Article: Mina'i wares: Discovery of a 13th century Islamic ceramic transfer technology
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MINA'I WARES: DISCOVERY OF A 13th CENTURY ISLAMIC CERAMIC TRANSFER TECHNOLOGY

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Mina'i polychrome ceramics were made during the 13th century in Iran. They are characterized by their almost white body; most probably of fritware composition. Glazed most often with an opaque white glaze, the wares are sometimes glazed with other colors such as turquoise or even purple. They are most noted and identifiable by their very unusual overglaze polychrome enamel painted decoration (Lane 1947; Grube 1976).

Bowls, decorated both internally and externally, beaker and bottle forms, and even some press-molded tiles, are typical mina'i object types. The bowls, which vary in shape and size, tend to account for the greatest population of wares within the production. Overglaze enamels were used to create images of humans, animals, arabesques, calligraphy, etc. on the surface of the glazed wares.

Historically, the imagery that decorate mina'i wares has been thought to be enamels painted onto the glazed surface. Microscopic examination of many of these pieces reveals that the imagery may have been made by means of a transfer technology in which enamel paint was used to create images independently from the ceramic form. The painted images were then transferred to and fired on the glaze surface, fusing the enamel in place.

Ceramic transfer technology has been historically attributed to the English who have been credited with inventing this technology in the 18th century (Drakard 1995; Wymna 1980; Coutts 2001). However, a survey of mina'i wares in various national and international collections strongly demonstrates that mina'i enamel decoration may be the earliest known example of ceramic transfer technology.

A fine example of mina'i ware that can be used to illustrate and develop a working theoretical model of the earliest example of ceramic transfer technology is a ewer in the collection of the Los Angeles County Museum of Art (Figs. 1 and 2).

The raw materials from which this and other mina'i forms are made is probably fritware. A fritware body is fairly consistent. It is composed of one part sticky white clay, one part frit and ten parts white sand. Frit is a type of ground glass specifically prepared to act as a material with a low melting point to consolidate and initiate fusion of the component of the fritware, i.e., the sand and clay. The base glaze is most often a white, tin opacified lead alkaline glaze, that may utilize the same frit found in the body as its primary ingredient to promote proper adhesion between glaze and body (Allan 1973).

Photomicrographs of a fritware body in cross-section (Figs. 3 and 4) are useful for studying the relationship between clay body, glaze, and overglaze, as well as understanding what the body is made from. Fig. 3 shows three layers; the ceramic body, glaze, and overglaze enamel. In Fig. 4, the individual quartz particles that account for the majority of the ceramic body are angular white to gray grains.

Until recently, the overglaze enamel decoration of the mina'i wares was thought to have been painted in a very straightforward manner, which is to say that the vessels were thrown or press molded, bisque fired, glazed and glost fired. After this, overglaze enamel paint and gilding were applied directly to the glaze and fired again. If the casual viewer were to see an example of mina'i on display, they would probably notice characteristic "crazing", which is the formation of countless cracks in the glaze.

Crazing is a glaze fault, incurred when the clay body and glaze do not "fit" to each other correctly. The glaze is too small or under tension in relationship to itself and the clay body. At room temperature, the glaze is attempting to shrink, resulting in the formation of some cracks. When the clay body and glaze respond to fluctuations in temperature, expanding and contracting, the clay body expands more than the glaze, causing it to craze, releasing stress in the glaze layer.

Craze lines are very easy to distinguish in the white glaze because over time, the cracks fill with grime and dirt and discolor to a warm gray-yellow coloration. It would seem plausible that because the glaze crazes, the enamel layer above the glaze crazes on the same lines.

When casually examining mina'i wares, what appears to the naked eye as crazing is found on close inspection to be independent movement of the design. The enamel has not crazed, nor is it related to any crazing that exists in the base glaze. The apparent 'crazing' in the enamel of mina'i wares is not accompanied by cracks formed during cooling to relieve post-fire tension. Curators have suggested that the movement in the enamel my be attributable to a runny glaze.

The closest parallel is in transferware technology. Transfers, in ceramic terminology, are more commonly called 'decals'. The modern ceramic decal is the descendent of historic transfer technology. Everyone has seen and lives with ceramic decals, which can be found on any coffee mug bearing the insignia of a favorite sports team or logo (Fig. 5). Transfers are independent images created from ceramic raw materials, i.e. enamels. After creating the image, it is applied to the ceramic for a final firing.

The English have been traditionally credited with "inventing" the decal in the mid 18th century. The plate in Figure 6 is an example of an early decal decorated ceramic. On of the earliest people to employ this technique was John Sadler of Liverpool in 1749. John Sadler and Guy Green of Liverpool, applied in 1756 for the patent for the glue bat method (Figs. 7 and 8). Transfer technology, in the case of English ceramics, allowed a complex image which could not be painted directly on the surface of the object to be created independently and then applied to the ceramic (Drakard 1995).

"Bat printing" was the first transfer system employed. In this system, images on old out-of-use copper etching plates, which had been engraved or etched to create an image for such things as newspapers, were "inked" with linseed oil. The plates were then coated with a ¼" thick layer of animal glue to form a "glue bat", which when cooled, was peeled from the copper etching plate, picking up the oil from the plate. The bat in turn was pressed onto the ceramic to transfer the oil (Fig. 9). The oil image on the ceramic was then dusted with pigment and fired (Fig. 10).

The glue bat method was shortly supplanted by the tissue method (Fig. 11). Patents for this technology were applied for both by John Brooks (a Birmingham engraver) between 1751 and 1754, and Harry Baker in 1781. In this procedure, paper coated with gum arabic was applied to the plate and pushed through a press to "capture" cobalt containing ceramic "ink" which had been applied to image-bearing copper plates. The sheet of tissue was then pulled from the copper plate and transferred to the ceramic surface and fired. The tissue burned off during the firing, transferring the image onto the glaze.

There are advantages and disadvantages to both methods. The disadvantage to the glue method is that the bat flexes too much, both expanding and contracting the image that is being applied. It also is easy to smudge the transferred oil or dusted image. Its advantage is that it fits concave and convex contours well.

The advantages and disadvantages of the tissue method is the reverse of the bat method. In the tissue method, if the tissue tears, which it often does, both unintentionally and intentionally, a diagnostic transfer fault is incurred.

In fitting the tissue, i.e., the support, it is difficult to disguise where the tissue overlaps. Attempts to disguise the overlaps often result in tears, losses, shifted images, etc. Various cuts and disruptions can be seen in the application of the tissue image to this late 19th century, early 20th century porcelain (Figs. 12 and 13).

Today, the most widely used mass-production method of applying an image is by paper transfers or prints from lithographic plates. Instead of substituting oil for normal printer's ink, varnish is used to ink the plate, then transfer paper is pressed onto the surface to pull varnish from the plate. The varnish is then "inked" and the tissue paper transferred to the ceramic. The other printing option is to have the glue bat attached to a flexible piston that off-set presses onto a plate, pulls the varnish, then presses it onto a ceramic surface where it is dusted with ink.

Decals can also be made by silkscreening an oil-based ceramic material onto a gum-based paper. The decal and film are transferred to a ceramic, pressed in place, and fired during which time the support burns off (Fig. 14).

The ceramic faults associated with transfer technology previously discussed, that is, the disruption of the carrier of the enamel paint causing such things as tears and shifted images, can be found on mina'i wares.

When examining mina'i in museum collections, three scenarios are usually encountered.

1. Microscopic examination clearly shows the ceramic faults associated with transfer support movement. The faults include: broken individual painted lines, arabesques that split and move sideways (Fig. 15) or spin, splices through the support which were carefully laid down but detectable through the microscope, large areas of multiple layers of color that break cleanly and move apart (Figure 16), splits that move through numerous areas of unattached, independent color, and tenting of the enamel support.

2. Microscopic examination shows that vessels are heavily overpainted so that distinguishing the ceramic fault is impossible without removing the overpaint. These vessels cannot be fully studied at the time.

3. No ceramic faults can be found, which identifies the mina'i as either directly painted or simply a well done, fault free transfer. This is the case with the Freer beaker, perhaps the most famous example of mina'i ware (Freer Gallery of Art, Smithsonian Institution, # 28.2).

In order to prove and substantiate the working hypothesis that mina'i is the earliest example of transfer technology and that it was developed earlier than previously thought, colleagues JoAnna Rowntree, Amy Green and I have begun to experiment and explore replicating the mina'i technology in order to duplicate the technique of using overglaze paint on goldbeater's skin. We have bought a variety of overglaze enamels and have stretched the goldbeaters' skin over an image in order to copy and transfer images to a low-fire ceramic. Goldbeaters' skin was chosen as the enamel support, since it would have been available in the 12th century and could exhibit faults. This is still an experiment in process. We have yet to replicate the exact procedure.

One might ask: Why create a design in this manner? It is true that the Islamic world had many wonderful, gifted painters. However, the paintings that have survived from this period are primarily wall paintings. Wall paintings and miniature paintings are flat; vessels are not. Mina'i wares vary greatly in size and shape as well, which demands a flexible painting technology.

Painting and constructing an image on a flat surface is quite different from creating a composition on a convex, concave or three-dimensional surface. One approach to construct images on non-flat surfaces might employ the use of grids. Grids could have been drawn on vessels prior to the application of paint and gilding to aid the painter in order to orient and proportion their composition. Known examples of fitting a design to a convex, round ceramic can be found in contemporary American Indian ceramics, such as Acoma pottery in which the artist first drew on the vessel to make the design fit, making adjustments along the way.

Mina'i painting varies in both in quality and compositions. The finest example examined to date is a fragment that shows a portion of a head in the collection of the Metropolitan Museum of Art. In the creation of mina'i ware, no matter the level of quality, someone was spending a great deal of time trying to compose a series of images, whether figural, floral, or geometric for a surface on which everything had to fit properly. The upholstery of numerous images on a convex or concave surface is challenging. Goldbeaters' skin, which may have served as the support for the painting, allowed the painter to position and reposition his images to fit the surface and composition at will, simply by keeping the surface moistened with water. Further examination is needed to determine the exact process.

Modern decals are of industrial interest since the same image can be created repeatedly for mass production purposes. The Islamic decal, I believe was not being created with this purpose in mind. The decorator had discovered a way, I believe, by which a complex composition could be created without disturbing individual components of the composition.

This project is still very much a work-in-progress. After examining wares in the collections of the Miho Museum, Los Angeles County Museum of Art, the Walters Art Gallery, The Metropolitan Museum of Art, the Freer/Sackler Galleries and the Victoria and Albert Museum, I am convinced that we are not looking at a runny glaze.

It has become consistently clear that the enamel was painted onto a support that shrank and moved in a variety of directions. The transfer theory, or a variation thereof, may still work. However, there are still many steps that need to be clarified in order to resolutely state that transfer technology was strictly the technique that was being used on these wares. If this is proven, then the credit for this invention belongs to the Islamic world, preceding the English patents by 500 years.

Acknowledgments

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Figure 2. Top view of mina'i ewer shown in Fig. 1.

Figure 1. Mina'i ceramic ewer. Los Angeles County Museum of Art, M.2002.1.7, The Madina Collection of Islamic Art, gift of Chamilla Chandler Frost. Late 12th-early 13th c., Iran.

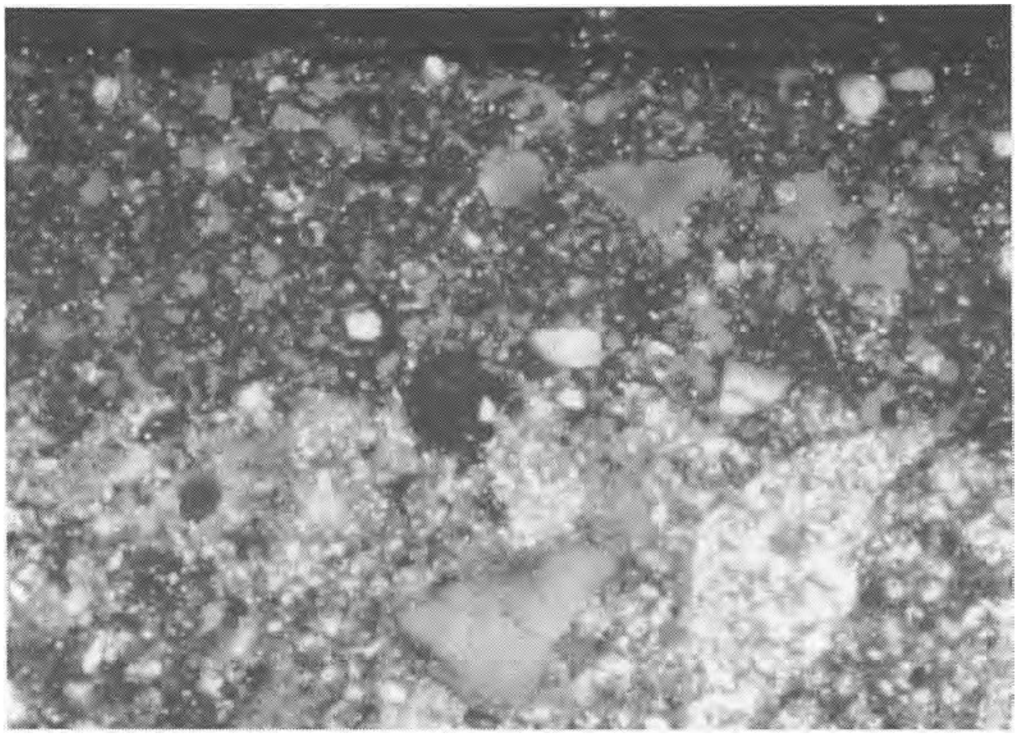

Figure 3. Cross section of fritware fragment

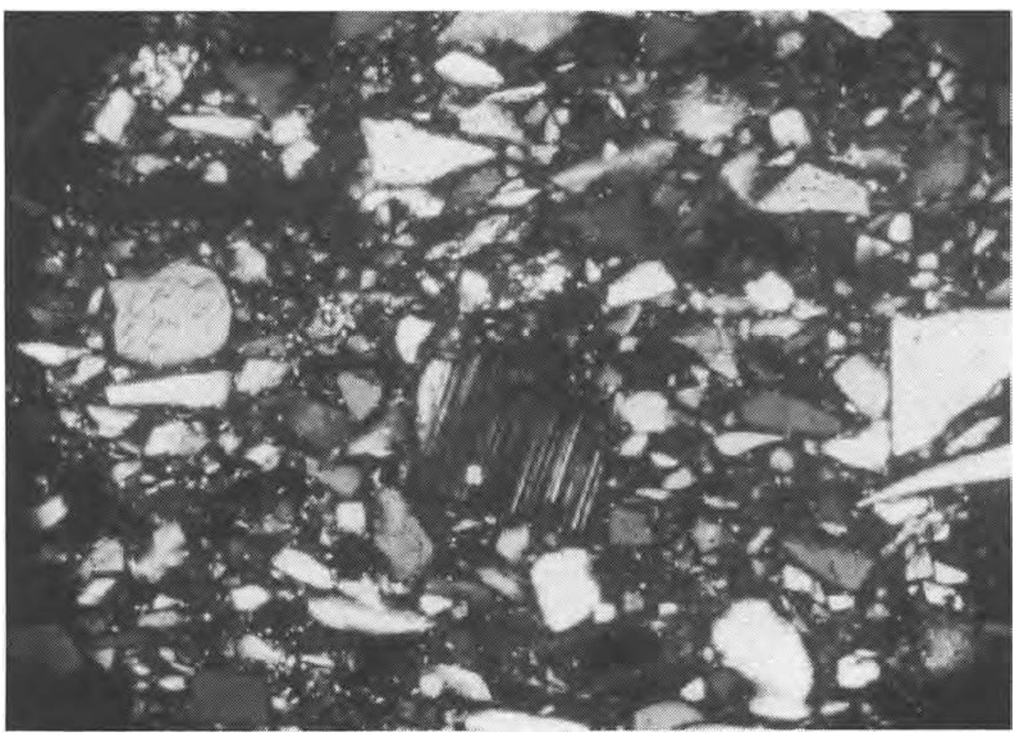

Figure 4. Magnified quartz grains in the fritware

Figure 5. Modern ceramic mugs with decals

Figure 6. English porcelain plate, 18th century, with decals (Los Angeles County Museum of Art, 50.28.17).

Figure 7. Application of oil to copper plate (from Scott 1994).

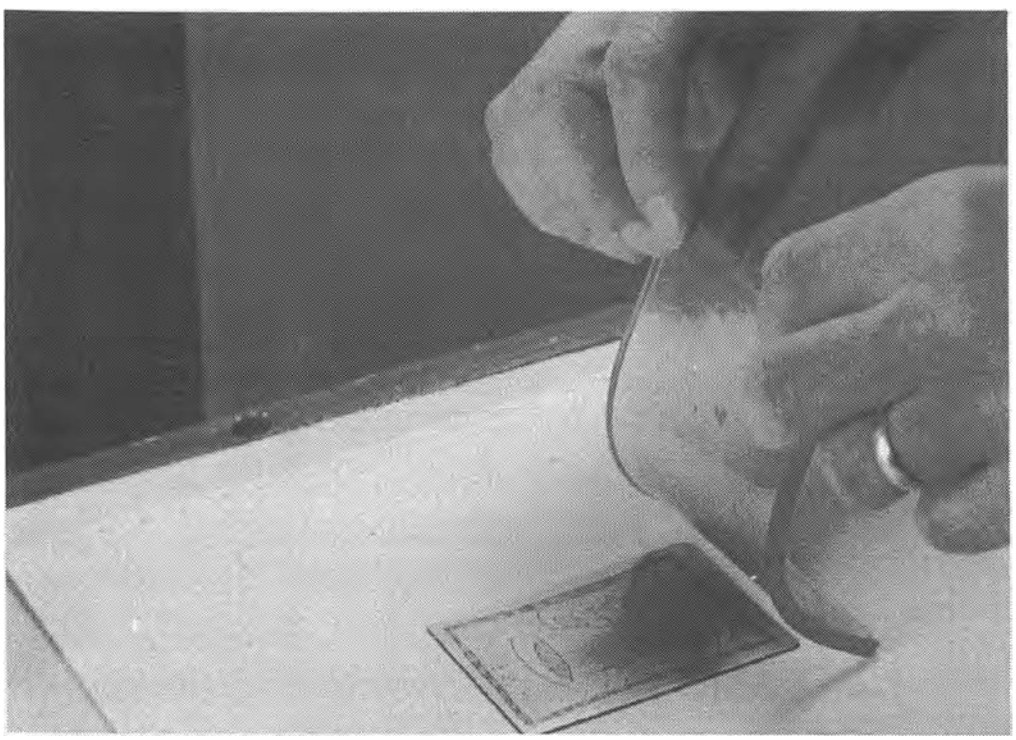

Figure 8. Application of "glue bat" to the oil laden copper plate (from Scott 1994).

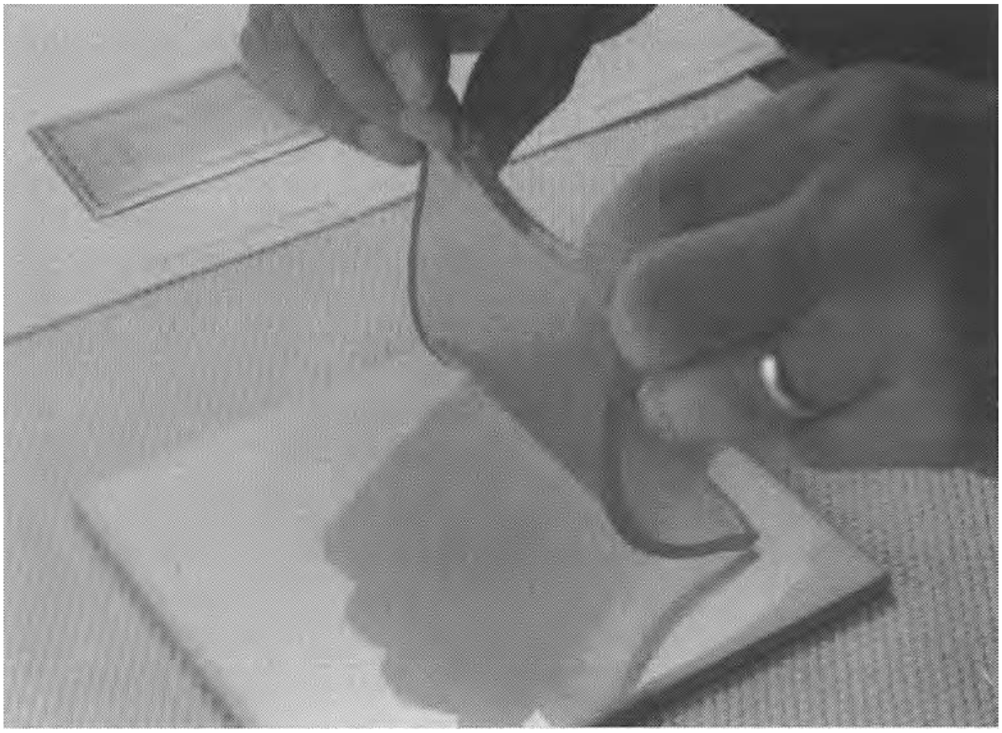

Figure 9. Transfer of oil image on the glue bat to the glazed ceramic (from Scott 1994).

Figure 10. Dusting the oil image with ceramic pigment (from Scott 1994).

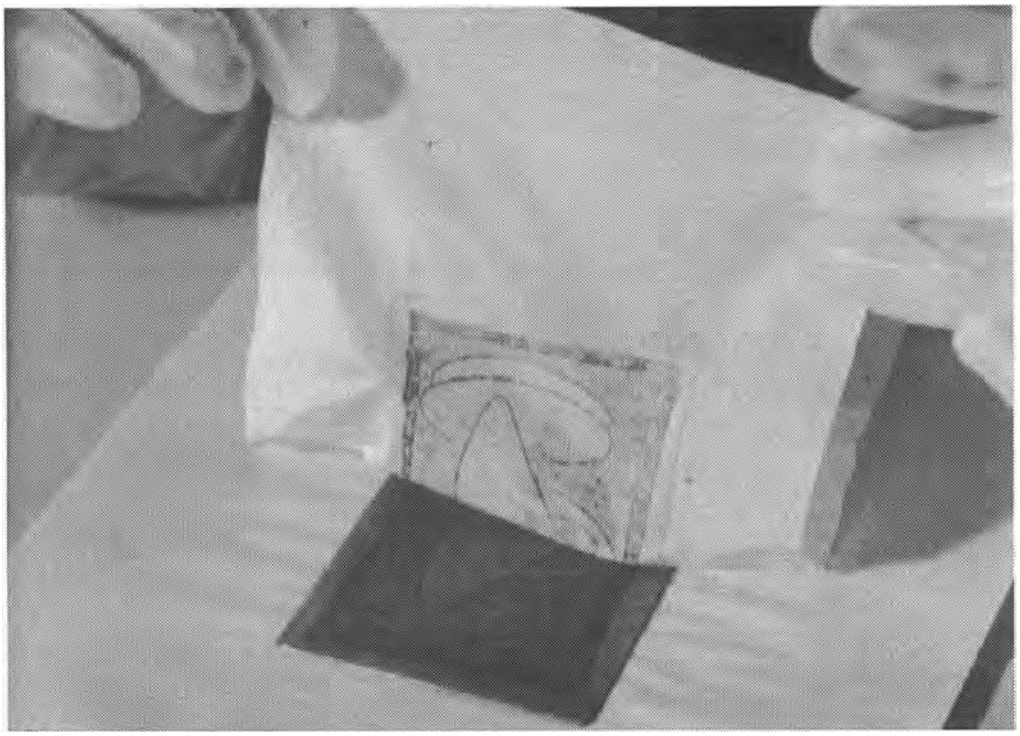

Figure 11. Lifting a tissue transfer from an inked copper plate (from Scott 1994).

Figure 12. Late 19th century blue-on-white porcelain vase with transfer image (collection of the author).

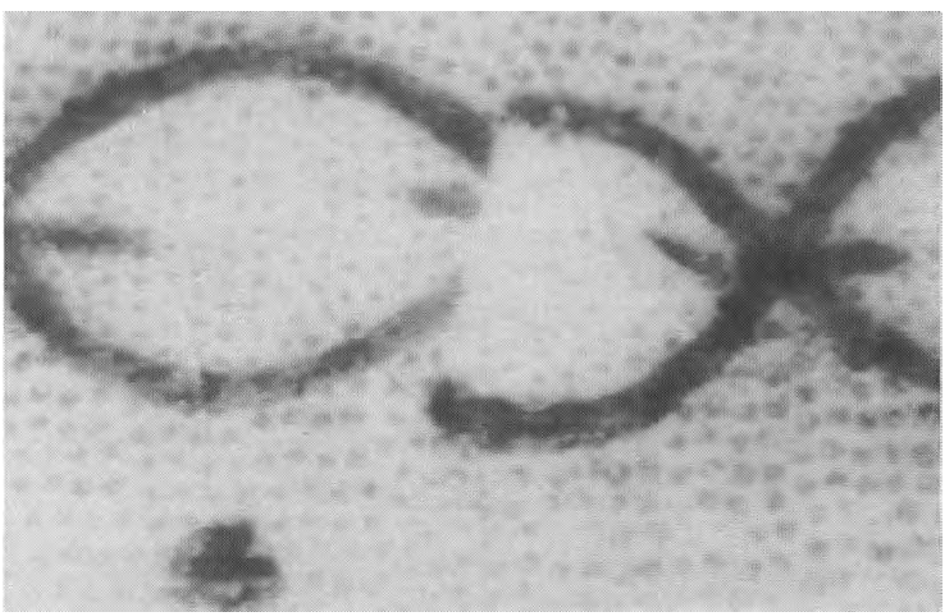

Figure 13. Splice through the transfer design on the vase in Figure 12 at high magnification showing hidden upholstery of the decal to the glaze surface.

Figure 14. Application of a gum based paper design onto a pitcher (from Chandler 1968).

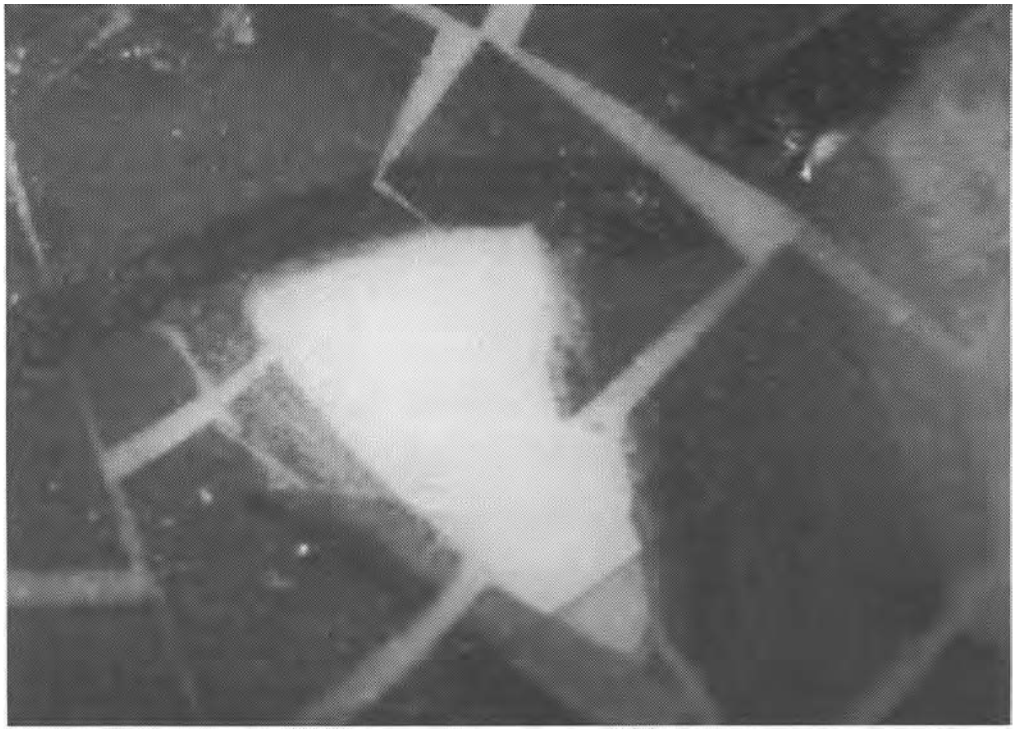

Figure 15. View of transfer image from LACMA ewer M.2002.1.7 showing split decal.

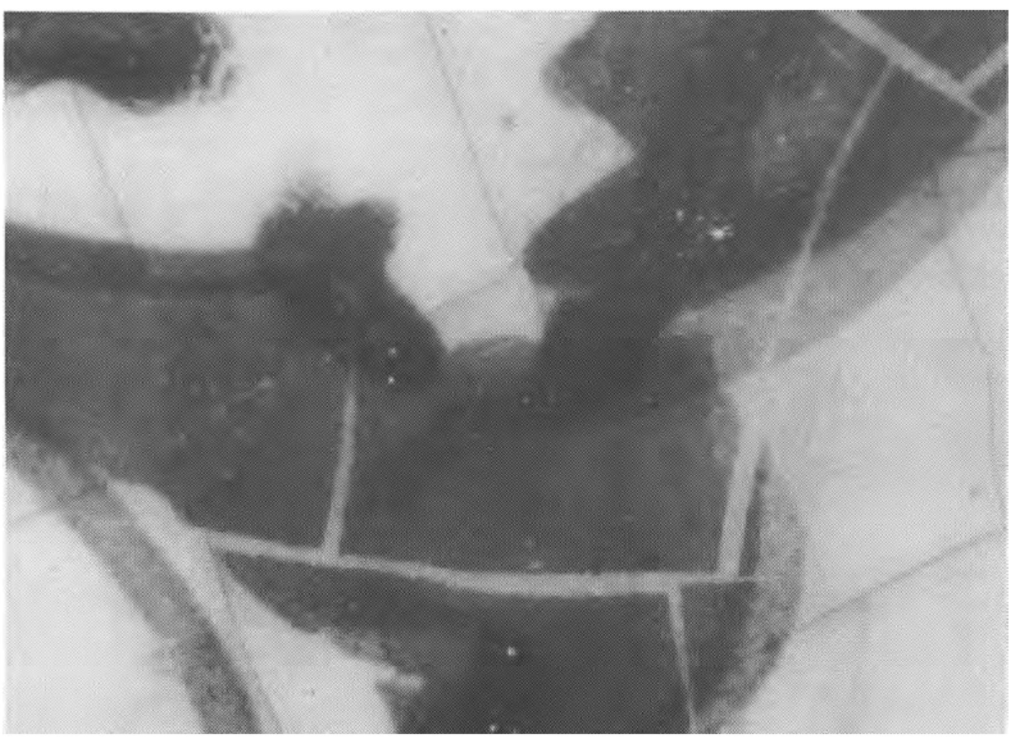

Figure 16. Enlarged microscopic view of Figure 15.