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CONSERVATION AND RESTORATION UNDER FIELD CONDITIONS: CERAMICS TREATMENT AT SARDIS, TURKEY

Tony Sigel and Stephen P. Koob

Abstract

During the course of two field seasons at the archaeological excavations at Sardis, Turkey, ceramics from the Lydian empire dating to 546 B.C. were treated, including a group destined for exhibition at the regional archaeological museum. Working out of doors, with extremes of temperature and limitations in resources, encouraged innovations in technique, use of materials, and methods of work. The principle of using only stable, easily reversible and well understood materials was followed. Combinations of materials which may interact poorly in the future were avoided, and previously treated ceramics requiring re-treatment were examined in this light. This paper describes in detail the techniques for conservation and restoration employed on site with an emphasis on simplicity and improvisation. The use, behavior and idiosyncrasies of materials are discussed as well as adjusting for, and taking advantage of, environmental conditions. Topics include cleaning, desalination, consolidation, reversing earlier treatment, adhesive preparation, assembly, loss compensation strategies, molding and fill materials and their use in structural and detachable fills. Emphasis is placed on the correct uses of plaster of paris, and plasticine as a molding material. Shaping and finishing techniques are discussed along with variations in restoration styles. Inpainting methods and materials are also described.

Introduction

This paper deals with the treatment and re-treatment of archaeological ceramics from the ancient Lydian kingdom of Sardis, in Western Turkey, and is derived in part from the authors' work during the 1995 and 1996 field seasons. Sardis is situated about 90 km east of the Mediterranean coast and is the capital of the ancient Lydian empire. The ceramic materials under discussion date precisely to 546 BC, when the armies of Cyrus of Persia laid waste to Lydian Sardis, ending the reign of the fabled king Croesus.

The conservation of excavated artifacts at the Archaeological Exploration at Sardis in Turkey has been ongoing since the establishment of the modern excavation in 1958. In its conservation laboratory constructed within the original expedition compound, Sardis has also provided conservation training opportunities to many object conservators, including a long-standing arrangement with the Conservation Center of the Institute of Fine Arts, New York University.

The excavation compound is situated just a sherd's throw from the temple of Artemis, where our worktables were set up under the trees. The palette of conservation supplies used for the

treatment of ceramics has been intentionally limited to a few very stable, well understood, and easily reversible materials: Plaster of Paris, Acryloid B-72, and acrylic emulsion paints. This should reduce the possibility of future negative interactions between a larger variety of proprietary materials which may themselves be of questionable stability and permanence.

Through sorting and puzzling through thousands of sherds, groups making up individual vessels were assembled and recorded. After testing for stability, the sherds were washed in water. Friable and weak pottery often required particularized cleaning and consolidation. After cleaning, the sherds were tested for soluble salts. The conductivity of the ceramics tested over the last 2 years has averaged around 150 micro mhos, which fortunately indicated a relatively salt-free burial environment. For occasional insoluble deposits, 3-5% nitric acid has proven to be an excellent treatment, preceded and followed by soaking in deionized water.

Joining

Well-known for its stability and reversibility, Acryloid B-72 resin in adhesive form was made up in acetone/ethanol 4:1 with a small amount of fumed silica. The ethanol is added to slow down the solvent evaporation rate and setting time, to compensate for the often very hot and dry conditions. Prepared and transferred into tubes it is very easy to apply. Lighter and heavier solvent-to-resin concentrations can be made to suit the requirements of different wares.

Before assembly, all break edges are sealed with a solution of 7.5% B-72. This 'priming' of the substrate strengthens the adjacent ceramic fabric, creates a 'like to like' bond, and prevents premature absorption of the adhesive solvent from the join. After applying the adhesive, the join is registered and closed without pressure to evenly distribute the adhesive, then pulled apart for a few seconds. This is done to pre-set, or allow a little tack to develop through evaporation, and is perhaps the most important and least appreciated component of making successful B-72 joins. Pulling the join open quickly reduces adhesive 'stringing'. Open time will depend on the amount of 'tack' needed for each particular join depending on weight, size, porosity and on the prevailing temperature and humidity. Experience is the best teacher. The join is then re-closed and pressure is applied. After a minute or two the excess glue and consolidant along the join can be cleaned up quite rapidly with a brush and acetone, taking care not to over-wet the new join. A vessel can thus be built up rapidly and with great accuracy, completing one join and going on to the next, then returning to the first to clean, and so on.

Brush cleaning is non-abrasive, allows complete access into cracks and recesses, and avoids the 'nasty cotton fibers from swabs' problem. The brush is dipped into acetone, blotted on paper toweling to reduce the volume, and the join surface lightly rinsed clean of excess adhesive. The brush is blotted and the procedure is repeated until the area is clean. In this manner the excess resin is suspended in solution and transferred off the surface in a controllable, gentle way. This technique is extremely useful for a wide variety of cleaning activities on various substrates.

Windsor & Newton 'Scepter Gold 606' brushes, 1/4" width, are particularly well suited for general cleaning and removal of excess adhesive. Often a worn, and therefore shorter and somewhat stiffer, brush is more effective for these chores.

If you find mis-alignments, the thermoplasticity of B-72 can be taken advantage of using a hair dryer, the sun, or other heat source to warm and adjust a join. To 'set' a join warmed for this purpose, after realigning, switch the hairdryer to cool or hold the repositioned join under the cold water tap.

Before filling, break edges and also the surfaces surrounding the fill may be given a protective coating of 10-15% B-72. This prevents plaster ghosting and inadvertent abrasions to the surface. It can be left in place throughout the filling and inpainting process, and then removed as the final step. For detachable fills, the edge coating can be doubled in thickness to ease removal.

Filling

Plaster of Paris is the principal fill material used at Sardis. It has unique and variable handling properties that can be exploited throughout its setting process. When properly consolidated, or sealed, and attached to the vessel, it is extremely stable. When possible, fills or restorations are made 'detachable', removed, and glued back in place much like another fragment. As plaster is not a particularly adhesive material, the use of adhesive to attach the fill greatly strengthens and adds to the long term stability of the vessel. It is also advantageous in that fills can be cast, removed, and taken away from the vessel for shaping and finishing, avoiding both plaster dust mess and exposing the vessel to physical and psychological trauma.

Mold preparation

Plasticine is used almost exclusively as the backing or molding material, although dental sheet wax, masking tape and other materials all have their uses. Hard gray Harbutts brand plasticine is non-sulfur containing, has a low oil content and is therefore well suited for the purpose. Its thermoplastic properties can be exploited easily in the field: it can be warmed and softened in the sun to take an impression, and cooled to harden and set with cold water. It is capable of capturing fine detail, such as interior wheel marks (Figure 1). As the concave interior surface of a fill is considerably more difficult to work than the exterior, time and trouble can be saved by perfecting the fill backing. The plasticine is first rolled out on a plastic tray or glass sheet to form a smooth slab. Knead in some dry plaster if it feels too oily. A few drops of water on the glass will prevent sticking. It can then be shaped to an adjacent undamaged interior area with the same profile as the loss area, again with water to prevent sticking. If you have access to cold water, cool the mold at this time to minimize distortions when transferring. The backing is then gently removed, dried, and shifted to the loss area, where it is adhered with pressure applied carefully to

the edges first, then inwards towards the loss, bringing the mold up to, but not past, the plane of the surface of the loss. When everything looks nice, check for leaks by pouring water into your mold. If any are found (check inside) they may be plugged with more plasticine and/or squeezed close.

Pouring fills

Mix the plaster gently with the fingers to avoid generating air bubbles. Use warmer water to accelerate, cooler to retard the setting process if needed. Avoid additives such as adhesives, etc. (they will invariably alter the setting process and may affect long term stability. The properties of the dry plaster fill will be modified with B-72 later). Position the loss in a horizontal orientation with props. It's also a good idea to leave a paper towel or two in and around the vessel to catch any spills or drips. Pour the fills, corners first, to ensure no air is trapped. The loss is overfilledso that the plaster is contained but 'bulging' slightly. Tap the vessel gently to release air bubbles. It will probably be necessary to redistribute plaster as it sets, as it will shrink slightly away from the edges. When the surface shine of water is gone, the surface is shaped and refined with spatulas, scraping, redistributing, and smoothing. At a certain point the plaster will start to tear, and should be left alone. If the weather is very hot, add drops of water to complete the reaction.

Finishing

When the plaster has achieved a 'hard but damp' state, initial shaping of the fill is begun with a scalpel, carving first from just past the fill edge towards the center. The scalpel is held flat, the inside edge of the blade bevel resting lightly on the surface outside the loss; this keeps the cutting edge fractionally but safely above the ceramic surface (Figure 2). With the rough shape completed (Figure 3), the fill is finished with small scrapers and sandpaper, under a running tap if possible.

Incising fills

Incising fill edges defines replacement areas clearly, provides a more consistent visual appearance with adjacent joins, and can save considerable time finishing and inpainting. Establishing the width of the incised line is a judgment based upon the degree of wear and consequent size of adjacent breaklines (Figure 4). It should also be done with the plaster damp, using very little cutting pressure. If the plaster has dried completely, re-wet. Simply guide the upside down blade tip along at the chosen angle, taking a light cut and letting the weight of the scalpel do the work.

After drying, fills are consolidated with 7 to 10% B-72 by immersion or pipette. A polyethylene bag can be loosely draped to slow drying. Consolidation strengthens the fill, seals the plaster

from moisture exchange, and forms a compatible and non-absorbant substrate for inpainting.

Structural and detachable fills are often required to utilize poorly joining and non-joining sherds on fragmentary vessels. The first example is a beautiful and very fragmentary East Greek 'wild goat style' Oinochoe (Figure 5). The plasticine backing provided support for both the floating sherd group, and the structural fill that allows it to be incorporated into the pot. Bamboo sticks were used to support the weight of the backing, with the upward pressure distributed through cardboard and a rubber clay smoothing tool (Figure 6).

Bamboo can be exploited for its thermoplastic properties to create curved braces, temporarily glued in place with B-72 to hold sherds or groups, in this case the foot, in proper orientation (Figure 7). Wet the bamboo before bending over the flame from a candle or alcohol lamp, and keep it moving to avoid charring. These temporary bamboo attachments can be removed later by draping their adhesive joins with cotton soaked in acetone, under polyethylene wrap.

Large, heavier coarse wares with significant structural losses may require a supporting structure to hold sections safely in proper orientation during the casting of a detachable fill. Temporary structures using ephemeral materials such as bamboo, paper towel tubes and tongue depressors, as well as more substantial materials can be improvised for this purpose, and removed later with acetone (Figure 8). The combined weight of the plasticine and wet plaster can easily distort the shape of a large plasticine backing, so support it well, use cold water to firm it up, and work in the shade (Figure 9).

Very large files are invaluable for leveling and refining large fills. When used carefully and correctly, they excel at bridging and leveling planar inconsistencies rather than amplifying them. On the other end of the scale, dozens of small sanding sticks can be made up, in a variety of grits, from flat wood coffee stirrers and spray adhesive. Trim the tip to whatever shape is needed for odd corners and close-up work at the fill edge, and cut the stick back to expose fresh abrasive as the tip becomes worn or clogged (Figure 10).

Case Study: Treatment of a large Orientalizing Dinos

One major case study serves to illustrate many of the techniques discussed in this paper. A large Lydian orientalizing Dinos, or wine mixing bowl, was excavated at Sardis and assembled in 1963, spending the next 30 years at the regional archaeological museum. In the intervening years two additional sherds belonging to the Dinos had been unearthed and it was felt the time had come to retreat this important piece, incorporating the new sherds and making the restored vessel more exhibitable. Substantial areas of the body and rim were missing, and the fill was mis-shapen and tenuously attached, with badly discolored and flaking paint. The original joins were of a poor quality, some having failed, the brilliantly colored slip glaze decoration was obscured by a film of insoluble green/brown burial accretion, and the previous restorer had inadvertently filed down

areas of the original surface with a plaster rasp (Figure 11a).

The Dinos, having been assembled with a PVA adhesive, was disassembled with an alternating warm water/acetone bath (Figure 11b). Following a thorough pre-soak, the disfiguring burial accretions were removed from the surface with 3% nitric acid applied locally with a soft brush. This was followed with several post-soakings in changes of de-ionized water, with regular conductivity monitoring to ensure the removal of any acid remnants. The sherds were allowed to dry and arranged for reassembly (Figure 11c).

The Dinos was re-assembled with B-72, and given a protective working coating of a 20% solution of B-72 in acetone (Figure 11d). It was decided that portions of the old plaster fills could be re-used, with what turned out to be a great deal of reworking (Figure 11e). In retrospect, this did not turn out to be the time-saving step imagined and I would not do it again, much preferring to start fresh. With the body fills attached and augmented, the correct exterior contours were formed with the aid of very large files, as discussed before, using a series of horizontal and diagonally overlapping strokes. Profile templates made with the aid of plastic contour gauges were used to monitor progress. A flexible plastic ruler, bent into the proper arc over the fill, will indicate high and low spots needing further attention.

A cardboard-backed plasticine ring was assembled (Figure 11f) and installed into the vessel as a scaffolding to support the interior wall of the rim mold with springy bamboo skewers (Figure 11g). The plasticine sealed the ring to the interior of the vessel, and to the rim molds, preventing leaks. Dovetail sawcuts were made in the edge of the roughened plaster shoulder to provide a mechanical key for the soon to be poured rim plaster.

Inner and outer rim molds were formed against the remaining original rim surfaces in a continuous linear fashion and applied. The cardboard disc cut-outs remaining from the scaffolding were used to ensure concentricity of the molds (Figure 11h). Masking tape was used as a 'strap' to hold the plasticine against the plaster shoulder, as it adheres poorly when wet and can leak under the weight of the plaster. After filling the finished mold with water to saturate the plaster shoulder and check for leaks, the rim was emptied of excess water and the plaster poured in one of those exciting conservation moments. When the mold was removed, the lengthy preparations were rewarded with a successful result (Figure 11i). The plasticine nicely reproduced the faint chatter mark texture on the rim edge, and the rim and shoulder were well integrated, requiring little further work.

Air bubbles and other minor repairs fills were completed, wetting the plaster again and using a thicker plaster mixture, small spatulas, and the finger tips. The fills were wet sanded with first 220, then 400 grit waterproof sandpaper. With the fills completed, the plaster was consolidated from the inside out through percolation. The keyed joins of the reused fill areas were visually distinct from the integration of the new plaster, slightly darker in tone. Final sanding of the consolidated plaster was carried out with 400-600 grit papers.

Generally, it is a good idea to start inpainting on the interior of an open vessel. In that way all of the application issues can be worked out before starting on the exterior, or 'money' surface (Figure 11j). Wheel-applied slip artifacts and register lines can be effectively reproduced by holding the paint-loaded brush stationary and spinning the vessel on some sort of a turntable. Used judiciously this can help to moderate the blank, artificial appearance of large inpainted fill areas. The paint can be carried over onto the B-72 barrier layer to maintain the continuity of the brush strokes, then both the excess paint and coating are cleaned back to the break edge with a brush and acetone (Figure 11k). Restoration of losses in surface decoration was limited to continuing the register lines, which added visual interest and continuity to the otherwise large, blank fill areas (Figure 11L).

Acknowledgments

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Suppliers

Fine tip glue tubes: Unipac Supply Co., Pittsburgh, PA 15227, 412-885-2266
Tin mastitis tip/black friction fit. A box contains a gross (144) and costs 58.75.

Acryloid B-72: Conservation Materials Ltd. Box 2884, Sparks, NV 89431

Hydrophobic Fumed Silica: Aerosil 202. DeGussa Corp., Pigments Division, PO Box 2004, Teterborough, NJ 07608

Cleaning Agents: Symperonic 'N'. Archival Aids, or Conservation Materials.

Plaster of Paris: French's Diamond 'P' fine dental plaster. Samuel H. French & Co., 4446-50 Cresson St. Philadelphia, PA 19127.

Plasticine: Harbutt's Ltd. High Street, Bathhampton, Bath BA2 6TA, UK, also Conservation Resources International, L.L.C. 800-634-6932.

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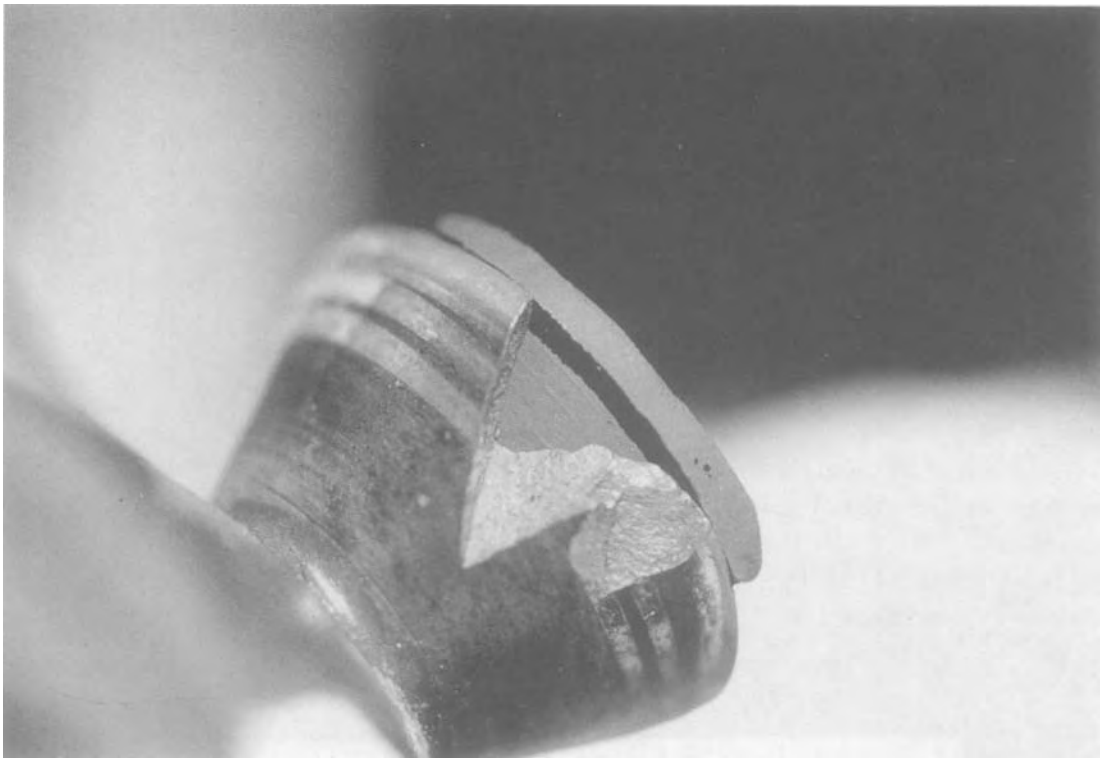


Figure. 1. Plasticine backing for foot rim loss in Lydian skyphos.

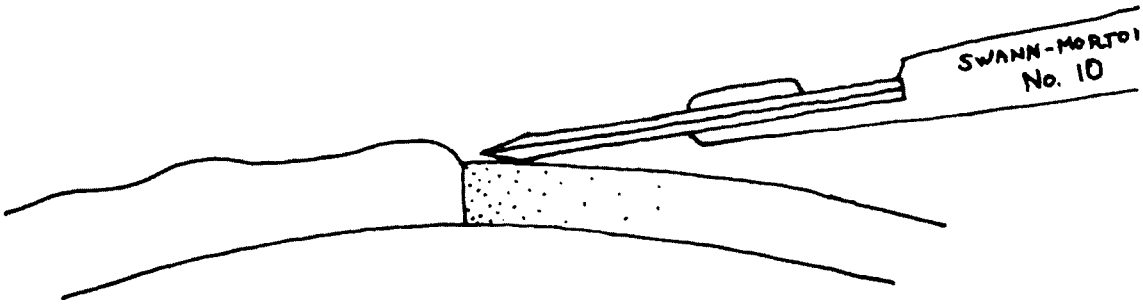


Figure. 2. Scalpel position for fill carving.

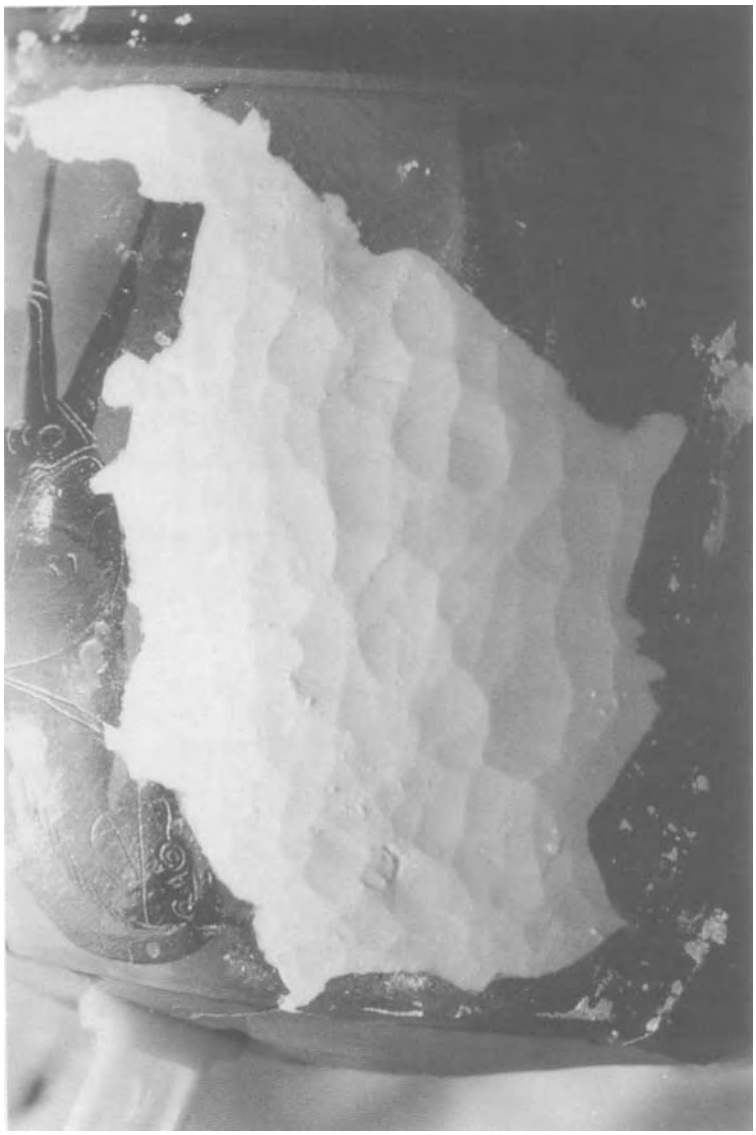


Figure. 3. Completion of rough carving on fill in Attic hydria.

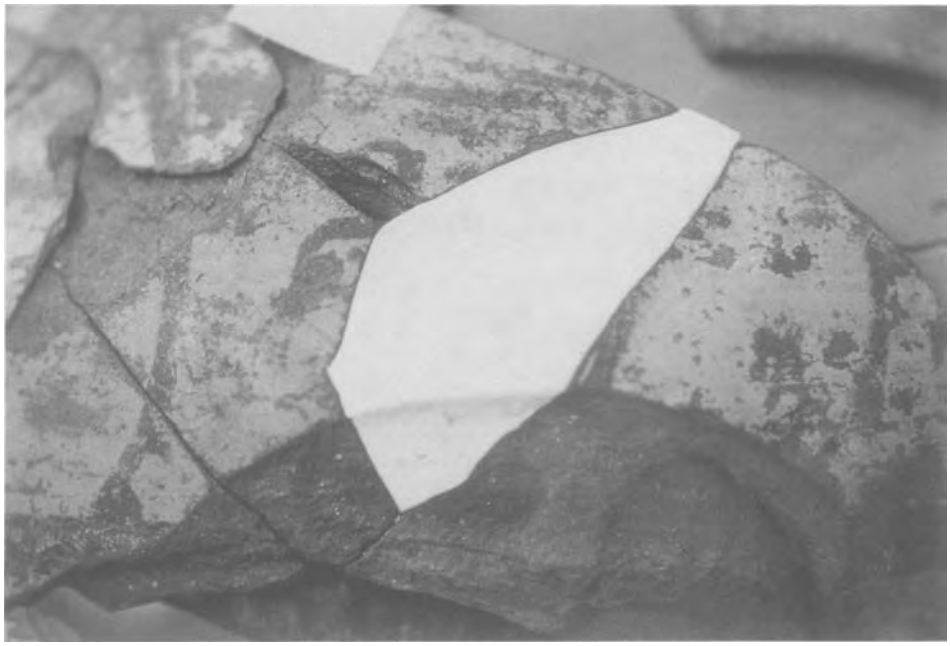


Figure. 4. Incised fill edges complementing adjacent break edges.

Figure. 5. Plasticine backing supporting floating sherd group; plaster poured (above).

Figure. 6a. Bamboo struts under tension supporting backing.

Figure. 6b. The completed shape showing bridging, or structural fill.

Figure. 7a. Temporary bamboo struts in place. Note shiny isolating B-72 layer and plasticine backing.

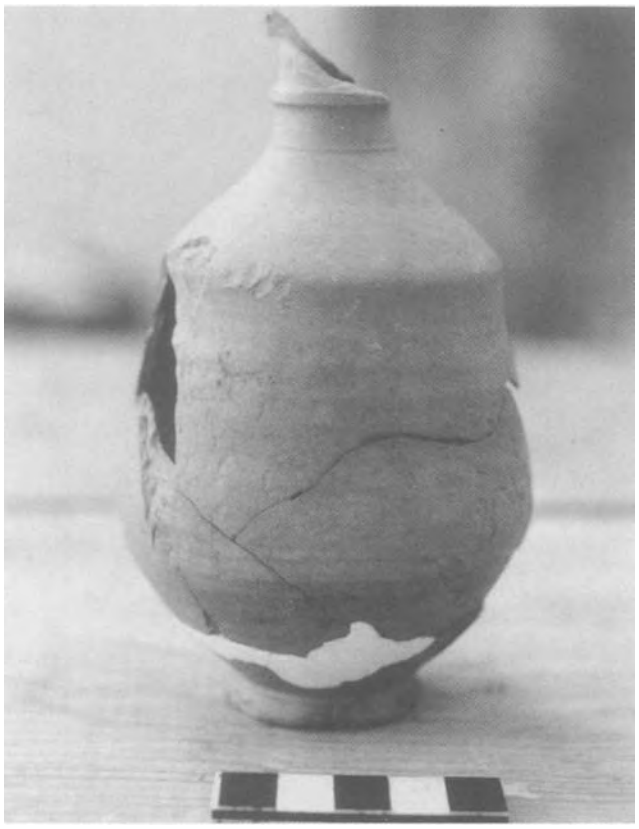


Figure. 7b. The completed fill.

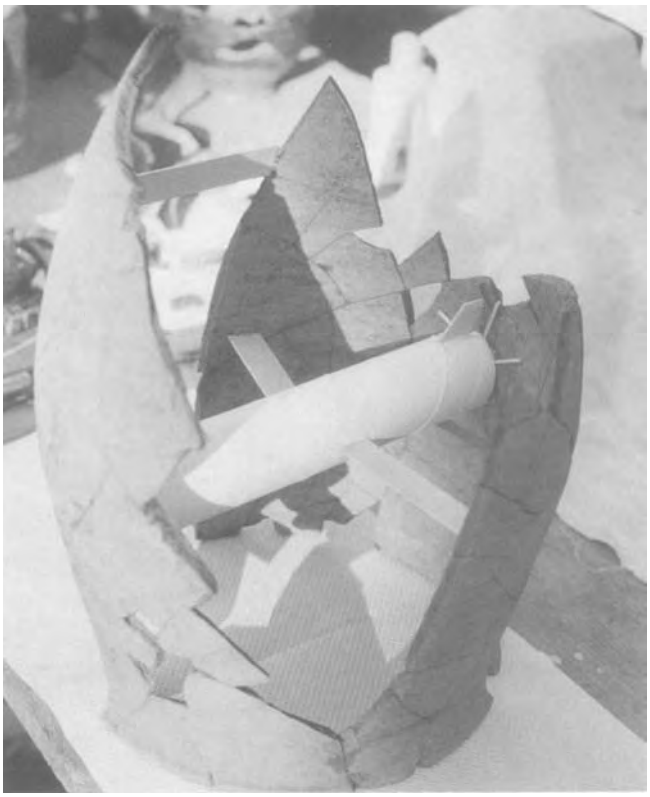


Figure. 8. Fragmentary vessel braced temporarily in preparation for structural fill.

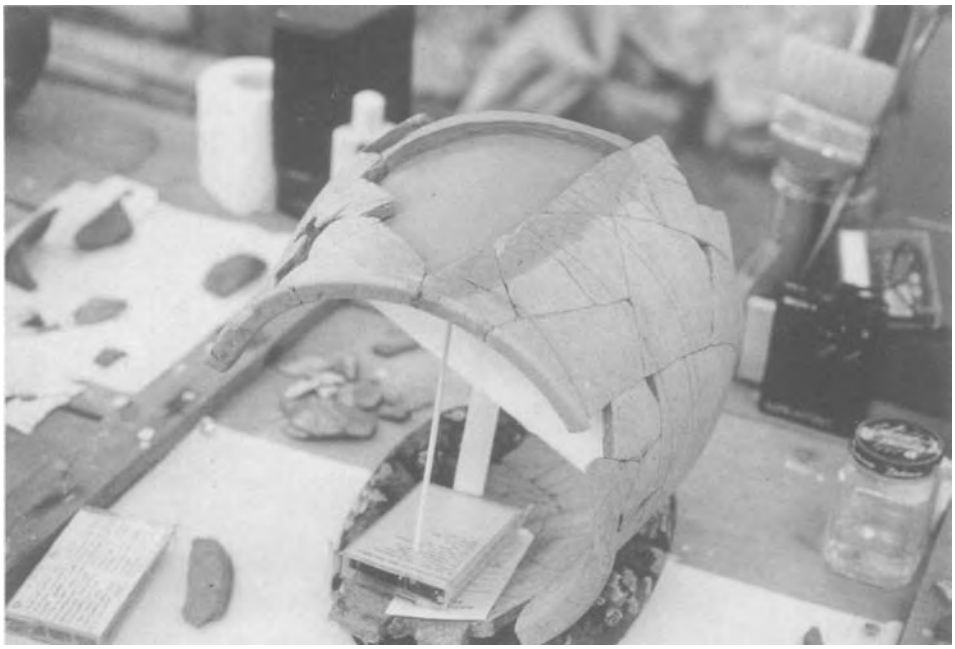


Figure. 9. Ready to pour. Note also tensioned bamboo support for mold.

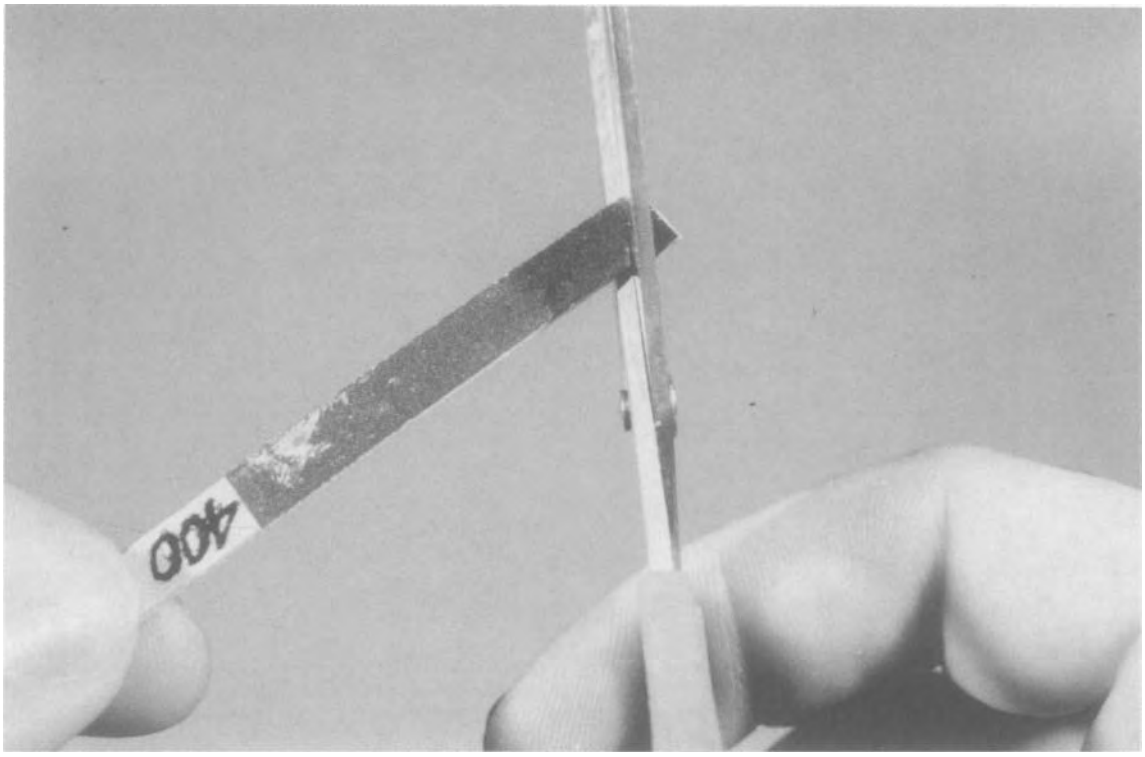
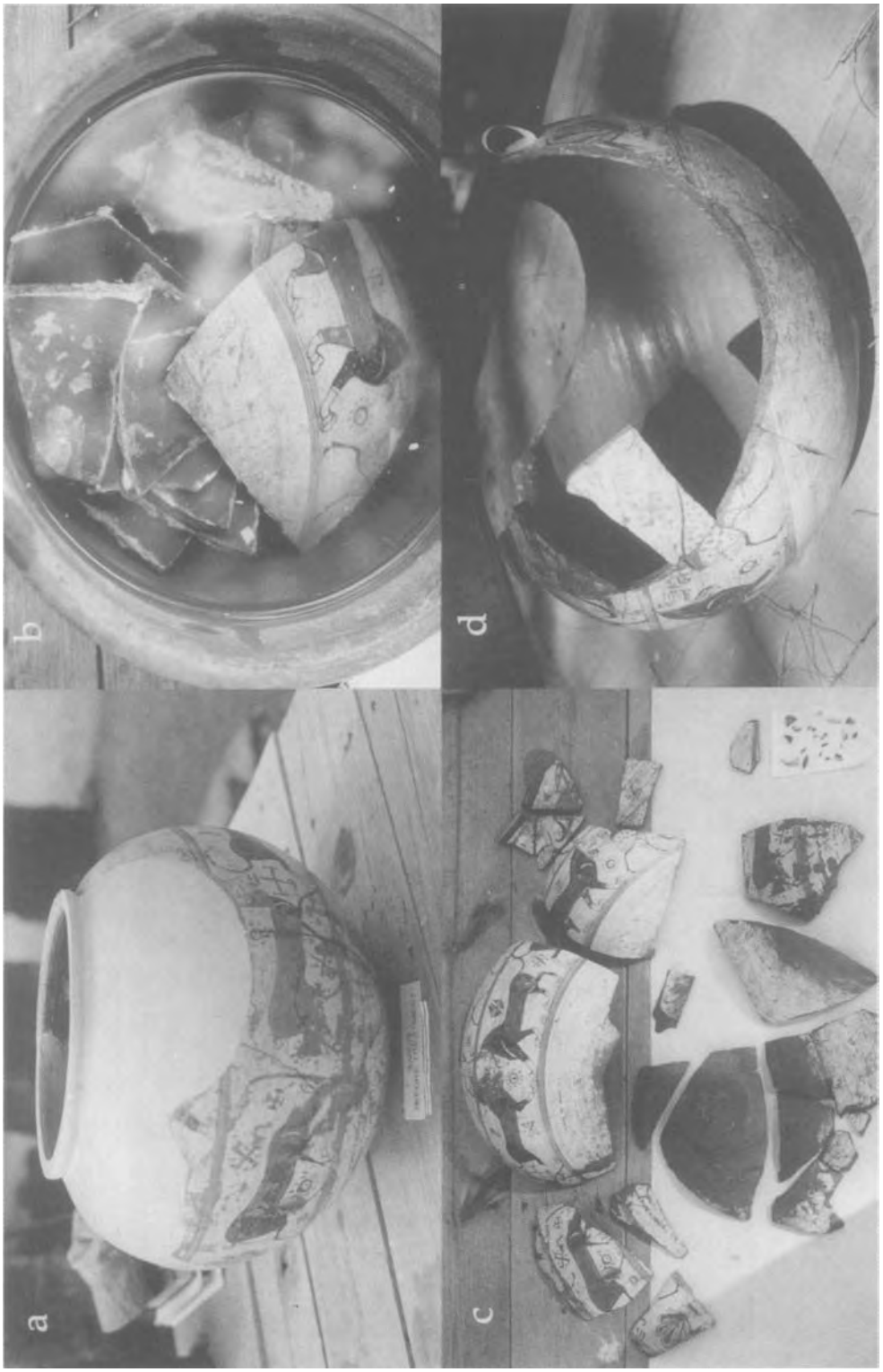
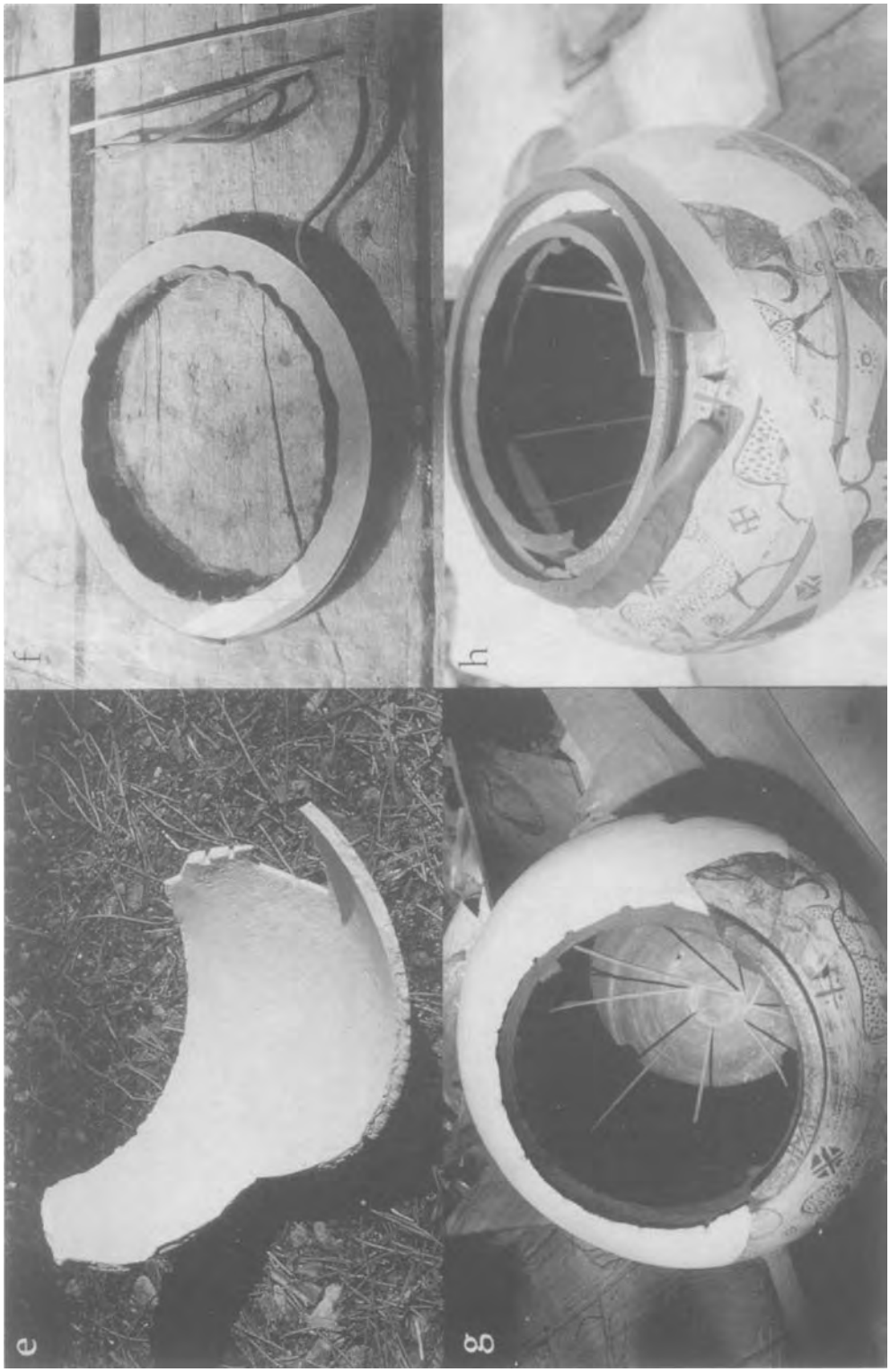


Figure. 10. Trimming sanding stick tip.



Figures. 11a-d. (a) before treatment, (b) disassembly, note opaque PVA accretions, (c) clean, dry and ordered for reassembly, (d) reassembled and coated.



Figures. 11e-h. (e) portion of old fill prepared for re-use, (f) cardboard backed plasticine ring, face down, (g) ring in place, supported with sprung bamboo. Note sawcuts to receive rim plaster, (h) Outer and inner rim molds in place.

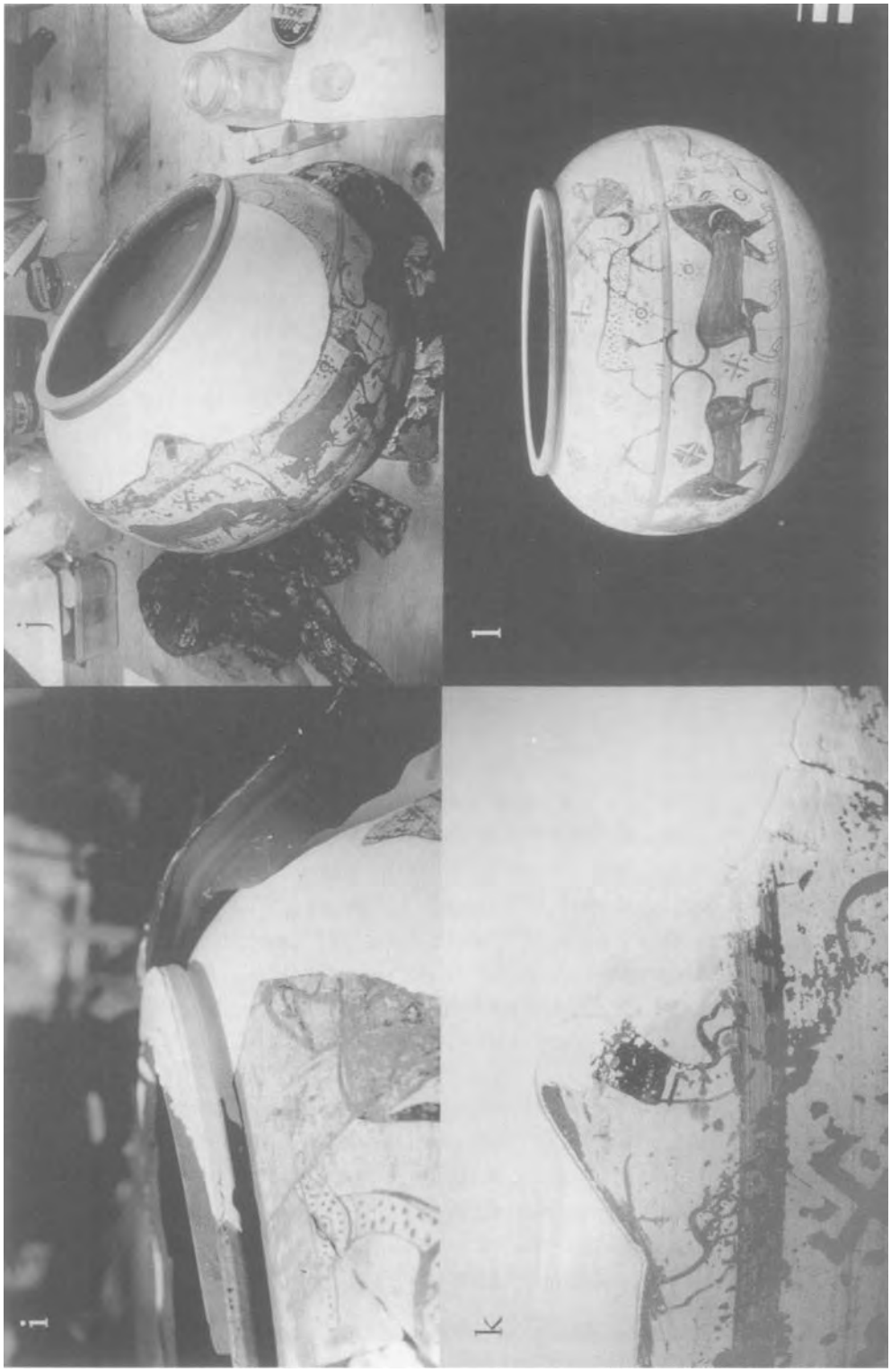


Fig. 11 i-l. (i) Removing outer rim mold. Ahh..., (j) Interior inpainted, exterior rim underway, (k) Paint overlap on B-72 barrier (right), cleaned back to incised edge (left), (l) Completed vessel..