

PROGRESS REPORT FROM
CERAMICS CONSERVATION LAB, PHNOM PENH

Bonnie Baskin, Chap Sopheara, Pich Thyda and Tep Sokha

Each year, thousands of ceramics, ranging from tiny sherds to complete pots, are excavated in Cambodia and enter the archaeological record as primary artifacts of the prehistoric and historic settlements that developed here. But until 2002, when the Ceramics Conservation Lab was organized in Phnom Penh, there was no ongoing specialized resource for conserving this pottery. Ceramics were consequently not checked for critical levels of soluble salts, which are absorbed from groundwater and could later expand with humidity to force the top layer of clay to flake off. Adhesives used for joining sherds sometimes dissolved low-fired clay, while others failed over time because they were too soft for the tropics or lacked conservation-grade chemical stability. Cleaning techniques employed were often suited to modern household crockery, but destructive to fragile old surfaces. In short, there was need for a facility where these key cultural artifacts, sometimes the only evidence of the societies that created them, could receive conservation care – and at an international standard.

Established to help fulfill this need, the Ceramics Conservation Lab – housed in the Faculty of Archaeology, Royal University of Fine Arts (RUFA), since 2003 – has thus far conserved over 100 ceramics from RUFA-sponsored excavations at Krek and Phum Snay in central and northern Cambodia, and from excavations at Angkor by the Japanese Government Team for Safeguarding Angkor (JSA) and the Ecole Francaise d'Extreme-Orient. This report provides an overview of the lab's operations, in areas of both conservation and education, and describes some of the results it has obtained.

The conservation process

Ceramics conserved by the lab are first evaluated as to their material composition, manufacture, formal characteristics, and, most important, condition. A work number is assigned to the artifact, a detailed report is compiled, before-treatment photographs are taken, and all this information is entered into the lab's digital database.

Although treatment options for perplexing ceramics may be discussed by the staff over the course of days or even weeks, many objects follow a consistent sequence of treatments. First, pottery is cleaned, starting with a light dusting by soft brush. Cleaning serves both to reveal the artistic features and physical condition of objects and to remove substances that may be harmful to the material, such as dirt that,

lodged in cracks, will likely expand with moisture and widen those cracks. Generally, earthenware must be cleaned with dry methods (by brush, latex restorer's sponge, scalpel, bamboo stick) because wet-rubbing would damage it, while higher-fired wares can withstand cleaning with water or organic solvents applied by brush, poultice, or cotton-tipped swab. Yet cleaning is hardly straightforward: surfaces may be found too fragile and require stabilization before cleaning can occur. Or questions may develop during cleaning about whether certain types of dirt are in fact original residues, such as byproducts of use, and therefore too important to the history of the pot to be removed at all. Some dirt is almost always retained, including burial dirt left in the interior to serve as a source of specimens for future testing and encrusted insoluble salts on the surface that resist safe methods of removal.

After cleaning, absorbed soluble salts are measured with a conductivity meter dipped into deionized (salt-free) water in which a small sherd has soaked. While stoneware and porcelain are rarely porous enough to absorb appreciable amounts of salt, earthenware frequently must be desalinated – if, that is, the clay can withstand the water-immersion normally used to soak out salts, a process similar to using water baths to rinse laundry soap from clothing.

Once cleaned and desalinated, ceramics are ready for sherd-assembly and – should it be needed – restoration. If pots have broken into sherds or larger sections, the work begins with infusing the edges of these pieces, through touches of a loaded brush, with a very dilute adhesive solution that becomes absorbed into the clay by capillary action. This conservation process, called "consolidation," strengthens the edges in advance of joining them and also partly seals them so that the adhesive used for joining will remain largely in the join, without dissipating by absorption into the clay body.

Assembly itself is an often lengthy and arduous undertaking (Figures 1 and 2). It has been said that there are only two kinds of joins, perfect and wrong, and the wrong ones must be redone. The fact is that a joining inaccuracy of even a millimeter will become compounded farther along in the assembly process, like a wrong turn early in a journey. Sherds added later will be out of alignment, gaps may develop where sherds ought to fit tightly together, and the entire shape of a pot may become distorted. For all these reasons, joins must each be as close to perfect as possible, and adhesives must be "reversible," that is, removable,



Figure 1: Before treatment.



Figure 2: After treatment.

to permit re-workings. The lab's adhesive, a 1:1 combination of Acryloid (Paraloid) B72 and B48,¹ purchased as pure pellets that can be dissolved as needed in laboratory-grade acetone, is readily reversible. Thus it can be softened with acetone or the heat of a hair dryer for making small adjustments or cleared away with acetone for removing sherds and then re-adhering them.

After assembly, or during it, the gaps left by missing sections may need to be filled to make the pot stable. Accordingly, the edges around a gap will be sealed with adhesive so that fill material won't permeate the clay and fills can be removed, if desirable, in the future. Then plaster is smoothed into the gap, often over a support of plasticene clay or a sheet of dental wax shaped to the missing area; the hardness and fine-grained texture of porcelain is usually



Figure 3: Painting done to integrate restorations with the original pot.

better matched by epoxy putty, however, rather than plaster. Once the plaster fills have been filed and sanded to refine their contour precisely, they are sealed on both sides with dilute adhesive to protect against moisture and then painted with acrylic paints, watercolors, and a range of acrylic glazes – the whole paint layer reversible in acetone – to blend with the rest of the pot (Figure 3). Sometimes fills are needed not structurally but aesthetically, so that a broken pot can be read as a single, integrated, understandable object; for example, the missing section of a rim may be restored.

Restoration raises complicated questions of how much to restore and how detectably or undetectably to restore it. While a discussion of restoration is beyond the scope of this report, it may be useful to note some guidelines set by conservation practice. Restoration should never invent spouts, necks, handles, or other elements that cannot be known with certainty from the pot itself or from duplicates found in museums or the ceramics literature. Restorations should not re-create more than half of a pot and paint it for undetectability, which, like invented appendages, would produce a falsified artifact. Restoration must never cover original surfaces. And restoration plans are best determined through discussions between conservators and archaeologists, curators, or other ceramics specialists. As a rule of thumb, however, the lab paints restorations so that informed viewers can detect them possibly from arm's length, but definitely from close-up (Figure 4).



Figure 4: Close-up of painted restoration.

¹ This combination was suggested by conservator Donna Strahan, who had developed and tested it at Troy. It combines B72, a conservation-grade acrylic resin widely used for ceramics and abundantly tested in Europe and North America for its ageing properties, with a conservation-grade acrylic with higher temperature-resistance, B48. While B72 alone has a softening point (glass-transition temperature) of 40 degrees C, the combination of the two resins raises this to an estimated 55 degrees.

Staffing

Work in the lab is performed by a Western-trained American head conservator and three Cambodian associate conservators. All RUFA graduates in archaeology, the associate conservators have received training designed as equivalent or superior to the preparation in ceramics given to the head conservator in the archaeological conservation program of the Institute of Archaeology, University College London. With expertise not only in the conservation of pottery, but also in technical aspects like firing events, manufacturing techniques, typological analysis, and excavation methods, the associate conservators will, upon completing their three-year training program in late 2005, become the first ceramics conservators in mainland Southeast Asia. With the departure of the head conservator after 2005, they will also become the co-directors of the lab.

Courses

The lab staff teaches a class on archaeological ceramics, covering ceramics history, science, technology, excavation, and conservation, in both Phnom Penh and Siem Reap. In Phnom Penh, at RUFA, the class is a semester-long course for archaeology undergraduates, who receive a Certificate in Archaeological Conservation when they finish the program (Figure 5). Class time is equally divided between lectures and small-group discussions, on the one hand, and hands-on lab work on the other. Lab projects include examination and analysis of pottery samples, pottery-making using traditional forming techniques and reproduced traditional tools, an open firing of pots produced by the students, and conservation of modern pots that students bury in the first week of class and later excavate.



Figure 5: RUFA students holding their Certificate in Archaeological Ceramics, 2004.

In Siem Reap, a ten-session version of this class, focused on safer ways to excavate, clean, repair, and mark numbers on ceramics, and expanded with lectures on the history of Khmer ceramics and studies of kilns in the Angkor region, was co-taught in 2004 with ceramics historian Ea Darith, then head of the research team at APSARA Authority. Hands-on activities in the class included pottery-making in the APSARA Authority ceramics studio, using clays and glazes compounded from raw materials found in the Angkor district. Attending the class were eighteen members of seven Cambodian and international archaeological organizations working at Angkor.

Findings from the ceramics conserved

The most remarkable ceramics the lab has conserved are six clay-and-iron "epaulettes" – so designated by archaeologist Dougald O'Reilly, who, with his team from RUFA, found them on the shoulders of skeletons at Phum Snay, an Iron Age site in northwestern Cambodia provisionally dated A.D. 300-600. Unexampled in Southeast Asian ceramics, although the horn motif they display appears in pottery from Thai sites like Lopburi, the epaulettes consist of an L-shaped fold of high-fired clay sometimes supporting an iron buffalo horn, or its traces, in the corner of the fold (Figures 6 and 7). One epaulette (Figure 8) has no horn but exhibits two bands of what appears to be a resin possibly used to affix a horn; a sample is being analyzed at the Freer-Sackler Gallery, Smithsonian Institution, Washington, D.C. While the ceramic portion of the epaulettes seems to have been cut from the neck and shoulder of a fired pot, it is a type of pot not yet found at Phum Snay. Rather, the angle subtended by the neck and shoulder used for epaulettes is more acute than that of most Phum Snay vessels, and the clay is dense and tempered with sand, unlike the porous texture and chaff-and-sand temper more typical at the site.



Figure 6: Epaulette before treatment.



Figure 7: Epaulette after treatment.

Another notable artifact conserved by the lab is a lamp (Figure 9) excavated by JSA from the North Pond of Prasat Suor Prat, Angkor. Ceramics historian Roxanna Brown (2004b) has identified this lamp as having the same shape as fire altars that appear regularly in temple friezes in central Java.

Figure 8: Epaulette displaying apparent resin.



Figure 9: Angkorian lamp that appears as a fire altar in central Java reliefs.



North Pond ceramics are further significant because of their extraordinary range, including unglazed, utilitarian, earthenware household pots (Figure 10); brown-glazed stoneware, like the lamp, typical of the Angkor period (Rooney 1983); and Chinese porcelains (Figure 11) dated to the 13th and 14th century (Brown 2004a). Because the soft mud of the pond obviates any stratigraphic structure, presenting instead a single unarticulated context in which all objects have settled, it is impossible to ascertain whether these ceramics represent a single time period or a sequence of periods. Specifically, perhaps the domestic earthenware was produced during the Angkor period, predating or coexisting with the production of glazed stoneware. Or perhaps it represents a pre-Angkorian settlement situated in the vicinity, a possibility consistent with reports of prehistoric artifacts at other sites at Angkor, such as Baksei Chamkrong and Chau Say Tevoda (Stark 2004), and with EFEO's findings of pre-Angkorian sites in and near the Western Baray.



Figure 10: Domestic earthenware from Prasat Suor Prat, Angkor.



Figure 11: Chinese celadon plate from Prasat Suor Prat, Angkor.

Finally, among earthenware and stoneware from several sites, there is evidence of variability in the kiln environment during firing. Confirming Marc Franiatte's observations that ceramics from the Royal Palace at Angkor Thom display under-fired areas, resulting from uneven temperatures within the kiln

(Franiatte 2000), the lab has conserved several hybrid pots, such as hard, high-fired vessels with a soft low-fired foot. The lab has also found that the line between the high- and low-fired regions marks not only a discontinuity in the clay body, but also an axis of fragility. One hybrid bowl, from Phum Snay, with differently-fired right and left halves, has broken exactly along this axis and also sprung; that is, the release of tension at the moment of breakage made one edge spring into distortion. Consequently the right and left halves, one with edges showing well-fired clay and the other with edges exhibiting a dark under-fired core (Figure 12), no longer fit together.

Similarly, the lab has found oxidized patches on otherwise reduction-fired pottery. In reduction firing, air vents on a kiln are closed down so that the fire, to keep burning, must augment atmospheric oxygen with oxygen taken from metal oxides in the clay and glazes being fired. The metals then become chemically reduced (e.g., the Fe^{+++} of Fe_2O_3 becomes the Fe^{+++}/Fe^{++} of Fe_3O_4), and most metals undergo a concomitant color change. Despite a reducing atmosphere throughout the kiln, however, air leaks can keep localized areas oxidized. Thus a gray (reduced) unglazed jar may have a red (oxidized) spot on its side, or a green-glazed (reduced) lid may have a beige (oxidized) top surface (Figure 13). Moreover, a cold draft of air into a reduction-firing kiln can produce an area on a pot that is both oxidized and under-fired. These variations, which turn up repeatedly, demonstrate the inconsistent environment inside traditional kilns, though the fortuitously placed bursts of brown on the olive-green glaze of certain frog-shaped lime pots in the National Museum suggest that known air leaks may sometimes have been exploited for the color effects they created.



Figure 13: Edges of broken bowl fired at inconsistent temperatures.



Figure 12: Reduction-fired lid with oxidized top surface.

Summary

Established as a resource for archaeological teams, ceramics researchers, students, and institutions housing ceramics collections, the Ceramics Conservation Lab is involved in conserving ceramics to museum-quality standards. Through conservation, training, courses in archaeological ceramics, and other services, the lab aims to improve the excavation and conservation practices applied to ceramics so that this key part of the Cambodian cultural heritage may best be understood and preserved.

Acknowledgments

The lab wishes to express its abiding thanks to the Honolulu Academy of Arts, which has sponsored the lab through a grant from the Carpenter Foundation, and to the sponsors of special projects at the lab: Global Heritage Fund, Friends of Khmer Culture, the U.S. Embassy Public Affairs Office in Phnom Penh, and Adopt A Pot. Our thanks also to our colleague Ea Darith for his suggestions for this report and to the administration of the RUFA Faculty of Archaeology.

References Cited

Brown, R., 2004a, Personal communication, 3 March 2004.

Brown, R., #2004b, Personal communication, 28 November 2004.

Franiatte, M., 2000, "Nouvelles analyses de la ceramique khmère du Palais Royal d'Angkor Thom: Etude préliminaire," *Udaya* 1 : 91-124.

Rooney, D. F., 1984, *Khmer Ceramics*, Oxford : Oxford University Press.

Stark, M., 2004, "Pre-Angkorian and Angkorian Cambodia," in Ian Glover and Peter Bellwood, eds., *Southeast Asia from Prehistory to History*, London, Routledge Curzon : 89-119.