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## **THE CONSERVATION OF TUMBAGA METALS FROM PANAMA AT THE PEABODY MUSEUM, HARVARD UNIVERSITY**

Scott Fulton and Sylvia Keochakian

### **Abstract**

A grant awarded by the Institute for Museum and Library Services (IMLS) made possible a major conservation initiative for an important but very fragile group of tumbaga (gold/copper alloy) figurines from Veraguas, Panama (ca.1300-1500 A.D.). Approximately 70 of these small pendants required immediate attention due to unstable mount materials and restoration adhesives used in the 1930's and 40's. Cellulose nitrate (Celluloid) was identified as the primary mount medium to which the artifacts were adhered. The adhesive and consolidant was identified as a polyvinylacetal resin (Alvar). The predominant corrosion product was identified as basic copper nitrate.

Conservation treatment included methods that allowed the safe removal of the artifacts from their destructive Celluloid mounts. Earlier excessive applications of Alvar adhesive needed to be reversed or reduced and loose extant fragments required reattaching. The removal of basic copper nitrate corrosion products was effected on a local level using solvent gel techniques. Delaminated fragments of gilding trapped in glue and left behind on the Celluloid supports, was reclaimed by an unconventional backing technique using gossamer nylon and a cellulose ether adhesive. Each of the tumbaga figures was re-housed to promote safer handling for research and to facilitate access in storage.



Figure 1. Tumbaga pendant (PMAE# 51-57-20/ 19300).



Figure 2. 1938 S.K. Lothrop, Sitio Conte, Veraguas, Panama (PMAE# 996-20).

### **The Collection**

In 2002 a grant was awarded to the Peabody Museum by the IMLS to support an ambitious but much-needed conservation project: the stabilization and re-housing of the Central and South American metal artifacts collections. This paper describes a small but significant part of the larger effort to re-house the Peabody's collection of Latin American metals. The end result of this project was the stabilization of nearly 1600 metal artifacts. The affected artifacts were drawn from general Meso- and South American collections that are of archaeological and ethnographic significance, including precious metals from the Sacred Cenote at Chichen Itza, and unique early silver-alloy metalwork from Peru.

165 tumbaga artifacts from the area of western Veraguas in Panama received treatment during this project. Of this number 65 were of primary concern and are the subject of this paper. They first came to the Museum ca. 1935 as new excavations along the Pan American highway yielded fresh evidence of pre-historic cultures at several sites including Sitio Conte. The tumbaga objects are representative of metalwork dating from pre-conquest Panama, approximately 1300 – 1500 A.D., and are indicative of a high level of technical sophistication and skilled craftsmanship.

Explorations in Panama by Peabody Museum archaeologist Samuel K. Lothrop (Fig. 2) resulted in new accessions of tumbaga figurines through the 1940's and 50's. Cast in zoomorphic and anthropomorphic forms (Fig. 3) from alloyed gold and copper, the artifacts discussed in this paper were extensively restored and mounted shortly after they were acquired during the early 1940's and prior to being placed in exhibit cases. Later acquisitions during the 1950's were treated similarly and placed on exhibition as they were accessioned. Issues of inherent vice associated with the materials used for restoration and conservation of the objects were not well



Figure 3. Tumbaga figurines (left to right, PMAE# 50-19-20/ 13294 and 40-17-20/ 7554)

understood then. Over a span of nearly 60 years the choice of what were at the time “modern” plastics and adhesives proved to be detrimental to the long-term stability of the objects. The pendants were on display for more than three decades until the late 1970’s when they were de-installed and placed in plastic bags. This re-storage measure proved ultimately to exacerbate the existing problems due to the incompatibility of mounting materials (cellulose nitrate) with a fluctuating micro-climate inside the polyethylene bags.

The process of organizing and stabilizing the collection was started in 1996 with efforts to identify the constituent materials and arrest various chemical mechanisms that were contributing to their unstable condition. Earlier storage methods causing problems included housings made of unsound materials such as matchboxes, cigarette boxes and peanut cans; dense packing of artifacts with little or no cushioning; and housings that limited accessibility of objects to researchers (Fig. 4). The tumbaga collection became a focal point because of the obvious evidence of conservation problems related to unstable mount materials and adhesives. Treatment methods and protocols evolved and underwent modifications as the conservators became more informed about the fragility of the tumbaga figurines.



Figure 4. Old storage systems.

### Manufacturing techniques

Most of the tumbaga pendants have an open back but others are hollow and could have functioned as bells or rattles. They were cast using the lost-wax method (*cire perdue*). The form was modeled in wax including all details, while the reverse or “hollow” sides were left rough. The wax model was encased in a clay mold which was fired to bake the clay and melt out the wax, leaving a void to be filled with molten metal. Once the metal had solidified, the clay casing was broken up, and the object cleaned. The result was a unique and individual casting.

The surface color of the objects could be modified by a process called “depletion gilding” (*mise-en-couleur*), a gold surface enrichment. The cast copper-gold alloy figurines were treated chemically to remove the base metal from the surface of the object giving the finished piece the appearance of high purity gold. Either mineral salts or acidic plant extracts could have been used for this procedure. Depletion gilding produces a well bonded but porous and spongy layer only a few microns thick, which was then burnished. A higher copper content would result in a more reddish color and a higher gold content produced a more yellowish color.

### Historical perspective and current condition

Non-gilded archaeological metals having a high percentage of copper are known to survive in better condition than gilded tumbaga objects primarily due to galvanic forces and preferential corrosion between gilded layers and the underlying alloy in a burial environment. The less noble copper will eventually corrode, the resulting corrosion products will undermine the gilding, and the thin gilded layer may eventually become detached from the heavily mineralized base alloy. Earlier experimental treatments of the 1930's and 40's for copper alloy artifacts at the Peabody Museum, followed procedures that were in common use at the time. Conservation theory and practice at the Peabody was influenced by active sharing and collaboration with conservators across campus at the Harvard University Fogg Art Museum. Rutherford J. Gettens, conservation scientist at the Fogg Art Museum between 1928 and 1951, suggested methods for cleaning bronze antiquities using solutions of sodium sesqui-carbonate as a means of chemically reducing copper corrosion product (Gettens 1938). Frederick Orchard, Peabody Museum restorer and contemporary of Gettens, reported using another treatment for removing extraneous burial accretions using Calgon (sodium hexa-metaphosphate). In a 1938 letter to curator H.J. Spinden at the Brooklyn Museums, Brooklyn, NY, Mr. Orchard describes boiling thin-plated copper objects [tumbaga] in Calgon to remove corrosion (Orchard 1938). The entire artifact was then, according to Orchard, "dipped into a 5% solution of Alvar 7-70 in acetone." (Orchard 1938). The same resin in a higher percentage was used for reattaching extant fragments together and affixing the figurines to the mounts. More recent condition assessments of the Tumbaga collections have noted that Alvar resin that was applied heavily in earlier treatment campaigns, had yellowed considerably (Gates 2004). Furthermore, thickly applied layers of Alvar had shrunk, resulting in a mechanical "pulling away" of original gilding from the base metal (Fig. 5). Over time, the Alvar had become increasingly brittle and cross-linking had rendered it less and less soluble in organic solvents.



Fig. 5. Delamination caused by Alvar coating (PMAE# 37-57-20/ 5154).

Most of these artifacts were glued down to cellulose nitrate mounts (Orchard 1938). Joins were often reinforced with cellulose nitrate backing strips. Wax, plaster and possibly cellulose acetate were also used but only infrequently. The condition of the figurines adhered to the Celluloid mounts was of primary concern. Cellulose nitrate is inherently unstable and slowly deteriorates over time regardless of favorable environmental conditions, controlled or uncontrolled. Negative bi-products released by degrading cellulose nitrate include nitrous and nitric acid that, combined with high humidity, react with copper alloy metals to form bright blue-green basic copper nitrate salts. Typical characteristics of cellulose nitrate deterioration include dimensional change, warping, embrittlement, cracking, sticking and color change (Fig. 6).

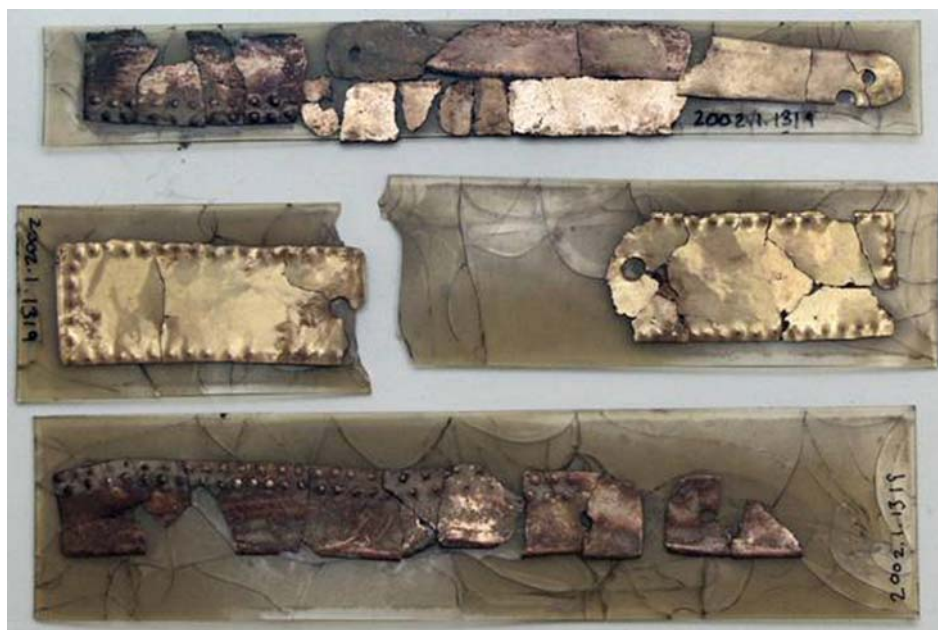


Figure 6. Deteriorated Celluloid mounts (PMAE# 2002.1.1319).

Since the mid-1970s, when the Veraguas Tumbagas were taken off exhibit and placed in polyethylene bags for storage (Fig. 7), they had been trapped in a micro-environment subject to acid off-gassing from the cellulose nitrate mounts, thereby accelerating the corrosion. Corrosion of the alloy was more prominent at contact points with the aging plastic. Many breaks occurred where the Celluloid sheet warped, cracked and crizzled, and the brittle metal failed at stress points (Fig. 8).



Figure 7. Tumbagas as found in storage.



Figure 8. Damaged Tumbaga figurine (PMAE# 37-57-20/ 4903).



## **A conservation strategy**

In 1996, a pilot research project was initiated, focusing on several tumbaga figurines, to determine an appropriate conservation strategy for the collection. A treatment protocol was established to address several goals:

1. Removal of the artifacts from the destructive Celluloid mounts.
2. Removal as possible of excessive coatings and adhesives.
3. Reduction of nitrate corrosion.
4. Reattachment of extant fragments.
5. Reclamation of detached gilding from the old mounts and replacement on the artifacts.
6. Consolidation of friable core material and delaminating gilding.
7. Preparation of individual housings to provide safer access for researchers.

The first stage was the removal of the objects from their encapsulating plastic bags and thereby slowing down the corrosion process. Corrosion products and support materials were examined and identified, methods for separating the figurines from their mounts were investigated, and methods for reclaiming gilding stuck to the old mounts were tested, while various re-housing options were designed and tested.

## **Removal from old plastic supports**

The figurines were placed in an acetone solvent chamber (Fig.9a – 9c) to gradually soften the mount and the adhesive, and to facilitate removal of the object from the mount. After extended exposure to the acetone vapors, the mount and adhesive materials were usually softened enough to carefully peel the mount away. Remaining fragments could usually be removed by direct injection of acetone between the fragment and the mount, and by a final acetone bath.

## **Reducing corrosion**

The blue-green corrosion was first identified as basic copper nitrate salts mixed with copper carbonates by x-ray diffraction analysis conducted at the Department of Earth and Planetary Sciences, Harvard University. Identification of the plastic supports as cellulose nitrate was confirmed by FTIR in the Straus Conservation Analytical Lab, Fogg Art Museum, Harvard University. Corrosion was locally treated by combining mechanical and chemical treatment methods. Dilute formic acid was combined with various gel materials such as Klucel G (hydroxypropylcellulose), Methocel A4C (methylcellulose), Polyacrylamide (acrylamide, methylene-bis-acrylamide) in an effort to achieve better control and to limit contact with the surface area (Figs. 10, 11). Areas of corrosion that failed to respond to any of the methods were left alone. Minimal disruption of the gilded surface was achieved using these techniques.



Figure 9. Removal from old mount (PMAE# 39-31-20/ 6392).



Figure 10. Corrosion removal using gel systems.

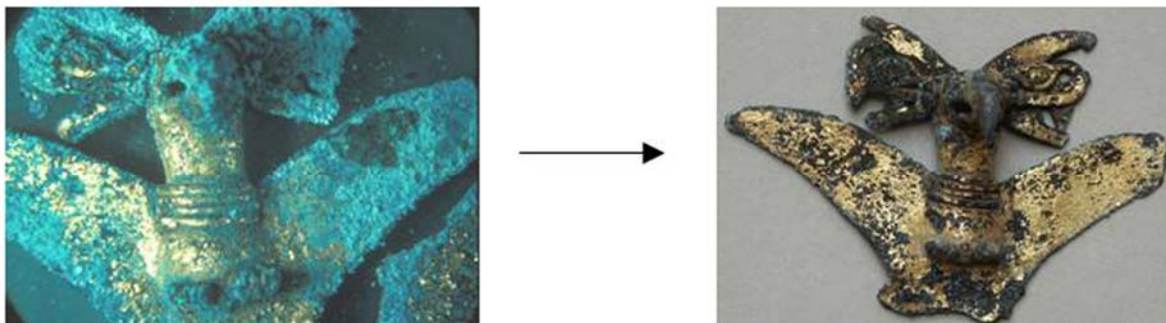


Figure 11. Corrosion removal before (left) and after (right) (PMAE# 40-17-20/ 7549).

### Reconstruction and reclamation

Extant fragments were reattached with Paraloid B48N (methylmethacrylate/butylacrylate co-polymer) (Fig. 12). Flaking gilding and brittle core material were consolidated with Paraloid B72 (ethylmethacrylate/methylacrylate co-polymer) in order to improve strength and integrity. Some joins were reinforced on the reverse side of the figurine with a backing strip of sheer nylon fabric (Cerex) adhered over the break edge. Gilding material that had become detached from the core material was reclaimed from the mount and reattached to the figurine (Fig. 13a - 13d). In preparation for reattaching the gilding, sheer nylon fabric was temporarily adhered with methylcellulose (Dow Methocel A4C) to the reverse side of the gilding. The mount with the gilding was placed into an acetone chamber for about 12 hours, an island around the gilding was cut out of the softened mount and placed into an acetone bath for several hours to dissolve remaining mount material. Excess fabric material was then cut away and the backed gilding fragment was positioned and reattached with Paraloid B72 over the area of loss.



Figure 12. Reassembling with gossamer nylon backing (PMAE# 54-1-20/ 19519).

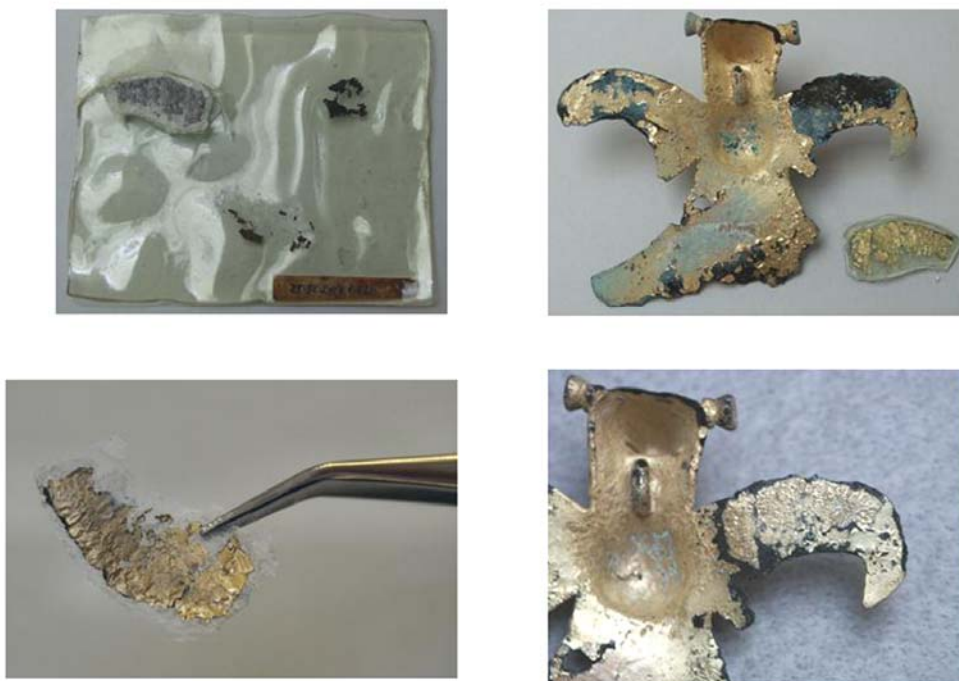


Figure 13. Reclaiming gilding from old Celluloid mount (PMAE# 39-90-20/6462).

### Storage mounts

After stabilization and treatment, the tumbaga objects were placed on custom made mounts made of archival corrugated board and nested in position between between Plastizote foam bumpers (closed cell polyethylene foam) (Fig. 14). If extant fragments or gilding could not be reattached, they were stored in vials, labeled accordingly and stored with the artifact on the same mount. Condition and treatment reports were entered into the Peabody Museum's relational data-base, 4D-EmbARK, while the artifacts were returned, in new housing, to collections storage (Fig. 15). This conservation support project successfully saw to completion the stabilization and repair of 100% of the Peabody Museum tumbaga artifacts in storage. Furthermore, it made possible an essential re-housing campaign affecting the remainder of the Latin American metals collections that safely opens the collection to future analysis and study.



Figure 14. New storage mounts (PMAE#'s 39-90-20/ 6465, 6468, 19300).



Figure 15. New tray storage.

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Stabilizing the condition of the Peabody Museum's tumbaga collection was first recognized as deserving of priority status in 1996 when collections care initiatives turned to the environmental needs in metals storage as identified in a 1992 IMS Collection Condition Survey. Since that time, the initiative to improve the preservation of these fragile objects steadily gained momentum thanks to the focused hard work and commitment shared by several conservators, conservation scientists and collections care specialists who participated in various phases of the project over the last ten years. Their individual contributions are greatly appreciated: Esther Chao, William Croft, Glenn Gates, Amy Groleau, Cricket Harbeck, T. Rose Holdcraft, Laura Lipscei, David Lange, Erin McGough, Susan Peschken and Amber Tarnowski.

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## Suppliers

Polyacrylamide gel materials (Acrylamide; N,N- methylene-bis-acrylamide; Ammonium persulfate; N,N,N,N – tetramethylene diamine (TEMED):

Aldrich Chemical Co., P.O. Box 14508, St. Louis, MO (800) 325-3010

Acryloid B-72, Acryloid B-48N:

Conservator's Emporium, 100 Standing Rock Circle, Reno, NV 89511 (775) 852-0404

Methylcellulose, Nylon gossamer fabric:

Talas, 20 West 20<sup>th</sup> Street, New York, N.Y. 10011 (212) 219-0770

Formic acid, reagent grade:

VWR Scientific, Inc., 50 D'Angelo Drive, Marlboro, MA 01752 (800) 947-4270

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