limoges from 1533 to 1541. It is de Langeac who is credited with introducing this new art form to the French court and for helping to promote Léonard Limosin to the role of 'peintre émailleur et valet de chambre du roi' in 1548 [2; p. 16]. Surviving pieces and contemporary inventories demonstrate that Limosin's works, and those of other enamellers, were to be found in royal chapels and palaces from the mid-sixteenth century, not just in France but in England, at the court of Henry VIII [3; pp. 29–30, 4].

Among other technical advances, two changes occurred in the 1530s. The first was the introduction of the sophisti-

cated grisaille technique, with white painting layered on a dark ground. The second was the production of more elaborate copper forms, including ewers, footed bowls with covers, candlesticks, table fountains and salts of various shapes. These were made from copper elements joined together in the manner discussed in this contribution. The surfaces would be unified through the application of a base enamel layer, usually mulberry-coloured or blue, before being painted and gilded to create a rich effect that completely concealed the copper structure beneath.

Painted enamel enjoyed its greatest prestige in the mid- to late-sixteenth century. Large workshops developed to cope with increasing demand in France and beyond for this new and innovative technique. The enamelling industry was important to the export trade of Limoges. Family names such as Pénicaud, Limosin and Reymond are found repeatedly in documents in the Limoges archives recording the activities of craftsmen in related fields, such as goldsmiths' work, painting and illumination or engraving; for example, Léonard Limosin is known to have worked as a painter and engraver as well as an enameller [2; pp. 22–25], and Pierre Reymond as an illuminator and designer of stained glass and liturgical silver [3; p. 82]. Many of their enamelled products are signed and dated, while other pieces can be attributed to particular enamellers or workshops on stylistic grounds alone. In addition, it is often possible to identify the woodcuts and engravings that served as source material for the narratives and ornamental designs on these enamels [5; pp. 24–32].

Following the French Revolution there was a nostalgic revival of interest in Medieval and then Renaissance French art, and painted enamels were avidly collected, particularly in Paris [6; pp. 9–12, 7, 8]. Painted enamels were highly placed in the aesthetic hierarchy of decorative arts and fetched high prices on the art market [9]. Plaques were put into modern frames, damaged sections of complex forms were repaired, covered over or replaced with modern elements to meet demand and pieces were even faked. The repairer Simon-Émerique Pierrat was a known specialist in this area, employing the skills of enamellers in the Sèvres porcelain manufactories until he was unmasked as a faker in a famous court case involving the Rothschilds in 1859 [10]. His pupil Alfred André (1839–1919) went on to handle and repair most of the important pieces on the art market and in private collections. André is known to have worked on enamels belonging to Baron Ferdinand Rothschild that are now in the British Museum; his technique of replacing whole damaged areas of old enamel with new, fired plaques has been studied by Tait and Freestone [11]. A casket set in the Waddesdon Bequest with enamels by Suzanne Court demonstrates André's method and his alterations can be dated to the mid-1880s [11].

The British Museum's collection of painted enamels was formed by Augustus Wollaston Franks from the 1850s onwards. Apart from pieces collected by Franks himself, or acquired for the British Museum at major auctions such as the Fountaine Sale of 1884 (see the ewer analysed below), it comprises mainly two collections [12]. The first and most important is that of Baron Ferdinand Rothschild, known as the Waddesdon Bequest, which was left to the British Museum in 1898. The second major collection is that of the Reverend A.H.S. Barwell, bequeathed to the Museum in 1913. Neither collection has been catalogued in full, although records for each piece, along with all available images, can found in the *Collection Database* on the British Museum website.[2]

The techniques and materials used to produce the enamelled decoration have attracted the interest of researchers and analysis has already begun to establish the recipes used by the enamellers [13–17]. Less attention has been paid to the metal substrate onto which the enamel was applied. Freestone and Lang examined a ewer in the collections at Waddesdon Manor using X-radiography, noting that the metal body was made in several sections joined by wires [18]. Recently, Speel carried out a more extensive technical study of Limoges painted enamels of the Grünen Gewölbe (Green Vault) in Dresden [19]. She described the construction of a slightly unusual ewer that was undergoing restoration; here, the use of wire ties was combined with tabs inserted through slots, particularly to attach the foot. In addition, an examination of damaged objects by Beillard revealed several techniques that had been used to assemble enamelled dishes and cups and drew attention to changes in these methods between the earlier enamels and those of the seventeenth century.[3]

RADIOGRAPHY AND ITS INTERPRETATION

X-radiography was carried out at exposures ranging from 10 mA minutes at 75 kV to 40 mA minutes at 90 kV, depending on the size and density of the object. The images were recorded on Agfa D4 or D7 radiographic film and scanned digitally at a resolution of 50 μm. The scanned images were processed in Adobe Photoshop to enhance the images to a publication standard, but without adding or subtracting any features seen on the films. Dense areas appear pale in the X-radiographic images; the lighter the shade the more dense the feature. The factors contributing to the density are thickness of the materials and the nature of the materials themselves. For example lead- and tin-containing white enamels appear pale on these images, but although gold absorbs X-rays strongly, it was applied so thinly to the enamels that it is not visible on the X-radiographs.

To understand the X-radiographic images it is necessary to allow for the superposition of the images from the enamelling on the front and back of the object and, of course, for the features of the metal base-plate that also appear on the image. Often a shadow image of the painting, or the 'bubbly' texture of the enamel, can also be seen in the X-radiograph.

FIGURE 1. Painted Limoges enamel salt cellar decorated with the follies of wise men; attributed to the enameller Pierre Reymond: height 7.1 cm. Donated by A.W. Franks in 1888

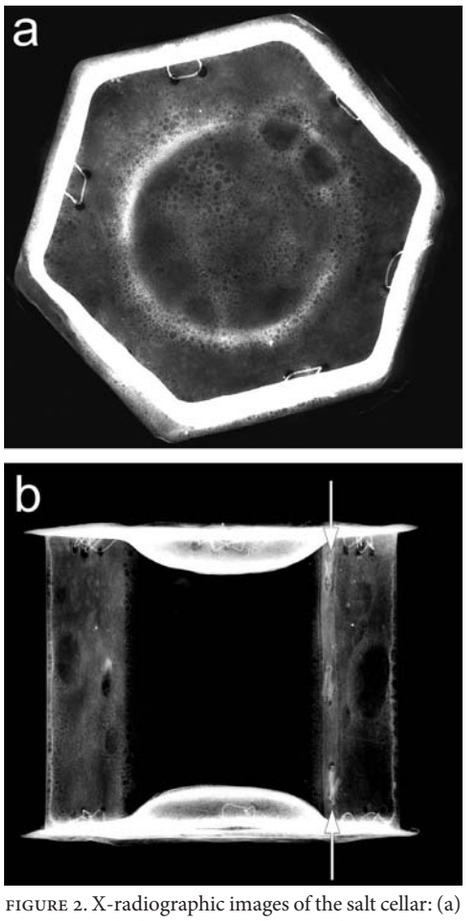

FIGURE 2. X-radiographic images of the salt cellar: (a) top view and; (b) side view showing the strip metal 'stitches' running down the side (marked with arrows) and the thin wire loops (white) threaded through holes in the top and bottom to hold them in place

Salt (1888,0705.1)

This hexagonal salt cellar is enamelled in grisaille with touches of green, mauve and blue and shows the follies of wise men with their names inscribed and details in gilding, Figure 1. It is dated 1542 and, although unsigned, is attributed to Pierre Reymond.

The X-radiograph in Figure 2 shows that the metal body of this salt is constructed from three pieces – the top and bottom were cut to shape from flat sheet metal and a circular depression hammered in the centre of both the top and bottom. The sides were formed from a single sheet, which was pierced with small holes where its ends overlap at the join, and thin strips of metal threaded through to 'stitch' it together. The top and bottom of the salt were secured to the sides with thin wires (that appear white in the X-radiograph) threaded through holes in the metal and tied off on the outside. The final enamelling hides the wires but slightly raised areas in the enamelled surface reveal their positions. The mottled, bubbly appearance in the X-radiographic images can be attributed to the enamel or counter enamel rather than to the metal.

Ewer (1885,0420.17)

This mid-sixteenth century ewer is enamelled in black, white and blue with details in gilding, Figure 3. The grisaille scenes illustrate the theme of Charity, complemented by texts from chapter 58 in the Vulgate version of the Book of Isaiah. It is signed 'PR' in gold on the handle and lip for Pierre Reymond. Unidentified arms enamelled on the lip

FIGURE 3. Ewer with scenes from Isaiah illustrating the theme of Charity; attributed to the enameller Pierre Reymond: height from base to top of handle 32 cm

of the ewer may be those of a religious confraternity rather than an individual patron. This ewer was in the Fountaine Collection at Narford Hall in Norfolk, where it was listed in the 1835 inventory, and is incised with a Fountaine collection mark 'af 10' under the foot. It was sold to the British Museum at Christie's on 18 June 1884 (lot 285) [20].

The X-radiograph of this ewer reveals a complex construction underneath the enamel, with the metal form composed of six main components, Figure 4. The body has three components: the neck, shoulder and bowl. A hollow D-sectioned handle, made of two strips folded together along their length is attached to the top of the neck and to the shoulder. The foot is hollow and flaring and, like so many similar ewers, there is some damage and restoration to the enamel where it joins the body. However, the X-radiograph shows the constructional features to be relatively well preserved. This ewer, like other Limoges pieces with narrow hollow bases (see also the footed bowl below), has an enamelled disc inserted part-way up the foot, presumably to conceal an unattractive mechanical join. The X-radiograph in Figure 5 shows a mushroom-shaped disc at the bottom of the ewer, although this was not visible on examination of the cavity with an Olympus Maj-522 boroscope, as it is apparently well covered by the counter-enamel layer on the interior. The boroscopic examination of this area revealed no evidence of damage, inferring that this mushroom-shaped disc is part of the original construction. How the disc functions is not, however, clear. There are no signs of tabs of the type seen on the foot of the ewer

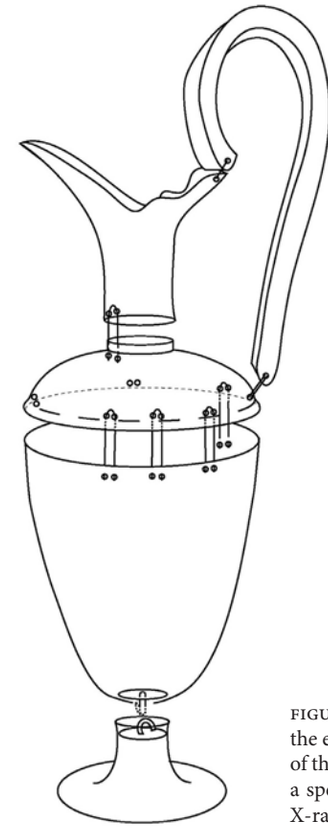

FIGURE 4. X-radiographic image of the ewer and an exploded diagram of the metal construction based on a speculative interpretation of the X-radiographs

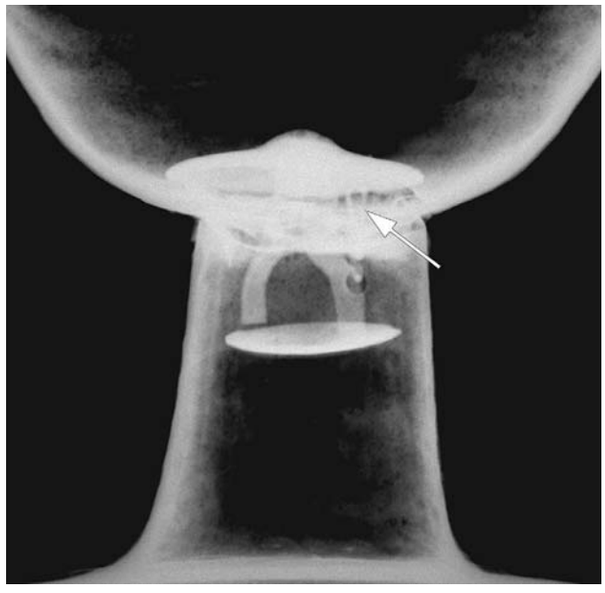

FIGURE 5. Detail of the X-radiographic image of the foot of the ewer showing the two discs with metal strips between them and what may be fine wires (marked with an arrow)

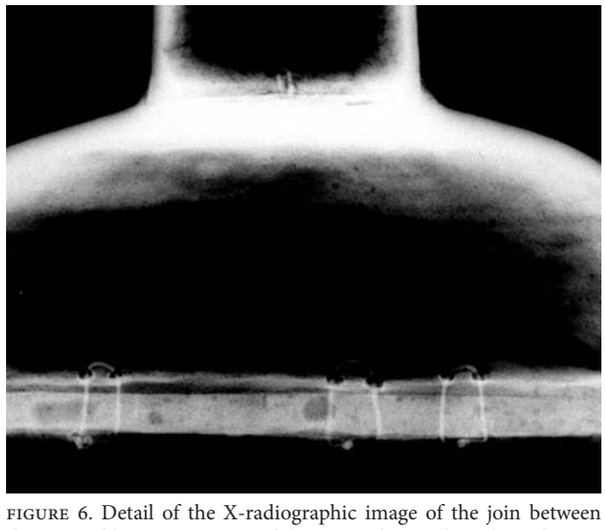

FIGURE 6. Detail of the X-radiographic image of the join between the top and bottom sections of the ewer. The overlap where the two sections fit together appears as the pale band across the image. The wire (white) is threaded through the pair of holes in the upper section and re-emerges from the pair of holes in the lower section, where the ends of the wire were twisted together. All this is now concealed on the exterior by enamel

examined by Speel, although there are fine white lines on the image that may indicate the presence of strands of wire threaded between the foot and bowl of the ewer. The mushroom-shaped disc has a projection from its centre that seems to protrude through the bottom of the ewer and connect in some way to the curved strip of metal apparently attached at one end to the disc in the foot. A ewer from the Wallace Collection (IIIF 265), also attributed to the enameller Pierre Reymond, has an enamelled disc in the foot, with two curved strips of metal on the back, but the bottom of the Wallace ewer has been repaired, obscuring the constructional features

FIGURE 7. Images from the boroscopic examination of the counter-enamelled interior of the ewer showing details along the join between the shoulder and lower body. In each case the dark horizontal feature is the leakage of the exterior enamel along the join: (a) the wire loop can be seen emerging into the cavity through two holes in the shoulder section of the ewer, and passing back through the top edge of the lower part of the body; (b) close-up of the wire loop, showing the exterior enamelling seeping in through the top holes; and (c) a wire loop, arrowed bottom left, and the wire joining the bottom of the handle to the ewer shoulder, arrowed top right. The counter-enamelling almost covers this join

that appear in the X-radiographic image. Further examination of undamaged ewers is needed to give more information about the original structure of such joins.

The joins between the other components are easier to understand. An X-radiographic detail of the join line between the shoulder and the lower half of the ewer body shows the wire ties threaded through holes in the copper, Figure 6. Examination of the interior of this ewer with a boroscope fed through the narrow neck (Figure 7) confirmed that the wires were threaded into the cavity through holes in the shoulder and back to the outside through holes in the lower section of the ewer. They were twisted into a knot on the outside and the surplus wire clipped off.[4] The handle was also attached by the same means, but with a double wire to attach the bottom of the handle and two single wires to attach it to the top of the neck.

Footed bowl or tazza *(WB 36)*

This mid-sixteenth-century footed bowl (Waddesdon Bequest 36) is painted in black, white and salmon pink with details in gilding, Figure 8.The grisaille enamels show scenes from the story of Jacob including his dream and ladder to heaven. This *tazza* is inscribed 'I.C.' and attributed to Jean de Court.

It can be seen from the X-radiographic image (Figure 9) that the hollow flaring foot does not quite touch the bottom of the bowl. The connection between the two is via a cylinder of metal concealed inside the foot and locked in place by a metal rod that was pushed through both the foot and the internal cylinder, Figure 10. The two ends of this rod are visible where they emerge from the foot and this feature has been noted on all bowls with a narrow foot that have been examined in the British Museum and the Wallace Collection. The X-radiographs of this footed bowl and other similar objects suggest the following sequence was followed for assembling the foot and the bowl (see Figure 9):

1. A cylinder, to fit inside the foot, was made by bending sheet metal and joining it with 'stitches' of thin strips of metal down the side. The top edge of the cylinder was cut to leave four protruding tabs. These tabs at the top of the cylinder were pushed through four slots at the centre of the metal bowl and folded flat.
2. Holes were made through the metal foot and the inner cylinder, to be fully aligned with each other once the foot was in position.
3. The bowl was painted and fired, perhaps using the cylinder as a support in the kiln. The foot and disc were painted and fired separately.
4. With the bowl inverted, the foot was placed in position over the cylinder with the holes aligned.
5. The enamelled disc was inserted into the bottom of the foot to conceal the interior construction. The purpose of the loop on the back of the disc is enigmatic but as it seems to be a feature of all such discs and has no obvious structural function, it may have been to assist in assembly. It is suggested that a fine wire may have been threaded through the hole in one side of the foot and cylinder, through the loop on the disc and finally back through the hole in the other side of the cylinder and foot. By pulling both ends of the wire, the disc could have been drawn up into the foot, sealing the opening and concealing the unattractive mechanical join between bowl and foot;
6. The whole assembly was secured by pushing the rod through the holes in the foot and cylinder and a final firing of the enamel bonded the disc in place.

FIGURE 8. Footed bowl (*tazza*) with scenes from the story of Jacob; attributed to the enameller Jean de Court: bowl diameter 25.1 cm. Waddesdon Bequest 36

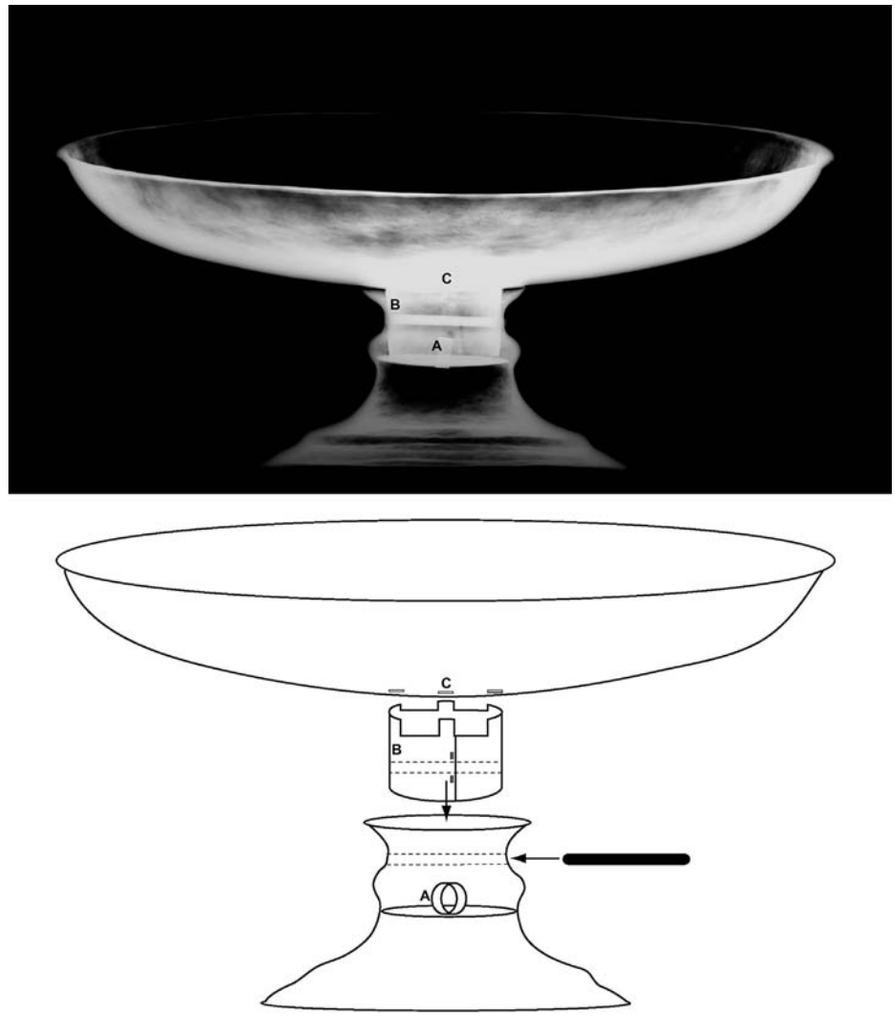

FIGURE 9. X-radiographic image of the footed bowl (note that the hollow foot does not quite touch the bottom of the bowl) and an exploded diagram of the metal construction as interpreted from the X-radiographs: 'A' is the enamelled disc with loop; 'B' the metal cylinder with stitched seam; and 'C' the bowl pierced by four slots to take the four tabs on the top of the metal cylinder

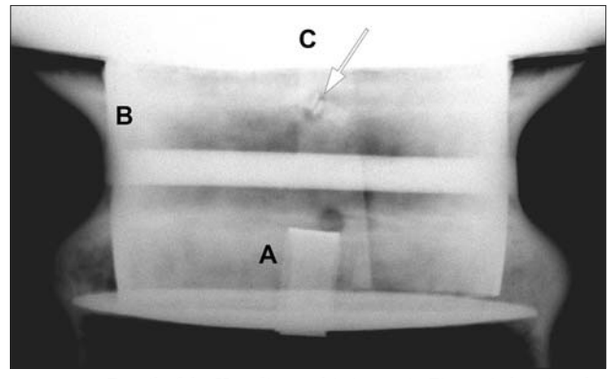

FIGURE 10. Detail of the X-radiographic image in Figure 9 showing the foot of the bowl. The 'stitched' join of the internal cylinder is marked with an arrow. The metal rod is pushed through both the cylinder and the outer foot, locking the construction in place, but does not engage with the loop on the back of the disc set inside the foot

This sequence is speculative, particularly the means of fitting the disc. On the X-radiographs there is nothing visible attached to the loop on the back of the disc and it is not in contact with the rod or the base of the bowl. There may be a material that is transparent to X-rays, such as thread, still inside the foot; alternatively, whatever was used may not have withstood the final firing of the enamel. This proposed scenario would account for the otherwise unsupported disc staying in place and also explains why so many of these discs have a loop or similar feature on the back. A wider study of more such bowls may help to clarify this point.

THE EVIDENCE FOR MANUFACTURE OF THE COPPER FORMS

Recent studies of the post-mortem inventories of enamellers in Limoges workshops of the sixteenth and seventeenth centuries show that they did not own tools for working copper, but mention instead copper blanks ready to cover with enamel. One inventory of 1675 lists 'various pieces of red copper of various forms ready to be made up and covered in enamel' ("diverses pièces de cuivre rouge de diverse façon à mettre en oeuvre et couvrir d'émail") [21]. Furthermore, although in the Middle Ages the professions of enameller and fine metalworker seem to be indistinguishable, by the end of the sixteenth century named enamellers are not the same as named fine metalworkers, although they often belonged to the same family [21]. It is therefore likely that each workshop would have had its own, probably local, supplier of blanks. Much the same differentiation between potters and painters or decorators is found in tin-glazed ceramic workshops in Nevers in the late sixteenth and early seventeenth century [12; p. 551, 22].

It is not known where the copper came from, but it had to be pure copper, *cuivre de rosette*, to be suitable for enamelling. Earlier Limoges workshops are thought to have used French copper, whereas it has been suggested that the sixteenth-century workshops used Spanish New World copper traded along the pilgrim route to Santiago de Compostela, which runs close by Limoges [3; p. 18, 23]. Alternative sources of supply were England, via the port of La Rochelle, or Germany, via Lyon [21; p. 164]. What is striking, as this technical analysis shows, is the relative crudeness of the workmanship of the copper forms in contrast to the skill of the painted enamel decoration that covered them. An exception to this rule is illuminating. The leading Limoges enameller of the mid-sixteenth century, Pierre Reymond (two of whose works are analysed here), made a group of cups, a ewer and footed dishes for the Nuremberg patrician and merchant Leonardt Tucher, all of which were decorated with his arms impaling those of two successive wives. The ewer is unusual in shape and differs from the conventional Limoges forms, and this is because the leading Nuremberg goldsmith, Wenzel Jamnitzer, was commissioned to make the copper forms. These were sent to Limoges via Tucher's office in Lyon to be decorated by Pierre Reymond in his workshop in Limoges, before being sent back to Nuremberg for further embellishment in silver by Jamnitzer [24]. The correspondence from 1561 between Leonardt Tucher and the Lyon office suggests that the commission was not without its difficulties [7, 25, 26]. The enamellers refused to work with the copper forms as they were too thick to be enamelled and suggested that they should thin the dishes by beating. But this was not possible in the case of the ewer, which it would not have been possible to thin, since the parts would then no longer fit together.[5] The story of this commission suggests that Tucher had Nuremberg forms and fashions in mind for this special commission, in line with the latest goldsmiths' designs and craftsmanship. Those pieces from the Tucher set that survive, which are now in Nuremberg and Munich, are indeed distinctively different from the rest of Limoges production, primarily due to the forms of the copper blanks for the ewers. The significance of the thickness, or rather the thinness, of the metal required for enamelling is of interest here. In Speel's study of the Dresden enamels [19; p. 156], the thickness of the metal was on average about 0.7 mm, with the edges often even thinner, which was also found to be the case for the salt and ewer examined here. Keeping the metal as thin as practicable helps to minimize the problems caused by differential expansion and contraction of metal and enamel during firing and cooling.

The assembly methods seen on the Dresden ewer have clear similarities to those for the British Museum and Wallace Collection ewers, but there are also differences: double twisted wires were used on the Dresden ewer, while single wires were found on the British Museum ewer; and the feet of both the Dresden ewer and British Museum *tazza* were attached by tabs, while the foot of the British Museum ewer has no tabs. It may be that different workshops favoured different methods or, as suggested by Beillard, the methods developed over time.

CONCLUSIONS

The metal forms for these enamels have two main characteristics. First that the metal is thin enough to minimize the differences in thermal expansion between copper and enamel. The Tucher correspondence confirms that this was essential to the enamelling process and that the conventional forms made in a leading goldsmith's workshop were unsuitable. The second rule is that all the joins must be purely mechanical. This can be explained by the need to avoid solder, which would melt at the temperatures required for the multiple enamelling stages. However, even taking into account these two factors, the crudeness of the metalwork is in such stark contrast to the quality of the enamelling that it requires a little more explanation.

Thin sheet metal objects with mechanical joins are known from the earliest times and are by no means always

crude. It would seem that the methods of constructing the metal forms seen here are very specific to enamelled work. The metal components needed to be tightly fixed together to avoid movement during the enamelling process and the use of wire, metal strip and tabs to hold them together appears to have been successful in this respect, although the finished objects are still vulnerable to the stresses of handling, as can be seen from the number that are now damaged and restored. It is likely that the difficulties of the enamelling process led to many failures and rejects, so that it was not worth investing time or material in making the metal bases when the enamel would later be applied thickly enough to mask the uneven surface of the joins. An example can be seen from the pair of salts in the Wallace Collection (IIIM 260 and 261), where the sides of one of the hexagonal salts exhibit a stitched seam similar to that on the British Museum salt discussed above. The second salt of the pair has not just one, but two stitched seams; although the piece of copper was too short it was not discarded, but another piece was stitched on to avoid wastage [1]. It is already established that at this period the metalworkers supplying the Limoges industry constituted a separate profession from the enamellers. The observations from this study lead to the conclusion that these were specialist metal workshops that were mass-producing forms with a construction and thinness specifically suited for enamelling. However, the number of these metal workshops and how the distribution of the copper forms to the enamellers was organized remain unclear. The minor differences in joining methods seen between the very few objects that have so far been examined in depth may offer means of grouping the metalwork, if not in terms of workshops, at least in terms of date. The examination of more such enamels may well provide rewarding insights into workshop practices for the Limoges painted enamel production.

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AUTHORS

Susan La Niece (slaniece@thebritishmuseum.ac.uk) and Antony Simpson (asimpson@thebritishmuseum.ac.uk) are scientists in the Department of Conservation and Scientific Research. Stefan Röhrs (roehrs.stefan@gmail.com) is a scientist at the Rathgen-Forschungslabor of the National Museums in Berlin and was formerly a scientist at the British Museum. Dora Thornton (dthornton@thebritishmuseum.ac.uk) is a curator in the Department of Prehistory and Europe at the British Museum.

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NOTES

1. Isabelle Biron and Thierry Borel also carried out scientific examination and X-radiography on other objects from the Wallace Collection at the Louvre laboratories, see Higgott [1].
2. www.britishmuseum.org/research/search_the_collection_database.aspx (accessed 31 March 2009).
3. Béatrice Beillard has presented her research into the construction techniques in as yet unpublished papers given at the conferences *Les émaux peints limousins: au cœur des arts décoratifs de la Renaissance* in Limoges, 22–24 September 2004 ('Les assemblages des pièces de forme') and *Conservazione e restauro degli smalti su metallo*', at the Villa Medici in Rome, 10–11 March 2008 ('Conservation contributions in the study of enamelled services').
4. Janet Lang interpreted the 'bubbly' appearance of the medial join on the ewer from Waddesdon Manor as an indication of the presence of a hard solder. However, the presence of solder seems inherently unlikely and a comparison of the X-radiographic images suggests that the bubbly appearance is attributable solely to the enamel.
5. Netzer [7; p. 21] cites the letter from Herdegen Tucher in Lyon to his father Lienhard (Leonardt) Tucher (after Grote [25], which is in turn based on Hampe [26]): "Was die Schalen und die kupfernen Vasen angeht, die Eure Weisheit hierher gesandt, um sie nach Limoges zu schicken, damit [sie] dort geschmolzenes Werk wie sie es in Brauch haben, darauf machen – so ist das Kupfer zu dick und nicht dünn genug geschlagen worden. Sie wollen die vir Schalen dort dünner schlagen und auf ihnen arbeiten. Aber mit der Vase geht es nicht, wenn sie diese dünner schlagen ließen, so würden die Stücke nach Aufbringung der Emaille nicht mehr aufeinander passen."