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Compiled by Virginia Greene and John Griswold

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FOREWORD

This, the fourth volume of the *Postprints* published by the Objects Specialty Group, includes most of the papers presented during the OSG session of the 1996 Annual AIC Meeting in Norfolk, Virginia. The papers relate to the theme of "interprofessional collaboration and inspiration". The topic was chosen to highlight ways in which conservators can and do draw from other fields for assistance and inspiration, and to emphasize the benefits of collaboration. As an adjunct to this idea, a sub-theme dealing with the selection, use and evaluation of proprietary products for conservation purposes was addressed by some of the authors.

The morning session began with Nancy Odegaard's account of a collaborative investigation of an archaeological object and its reburial. This was followed by a paper by Eric Hansen and Rosa Lowinger on the roles of the conservator and the conservation scientist in research and in treatments. Sadly, this paper is missing from the *Postprints*. Scott Nolley presented a paper addressing the use of thin layer chromatography for identifying components of colored natural resin finishes. Chandra Reedy et. al. presented a paper sponsored by the RATS group on the systematic evaluation of the Oddy test and the potential use of related tests borrowed from industry. This paper is, alas, also missing from our publication, and I hope it will appear in print soon in a professional journal. Nick Veloz presented his experimental use of an airless sprayer for applying wax to outdoor sculpture, an example of an ingenious yet simple adaptation of technology from another field. Donna Midwinter discussed several collaborative treatments in addition to the development of the Australian Survey of Sculpture, Monuments and Outdoor Cultural Material.

Tony Rajer's paper on Howard Finster's Bible House highlighted the close relationship required between client, conservator and other professionals in a complex and fascinating treatment. Ingrid Neuman and James Martin focused on a joint project between a conservator and scientist in designing a treatment strategy and evaluating proprietary products. Ginny Greene's account of the mounting of ethnographic featherwork and other artifacts in dioramas using mannequins made for the purpose from live models is another supreme example of collaborative ingenuity. Barbara Mangum and Valentine Talland, in two joint papers, brought the session to an end with two insightful accounts of conservators collaborating with a wide range of other professionals including scholars, scientists, engineers, technicians and others.

This compilation of papers was only minimally edited for format and punctuation. This is not a peer reviewed publication. The authors are encouraged to submit their papers to a juried publication such as the AIC Journal; they retain all rights of reproduction of their text and images.

John Griswold
OSG Chair
CONSERVATION AND COLLABORATION TO UNDERSTAND A TIPONI

Nancy Odegaard

Abstract

In this paper, the collaboration of a conservator and several specialists is discussed with regard to the identification, description, and preservation of an archaeological funerary fragment of painted fiber. Specialists verified the identity of the associated components. Information obtained from the conservator's technical study also enabled a cultural representative to interpret an otherwise unclear and mysterious object. This collaboration also identified the limitations of any conservation action and established that destructive analytical techniques and the introduction of additional materials such as consolidants were prohibited. A realignment treatment enabled the conservator to preserve the object in the state of deterioration found at the time of its excavation, thereby permitting accurate reburial. Together the technical study, realignment treatment, and a cultural comparison provided information that substantiated the preservation of cultural behavior spanning a period of almost 1000 years. This conservation effort was not intended to preserve the physical form of the object. Rather, through analysis and careful realignment it preserved an understanding of the object based on technical details that the conservator was particularly suited to obtain.

Background

In 1990 the environmental engineering firm of Dames & Moore was contracted by the State Office for Environmental Quality to survey and carry out a bio-remediation project of a site in eastern Arizona. The project was ordered after at least 25,000 gallons of gasoline and related by-products leaked from tanks and began appearing in the backyard ponds of down-grade property owners in the summer of 1989. These included high concentrations of benzene, toluene, xylene and ethylbenzene contamination.

The project area included a previously unknown prehistoric cemetery site. Though the contaminated land was privately owned, the Arizona Antiquities Act stipulates that a Notice of Intent to Disturb Human Remains must be filed with the Arizona State Museum (ASM). Under Arizona Revised Statutes § 41-865, the Arizona State Museum is mandated to assume the role of finding and consulting with tribal representatives regarding human remains that are determined to be over 50 years of age and from unmarked graves. In addition, Tribal Resolutions from the Hopi and a Statement of Cultural Affiliation from the Zuni were relevant to the project.

Once it had been determined that the burials were not contaminated and could be removed from the site, the bio-remediation firm subcontracted the archaeological excavation to employ professional methods to expose, map, photograph, and remove the burials. During the
excavation, information on the mortuary practice was derived from the skeletal remains and associated funerary objects. Deposits such as pottery were studied in order to identify the cultural affiliation and occupation dates of the site. Though not associated with the particular burial discussed in this paper, ceramics were associated with all of the other burials and ca. 1050 A.D has been suggested as the site date. Normal excavation techniques require that all remains and artifactual material be left until an entire burial is ready to be cleared. Thus, even extremely fragile, fragmentary, and pigmented objects may be left exposed for relatively long periods. Because conservation expertise is rarely solicited or available, most archaeologists working in the Southwest are inexperienced with organic material other than bone, and few practice the removal of objects by block lifting. This particular object was lifted onto the cardboard backing of a notepad and wrapped with aluminum foil. Notes made by the excavators indicate that their preliminary interpretation of the object was based on position and suggested that it may have been clothing. The fragmentary object was transported to a textile specialist for further examination and identification. In 1995 the textile specialist requested a conservation study because the object was painted and was not a textile.

Conservation Study

Accompanying the fragmentary mass of painted fibers were six pages of field notes and two 3 x 5 inch color in-situ photographs (Figure 1). The field notes indicated that the individual was an adult male (based on the pelvis) that had been placed in matting with the head positioned to the east, torso laid on the back, and legs flexed. The photographs and field sketches reveal that the object was placed in association with the proper left hand and over the groin area. The project archaeologists also reported that two turquoise pendants were located near the object and a small number of beads were scattered throughout the burial. They note that extensive disruption by rodents had taken place.

Under the Native American Graves Protection and Repatriation Act (NAGPRA), any interventive activities, such as excavation, examination, study, analysis, and reporting on associated funerary remains require respect and sensitivity. During the conservation study several object components were revealed, identified and verified through the collaboration of numerous specialists. Having status as an associated funerary object with a claimed cultural affiliation from the Zuni and Hopi tribes, the object could not be added to, restored, altered, preserved, or sampled using destructive techniques. The human remains, the 2 turquoise pendants and various beads did not accompany the fragment and were not examined in the conservation study.

The components identified in the conservation study included:
1) fiber: The overall structure of the painted fragments was incomplete, semi-flexible, flattened and with very little integrity remaining. Photographs taken during the field
excavation revealed that the object overlaid the human remains of the burial and that structural distortion and breakdown of the fiber had occurred, particularly on the underside and side edges of the object. General deterioration of the fiber consisted of rot, cuticular cracking and separation, and collapse of the stem. At first, the grass fibers appeared to be laid horizontally side-by-side in layers that were not interwoven. Approximately ten parallel elements formed the unit with partial stacking of additional elements. Further examination suggested that the shape may have been cone or cylinder-like with the structure of the object held in place by wrapping and overlapping of the fibers, or perhaps the fibers had been used to wrap around something no longer present. No evidence of adhesive joining or mechanical attachment, such as stitching, was found. The grass stem material was identified by Phil Jenkins of the University of Arizona Herbarium as giant drop-seed (*Sporobolus giganteus*), a tall grass having long spike-like panicles. Accounts of indigenous use indicate that it is an easily harvested food grain and that the stems are used in making *pahos* (prayer sticks) during the Hopi Soyal Ceremony (Dorsey and Voth 1901: 20). It grows at an elevation of 2500 to 6000 ft. and is common in the area of the site (Kearney and Peebles 1960:112-114).

2) Bone: Numerous medial and proximal phalanges (finger bones) appeared to be directly associated with the object and a fragment of the distal (lower) end of the femur (upper leg bone) was also present. This association suggests that the object was held in the left hand. The identification of these bones was verified by ASM Curator of Physical Anthropology, Walter Birkby.

3) Insects: The anterior body region or cephalothorax, the first appendage (base of the pediapalps), and partial legs (base of coxal area) of a spider (*arachnid*) were revealed. University of Arizona Curator of Entomology, Carl Olsen, verified the identification and added that the spider probably crawled into and was associated with object prior to the burial.

4) Seeds: Small dark colored spheres located throughout the artifact mass were identified as Amaranth (*A. cruentus*) by comparison with known specimens in the ASM collections. ASM Curator of Archaeobotany Suzanne Fish tentatively verified the identification. Accounts indicate that use of the edible seeds is ancient in the Southwest.

5) Feathers: The fragments of feather suggest that dark flight feathers were split along the shaft and that feather-halves were inserted horizontally between the grass layers so that the barbed area would extend outward from the fiber structure. There is some evidence that fragments of downy feather were inserted between the grass and paint layers throughout the structure. The fragments of feather were desiccated, brittle, matted, cracked and disrupted. Their identification as feather fragments, perhaps eagle or duck, was suggested by Tom Hules, ornithologist of the University of Arizona Ecology and Evolutionary Biology Department.

6) Pigments: Several examples of matte paint (coatings with high pigment volume concentrations in ratio to the binder volume in the same sample; Hansen et al. 1993:xiii),
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(without color mixing) that extend over several stems; thus, a generally vertical design that is complimentary to the vertical application of the brush strokes was formed. There is strong evidence of multiple paint layers, possible refreshing or overpaint. While a recognizable color design could not be identified, four stripes of black lines appear to form a pattern as they cross two stems in the lower center portion of the specimen.

Pigments used on the object include white (calcium carbonate), black (carbon), red (hematite), and blue/green (basic copper carbonate). The identification of these pigments was verified by Aniko Bezur of the University of Arizona Materials Science Department using environmental scanning electron microscopy and electron dispersive spectrometry (Hitachi E-SEM). Environmental scanning electron microscopy is a relatively new introduction to the art conservation field and offers a solution to the problems of moist and nonconductive samples (Stulik and Doehne 1991). The identification of an additional shiny and blackish pigment was identified as specular hematite based on visual and comparative observation and polarized light microscopy. Munsell numbers for the red color are 7.5 R/ 3 Value/ 6 Chroma and 7.5 G/8 Value/ 4 Chroma for the blue/green.

7) Binder: The non-volatile portion of the painted colors could not be confirmed. The appearance under magnification suggests that the primary vehicle (the liquid portion of paint in which the pigment is dispersed) was probably water or perhaps saliva for the blue/green, white, black, and red colors. This was based on the visible lack of adhesion between paint layers, flashing (patches of higher or lower gloss found at laps in brushed coatings), thickness, darkening, gloss and information from various ethnographic studies.

In the lower right corner specular hematite appeared as micaceous pieces in a dark, viscous, and amorphous material that resembled a visible binder. Tests done under the stereo microscope suggest that this material softens with water but not alcohol and was applied as a type of flow coating (the paint is poured or allowed to flow over the object without brushing). Though the appearance is similar to pinyon pitch [a diterpenoid], the material is more likely a honey (a Hopi suggestion) or yucca (Yucca baccata) fruit syrup [a polysaccharide] (a Zuni suggestion).

Though most of the bees in the Southwest are solitary, and social honeybees (Apidae) were not available before European contact, there are two possible sources for honey (Buckman 1996). One is the bumblebee (Bombus sp.) which although it is social (produces honey), is highly aggressive and stinging. Another possibility is that the honey was a trade item originating from the south (now part of Sinaloa, Mexico) where the stingless and social Trigona species bees existed.

A test for the presence of simple sugars (Stulik and Florsheim 1992) was modified to avoid destruction of the sample and was run against commercial honey and a blank. Despite the fact that the sample size was small (.0001 gr versus the 5 mg recommended) and unground...
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fact that the sample size was small (.0001 gr versus the 5 mg recommended) and unground (so that it could be returned to the piece), the test reaction produced a slight color formation. However, the test result was considered inconclusive because the sample reaction was difficult to see as blue-green. A confirmation using gas chromatography to separate the sugar mixture, and a mass spectrometer with chemical library to identify the ions in the compound in a magnetic field and get the molecular mass of the compound itself, would have required destruction of the sample. Members from the Cultural Preservation Committee of the Zuni tribe were asked about the object in 1996 but did not approve further destructive analysis testing.

Deterioration of the paint was more complex. The overall matte appearance and lack of physical integrity suggested that little binder was present (Figure 2). The rough paint surface also suggested that wide range of particle sizes may have produced increased voids or porosity in the film that made the paint more reactive to the deteriorative elements of the burial and excavation environments. Chalking, the presence of a loose removable powder evolved from the film itself at or just beneath the surface (Hess 1965:436) was evaluated using the American Standard Testing Method (ASTM) D 659. The test involved the comparison of paint transferred to a fabric against a photographic reference. Using the standard method of evaluating degrees of resistance to chalking ASTM D.659-44, the paints on the object were evaluated as white = no.6, blue/green >no.8, red >no.8, black = no.8, specular >no.8 (10 is low chalking and 1 is high). Flaking or the detachment of small pieces of paint film due to intercoat failure (Hess 1965:439) was evaluated using the ASTM D772-47 and overall the flaking may be designated as degree of No. 2 (10 is low flaking, 1 is high). In addition, the suggestion of fading or the physicochemical alteration of coloring matter made by comparison between the in-situ field photograph and condition during examination seems to be due to the accelerated chalking of the white calcium carbonate pigment.

Original Cultural Context and Use

Though the conservation study provided considerable technical information, identification of the object and further interpretation of its cultural use required further collaboration. Hartman Lomawaima, Hopi scholar and Associate Director of the Arizona State Museum, was asked to comment on the object. Though the painted fragments appeared to be culturally Puebloan, Lomawaima could not propose an identification without the information obtained through the technical study. Lomawaima considered the wrapped-like form of the grass fibers, the use of feathers and paint on the piece, and the association of the turquoise pendants as detailed in the conservation study. He then suggested that the object could be an object of record and function much like a talking stick or time capsule. He added that at Hopi, objects called *tiponi* are made of cotton wrapped into a cone-like shape. *Tiponi* have small objects such as feathers inserted and tied on as the structure is built up, they are painted, and they
symbolizing life and physical nourishment are beneath the plumes. Lomawaima mentioned that during use they are carried in the left hand like a rifle that is held upward from the butt.

The nineteenth century ethnologist Stephen (1936) provides extensive discussions and illustrations of the manufacture and use of *tiponi* at Hopi in the late 1890s. Stephen (1936:781-782) writes that

the *tiponi* were first obtained in the Underworld. Before the Hopi met together here, the chiefs each carried one. It is the mother of the people; in the interior are the seeds of all edible vegetation, all garden products, pinon nuts, cedar berries, every kind known to the Hopi. The feathers are eagle, turkey, parrakeet, yellow bird, all birds are typified or embraced. The cotton string wrapping is the garment; the bits of mother-of-pearl, turquoise, etc. tied around it, typify wealth...When people traveled in the early migrations, it guarded them.

Stevenson (1894:39-40) also provides some discussion of the manufacture of *I'arriko* at Sia Pueblo in the late 1880s (Figure 3). Stevenson (1894:9-40) writes that the *Ti'amoni* (meaning arch-ruler is instructed to make the *I'arriko* or supreme idol, which is

an ear of corn which may be of any color but must be symmetrically perfect, and not a grain must be missing, eagle and parrot plumes are placed in pyramidal form around the corn...The base of this pyramid is formed of splints woven together with native cotton cord and ornamented at the top with shells and precious beads. When completed there is no evidence of the corn, which is renewed every four years when the old corn is planted.

Additional discussion by Stevenson (1904:24,418-420), including several illustrations of *mili*, the sacred symbol of life and fetish of the Zuni, indicate that they are composed of seeds placed in the cavity of a perfect corn cob that is wrapped around. Feather plumes are arranged in specific order and pendants and beads are stung as a necklace for the object. Stevenson (1904:419) also suggests that four lines painted lengthwise are symbolic of the four regions.

It was suggested by Lynn Teague, textile specialist and Curator of Archaeology at the Arizona State Museum (1995), that because the date of the burial predates the cultivation of cotton (about A.D. 1100 for a noticeable scale of cotton production) among the Anasazi or Ancestral Pueblo Culture, it is likely that grass fibers may have been used for similar functions. She added that fiber matting blankets were reported for the burials, and that this is similar to the modern use of cotton textile.

Lomawaima was not certain how *tiponi* were positioned for burial but felt that a priest or chief would be buried with such an item if there was no person to inherit it. Previous
discussions of *tiponi* from archaeological sites have been limited to non-burial stone examples (Roberts 1932:61; Lange 1944:447; Jeancon 1923:64).

**Conservation Treatment**

The preservation of sacred objects and funerary remains among the indigenous groups of the Southwest varies. For example, while the Zuni may not wish to repatriate human remains, since 1978 they have actively sought the return of the sacred wood sculptures that may be painted or include attachments of other materials called *Ahayuida* or war gods (Ferguson and Eriacho 1990). The *Ahayuida*, are allowed to continue the deterioration process through placement in a roofless building that permits a continued natural decay while preventing theft and vandalism. As part of this bio-remediation project, representatives from the Cultural Preservation Offices of the Zuni and Hopi tribes were notified and have participated in the planned relocation of the burials. As they would like reburial of all remains and associated objects to occur near the present site, negotiations are under way for a suitable location. In addition, requests for research of the associated funerary objects have required written review and permission of the tribes.

When this mass of unassociated fragments and pigment was received, an acid free cardboard tray was constructed to support the cardboard notepad backing that had become weak and limp (Figure 4). Examination under a stereo zoom microscope facilitated a preliminary identification of the materials of composition and clarification for the state of deterioration. Fragments from the object were selected for various analytical procedures with the understanding that all would be replaced on the object. Thus they were not fixed (permanently mounted) and were replaced after analysis. Based on the image presented in the in-situ photographs and evidence of structure observed on the fragments, the fibers were realigned mechanically (Figure 5).

**Conclusions**

The conservation process for the *tiponi* was collaborative. Due to the legal status of this object and its implied cultural sensitivity, the conservation approach required: (1) a composition study utilizing non-destructive analytical techniques, (2) an assessment of the post-excavation deterioration process, and (3) a treatment that returned the object to its condition at the time of discovery be completed in a short period of time. Under more conventional museum circumstances the application of appropriate conservation techniques might have included consolidation, reassembly, and reconstructive restoration.

The context of the *tiponi* in a burial affords a discussion of ritual practices. Because the function and context of exotic or ritual objects may be derived through studies utilizing
prehistoric, historic, and ethnographic parallels; it is necessary to have an accurate technical
descriptions of objects that provide comparative details. In this particular case, the primary
archaeological requirement for this object was identification. The technical study and
realignment enabled a tribal representative to interpret the object and its function. The
treatment enabled the conservator to preserve the object in the state of deterioration found at
the time of its excavation, thereby permitting accurate reburial with the human remains.
Together the technical study, realignment treatment, and cultural comparison provided
information that substantiated the preservation of cultural behavior spanning a period of
almost 1000 years. This conservation effort was not intended to preserve the physical form of
the object. Rather, through analysis and careful realignment it preserved an understanding of
the object based on technical details that the skills of the conservator were particularly suited
to obtain.

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Figure 1. In-situ photograph of tiponi object.

Figure 2. Detail of painted surface.

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Figure 3. Sia *I-ar-ri-ko* or prayer plume illustration (Stevenson 1894, plate IX).
Figure 4. *Tiponi* object as received for conservation study.

Figure 5. *Tiponi* object after conservation study and realignment.
THE USE OF THIN-LAYER CHROMATOGRAPHY IN THE IDENTIFICATION OF HISTORIC ARTIFICIALLY COLORED VARNISHES AND GLAZES

Judith J. Bischoff, Scott W. Nolley and Jonathan Thornton

Abstract

Historically, natural dyes and resins have been used in the polychromed decoration of wood, as well as in clear colored coatings and glazes employed in the finishing of other types of artifacts. Largely impermanent as colorants, the presence of these materials in their aged and faded states can often go unrecognized when encountered in a darkened and yellowed varnish. Thus, it is important that the conservator be able to easily determine when an object has been intentionally colored. The goal of this study was to find a simple, low-cost method for the detection of colorants used in the historic production of such artifacts.

Thin-layer chromatography (TLC) was the principal method chosen for this investigation, based on its simplicity and low-cost. Some resinous materials used in the formulation of traditional varnishes, along with colored resins and natural and synthetic dye materials, were studied, alone and in combination. The method was assessed for its feasibility in the chromatographic separation of the various colored components and for its ability to aid in identification of these components.

Introduction

Capable of evoking sensation and emotion, color has always been an important element in human culture throughout its history. Colored materials such as pigments and dyes have historically been employed not only to embellish and enhance appearance, but to also indicate hierarchy and status. As the colored component in film forming materials, pigments and dyes have historically been employed to impart brilliant and transparent color to a wide variety of objects. Though a great deal of research has focused on the analysis of pigmented films, the research addressing the analysis of dyes and colored resins in colored varnishes appears limited.

For the conservator, identification of these materials in colored varnishes is problematic. Very often a pigmented surface coating, colored with a dyestuff and seemingly devoid of any colorant with discernible particle size, can be mistaken for a discolored varnish. The detection of such a colorant can be complicated by the altering effects of age. These determinations become even more of a problem to the conservator without access to the expensive analytical instrumentation that is required for these analyses. Often, the resulting data can only be accurately evaluated by someone having a great deal of experience with these materials.
What will be presented here is a brief overview of the colorants traditionally employed in these coatings, followed by methods for their identification including thin-layer chromatography (TLC). TLC was chosen for use in this investigation because it can be carried out on fairly small samples, requires only simple and inexpensive equipment, and has remarkable resolution in the separation of complex mixtures.

**History**

The procurement and use of dyes and pigments is as old as mankind. Tyrian purple, an early dye extracted from mollusks of the genus *Murex*, was used to dye the robes of senators in Rome. The extensive use of the blue dye indigo has been documented in India as long ago as 3000 BC. Important because of its exceptional lightfastness, this product of various species of the genus *Indigofera* was subsequently grown and exported around the world.

Of the red colorants, one of the most important was madder. This dye is a mixture of components, all anthraquinone derivatives, whose proportions are largely dependent on the source plant and the extractive process by which these materials are isolated.

The red dyes of insect origin are also anthraquinone derivatives. A by-product of the same infestation that produces shellac, Lac dye comprises up to 10% of the produced encrustation and is extracted with an aqueous base. Lac dye from India was so important in Europe that it gave its name to all other dye-based pigments as the term "lake." It was well known in Egypt and has been identified in Persian textiles from the 13th century. Kermes is the dye extracted from the bodies of the kermes insect. It was the principal insect dye in Europe before cochineal, also a scale insect, was discovered by Europeans in the Americas, where it had been used as a dye for centuries.

Red dyes extracted from the wood of several species of *Caesalpinia* were known as *brasil* wood. Having been imported from South East Asia, these materials were known in Europe long before the discovery of South America.

Natural yellow dyes are largely flavinoids, compounds quite common in the vegetable kingdom. Quercitrin, for example, was widely used in the 19th century. The most colorfast of the natural yellow dyes is obtained from weld, or dyers weed, and can be found in European textiles as well as Anatolian carpets. Saffron, the dried stamen of the bloom of the *Crocus sativus* yields a rather expensive yellow dye containing as its main colorant the glucoside crocin. A compound from buckthorn berries was used to produce the yellow lake called *Dutch pink*.

Most dyes can be made into insoluble pigments by precipitating the organic coloring material or dye onto an insoluble, transparent inorganic inert material. These materials possess particle
sizes in the range of other pigments and are called lakes. Known for their bright colors and transparency in organic binding media, these pigments lend themselves for use in the colored pellicular or binder-rich films known as glazes.

In addition to dyestuffs, another group of colored organic materials have also been employed in the fabrication of works of art. These brightly colored, water-insoluble plant exudates, known as resins, have always been attractive materials, historically incorporated into sealing waxes, adhesives and finish formulations based on other film-forming resins.

The foremost of these, the red resin dragon's blood, exists as two distinct types. One, the exudate of large trees that grow on Socotra and the Atlantic islands, the second, most commonly found today, is the product of the family Palmae originating in South East Asia. Other examples of red resins used as colorants are the accroides resins from the grass-tree, native to Australia. Dissolved in the coating, the presence of these materials is characterized by no distinguishable particles suspended in the film.

Natural dyes such as cochineal, turmeric, madder, and henna remained primary sources of dye colors until the commercial production of the first synthetic dye in 1856. This began the replacement of natural dyes with synthetics such as crystal violet and the triphenylmethyl dyes. In 1862 the discovery of the azo dyes, dyes manufactured from aromatic amines, revolutionized the dye industry.

Documentary evidence for the use of dyes in paints and coatings goes back to the 9th century Mappae Clavicula, a compilation of often fragmentary formulas from earlier sources that included recipes containing woad, indigo and lac.

When used as completely dissolved colorants in a drying oil, spirit varnish or oil-resin varnish these glaze formulations have served to expand the palette of wood polychromy. They have been used as a gold tone for white metal leafs and light woods and as translucent glazes for fine and decorative painting. In the 19th century colored varnishes and glazes were employed in the manufacture of japanned tin coated iron ware, papier maché and often over metal leafs and mother-of-pearl inlay. Toned varnishes and glazes were often applied to a paint in order to impart luminance and depth, for example a cochineal lake glaze over a red lead paint.

Preliminary Identification of Materials

When using any sophisticated analytical technique for the identification of colored materials, an historical understanding of the object as well as its visual examination can help to narrow the field of possibilities. For example, preliminary examination (prior to analysis by thin layer chromatography) of a varnish believed to be colored can not only reveal the presence of a colorant but can help to characterize the material. One such method is the examination of
the film in question with ultraviolet illumination. This can be clearly seen when reference samples of lake pigments in various binders are partially faded and compared to their respective controls under normal illumination and ultraviolet illumination.

Microscopic examination of a glaze or varnish sample is another simple diagnostic method. The presence of lake pigments is often clearly indicated by the characteristic appearance of the dye material bound to the insoluble inorganic substrate. In samples where the coloring material has faded, examination of the sample between crossed-polars can show the characteristic birefringence of the inorganic substrate when it is an anisotropic material. Conversely, colored resins and synthetic dyes do not typically exhibit particulate character under microscopic examination.

By integrating methods usually employed in the isolation of dyes from textiles, and the analytical technique of solvent extraction in sample preparation of colored varnishes for thin-layer chromatography, general assumptions regarding the identity of the colorant can be made. This information can then be used to fine tune the optimum conditions for accurate and clearly resolved chromatographic analysis.

Samples colored with lake pigments are treated with a few drops of sulfuric acid, which releases the dye from the inorganic substrate. Reference standards to be analyzed alongside the prepared unknown sample are treated similarly. Certain polygenetic dyes, dyes that display different hues under acidic and basic conditions, can be identified by their color changes at different pH values. For example, the synthetic dye brilliant yellow turns red when extracted under basic conditions.

Further characterization of a dye material can be made by examination of the organic phase in a solvent extraction of the dissolved film. For example, when samples of red dyes are extracted with acid, diluted with 1 milliliter of deionized water and shaken with an equal amount of low boiling point petroleum ether, madder and kermes go into the petroleum ether phase, coloring it orange. Cochineal and lac dye remain in the aqueous phase and can be extracted with pentanol. Ultraviolet illumination can be used to differentiate between madder and kermes, as madder exhibits a characteristic orange fluorescence. The petroleum ether and pentanol extracts can be washed with water to remove residual acid and used for identification of the dyes using thin-layer chromatography.

**Chromatography**

Chromatography, from the Greek for "color writing", is a method used in analytical chemistry to separate and identify the components of mixtures. The name derives from the earliest application of the technique, which was the separation of colored substances extracted from plants. Thin-layer chromatography was chosen for use in these investigations as it can be
Bischoff, Nolley and Thornton

carried out on extremely minute samples, requires only simple apparatus and has remarkable resolution in the separation of complex mixtures.

Thin-layer chromatography employs a stationary phase on an inert solid support, typically glass, aluminum or plastic. The thin layer, or adsorbent, is usually silica gel, alumina or polyamide powder deposited as a homogeneous layer on the inert support. The mixture to be separated is first dissolved in a volatile solvent, and a small sample of this solution is placed on one end of the plate with a small capillary tube. The solvent evaporates, and only the mixture to be separated remains on the plate in the form of a small spot. A glass tank is filled to a depth of approximately one centimeter with a carefully chosen developing solvent and the tank is covered to allow saturation of the tank atmosphere with the solvent vapor. The plate is placed in an upright position and the liquid rises along the plate by capillarity.

As the solvent comes in contact with the sample mixture, each molecule is transported in the flowing liquid, becoming attached, or adsorbed, to the stationary solid. The rate at which they do so depends on the mobility of the molecules, the temperature, and the binding forces involved. The length of time that each type of molecule spends in the mobile phase leads to a difference in the separation of substances. When the mobile phase has risen to within a few centimeters of the top of the plate, the development is stopped and the plate is dried. The plate is then examined under the appropriate visualization conditions for the material analyzed.

Plates spotted with resinous materials are developed twice with 5% methanol in xylenes, rotating the plate 90° for the second development. Plates spotted with extracted lake and synthetic dyes are developed once, with a solvent system consisting of chloroform, methanol, butanone and formic acid in the proportions of 6:2:1:1 respectively.

Visualization of Developed Chromatograms

Visualization of the developed chromatograms can be achieved by several methods, each giving different appearances. For example, iodine complexes with many organic materials and forms brown spots that are easily detected.

The most successful method of visualization for these materials, however, is ultraviolet illumination. In chromatograms visualized using UV illumination each of the natural colorants has a fluorescence fingerprint specific to that material, a pattern of spots of intensity and color that clearly identify the substance even in small concentrations. Ultraviolet illumination is also suitable in visualizing developed plates of synthetic dyes.
Analysis of Mixtures

These patterns seen for natural colorants are often identifiable even when present in complex mixtures. For example, TLC analysis of a colored shellac recipe from Robert Dossie's *Handmaid to the Arts* clearly exhibited the three spots characteristic of turmeric standard. Traveling the same distances on the plate as the reference materials, and distinguishable by their different colors under ultraviolet illumination, were the characteristic pale-orange spots indicating annatto, saffron and shellac.

Another example, even more complex, is Vernis d'Or, a gold varnish from a late 19th C. formulary. Characteristic bands can found in the TLC analysis; most notable are the spots indicating the presence of gamboge, sander's wood, dragon's blood and shellac.

**Case History: A 19th Century Box**

An example of the practical application of these techniques is presented in the analysis of a 19th century tinned-iron tobacco box coated with a varnish film colored with a yellow material. The exterior of the box displayed marked fading of the yellow colorant most notable in the exterior surfaces of the box protected by the lid. A sample of the coating was removed from the inside of the lid. Microscopic examination of the sample revealed a homogeneous film that did not appear to contain any pigment characterized by visible particles. The colorant appeared to be dissolved in the film, suggesting a colored resin or a synthetic dye.

For this analysis, a small amount of sample was dissolved in a 1:1 methanol:toluene solvent mixture and spotted on a polyamide plate against standards for a number of early synthetic yellow dyes historically used in paints and coatings. The standards for this analysis came from a reference collection generated by a workshop on early synthetic dye analysis given at the Smithsonian Institution's Conservation Analytical Laboratory.

The plate was developed, dried and examined under ultraviolet illumination. The solvent front, clouded by the fluorescence of the sample binder, indicated a single dark spot common to both the sample from the box and the reference for Martius yellow, an early azo dye used in paints, varnishes and lacquers as well as in the textile industry.

In an attempt to free the colorant from the binder material, the sample was extracted with a sulfuric acid and petroleum ether mixture. The two layers were separated and the yellow colored aqueous phase was extracted with pentanol. The pentanol extract was run against the martius yellow standard using the developing solvent best suited for dyes. After drying, the plate was visualized with ultraviolet light. A single spot, similar in color and position on the plate was found for both materials. This suggested that the yellow colorant used in the box...
coating is Martius yellow.

**Two-dimensional Chromatography**

Two-dimensional thin layer chromatography, also known as bi-directional thin layer chromatography, is a technique which is used for the separation of extremely complex mixtures. In such cases it is often necessary to use more than one solvent system in order to completely separate and resolve all components in the mixture. In this method, a square TLC plate is spotted at one corner with the sample to be analyzed and developed with the first solvent system. The plate is dried, rotated 90° and then developed with the second solvent system. Single spots arising from development in the first solvent system may be further separated into two or more spots upon development in the second solvent. This technique generally gives better overall separation and resolution than development in a single direction with a single solvent system.

Since a different solvent system is required for the separation of resinous mixtures than is used for dye mixtures, it was thought that two-dimensional (bi-directional) thin layer chromatography would be uniquely suited for the analysis of complex mixtures containing both classes of materials, such as the coating material on the tin tobacco box. This method has been used successfully for the separation of resin mixtures and for complex mixtures of dyes.

This method was applied to the analysis of a sample from the tobacco box. Two separate square plates were spotted at their lower right corners, one with the sample from the box and the other with the reference standard for Martius yellow. The two plates were developed first with the solvent system for resins. The plate was dried, rotated 90°, and developed with the solvent system for dyes. In this case, the similarities in color and position of the spots developed in both directions on the two plates clearly identified the dye in the yellow varnish to be Martius yellow.

This above example suggests that this technique shows promise for the analysis of complex resin-dye mixtures that have been used historically in the polychromed decoration of wood, as well as in the clear colored coatings and glazes employed in the finishing of other types of artifacts. Work is under way to further demonstrate the general use of this method for the analysis of metal alloys and mineral based pigments.

**Conclusions**

In a comparison of several natural dyes colored resins and synthetic dyes, thin-layer chromatography demonstrated remarkable resolving power and an ease of identification of
materials when compared against reference standards. Coatings that appear largely faded to the eye were easily characterized using these techniques. As with any analytical method, a certain fine-tuning of the procedure was often required to achieve optimum results and clearly resolved chromatograms. The resultant patterns clearly identify these materials when compared to their corresponding references. It should be noted that numerous factors can confuse the results however. Examples of these complication factors include extracting the colorants from extremely polymerized films, the knowledge that one might be visualizing the degradation products of these materials and the possibility that, over time, the applied film has incorporated extractives or other resinous compounds from the substrate. Nonetheless, dye identification techniques usually employed on textile materials and microscopic examination, in combination with thin-layer chromatographic analysis have demonstrated their value as valuable low-tech methods with which to approach the characterization of these materials.

Acknowledgments

This work is the result of a student research project carried out at the Art Conservation Department at Buffalo State College. Mr. Nolley would like to thank the faculty of the Art Conservation Department at Buffalo State College for their help and support during this project.

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Endnotes

1. "1 oz. turmeric, ground; 2 drams annatto; 2 drams saffron; 12 pts. spirits of wine (ethanol); 3 oz. seed lac." from Dossie, R. 1758. Handmade to the Arts. London.:J. Nourse bookseller.
2. “5 parts dragon’s blood, 5 parts elemi, 25 parts gamboge, 20 parts mastic, 12 parts sandarac, 20 parts shellac, 15 sanders wood, 10 parts venetian turpentine, 600 spirits of wine.” *Vernis d’or* from Andres, 1882. *Varnishes, lacquers, Siccatives and Sealing-Waxes.*

**Selected Bibliography**


DEVELOPMENT AND IMPLEMENTATION OF A NEW METHOD OF WAX APPLICATION FOR OUTDOOR SCULPTURE USING AN AIRLESS SPRAYER

Nicolas F. Veloz

Abstract

Waxes have been used for centuries to protect outdoor sculpture. Through the development of microcrystalline waxes and adjustments to formulations there has been a notable improvement in their serviceability. In a few instances, such as very smooth surfaces or rough textures, the application method has a significant effect on their longevity. This paper describes the development and implementation of equipment, materials, and techniques which allows the successful spray application of wax to outdoor sculpture.

Introduction

For almost 20 years we have used multiple coats of a variety of waxes as a protective coating for outdoor bronze sculpture conservation. Throughout that period, success (defined by uniformity of color and longevity of an effective, protective coating) has been increased through modification of the wax formulas and in the techniques used for the more traditional method of application (i.e. brushing the wax onto the surface). We have regularly attained two years plus serviceability from wax applied with brushes on sculpture having “normal” sculptural detail or surface finishing; however, very smooth finished pieces have not lasted as long because it has been impossible to get a smooth, uniform film thickness using brushes. Despite the type, shape, or size of brush, or what technique was used, we have always had some variation in film thickness because of brush-marks. Additionally, the surface has not appeared to be smooth, depending on light reflectance. These differentially thick coatings have also subsequently weathered in a manner corresponding with the brush marks and have consequently allowed streaky, localized corrosion. Similarly, such brush applied wax coatings has also affected the aesthetic appearance of plaques, particularly those with small sharp edged raised letters. No matter in what direction wax coatings are brushed, some portion of the letters scrapes the wax off the bristles resulting in significant unsightly areas of wax in the centers of “o”s, “p”s, “b”s, “a”s, lower case “e”s, and any other closed loop letter or figure, in addition to any excess wax elsewhere outside of the letters.

Spray Application of Wax

From almost the first use of wax as a protective coating, and realization of these problems, it has been felt that the spray application of wax coating would eliminate many of these problems; however, earlier attempts to spray wax using a variety of air-wax delivery systems proved to be unsuccessful. These efforts included the use of standard air-supplied spray guns (both pressure and syphon feed) and the use of a variety of hand-pumped sprayers such as
garden sprayers. In all instances these attempts have failed because the equipment required the wax be suspended "water thin" in solvent for it to be sprayed. This resulted in very thin coats, significant run off, puddling of wax in hollows and textured areas, and other similar problems. Since first learning of airless sprayers and their ability to spray thicker, more heavily bodied materials, I have wanted to assess their potential for spraying a thicker mixture of wax.

Airless sprayers operate differently from more readily recognized spray guns. Rather than atomizing and mixing paint (or other material sprayed, such as wax) in an airstream, which acts as a propellant; they are essentially high pressure pumps (operating at 1000 to 6000 pounds per square inch-gauge [psig]) and the material is atomized as it passes through a nozzle. This is similar to atomization produced by small hand misters such as those used for spraying cleaners and misting plants, albeit they operate at a constant flow and at much higher pressures. Due to cost (having to buy, with no return, an airless sprayer to even see if it would work), or having to rent one which had unknown materials previously sprayed through it or was in questionable mechanical or operating condition, and a variety of other factors, it was not possible to assess the potential for the use of airless sprayers on outdoor sculpture until the summer of 1995.

Preliminary Tests of the Airless Sprayer

For the test, the wax mixture normally used for brush application in the conservation of outdoor bronze sculptures was thinned and remixed to a thinner mixture, somewhat approaching the consistency of yogurt. Preliminary tests were carried out on newspaper and pieces of corrugated cardboard. There was some experimentation with nozzle sizes to see how the material flowed, and after determination of what was felt to be an acceptable flow rate was established it was possible to spray an even, uniform coating on the surface of the test materials. Following these preliminary tests, an old, no longer used cast iron plaque having raised lettering was sprayed. Further tests were conducted spraying the inside of a closed space, with small corrugated boxes used to simulate closed recesses of sculpture such as areas beneath coats, etc. This was done to assess the potential of "blow-back" which occurs when a conventional air/fluid sprayer stream is directed into a confined space. With conventional spray equipment the volume, turbulence, and velocity of the airstream/fluid is redirected or bounced from the walls or back of the space causing it to forcefully exit any opening through which it is sprayed. Later, additional tests and practice sessions for development and improvement of actual application techniques were carried out on kraft paper — shown in Figure 1. Standard commercial spray guns use approximately 5-7 cubic feet of air per minute, at pressures of 30-50 psig. Due to such blow-back little or very uneven deposition of material is actually deposited on the surfaces of confined spaces being coated. Since an airless sprayer does not have this large quantity of pressurized air transporting the coating material, there is little blow-back. Through these tests we found that
Despite the air turbulence caused by the atomized wax spray, it was possible to uniformly coat the inner surfaces of confined spaces similar to those often found on outdoor sculpture.

With both conventional and airless sprayers it is possible to have some control of the coating or film thickness through operator application adjustments; such as speed of stroke, variation in working distance, and number of applications or coats. More definitive, rigid, or fixed control is normally accomplished through equipment adjustments or settings. Air flow (volume) of conventional spray guns is controlled and adjusted through the use of a regulator to control the air pressure. They normally have two adjustments on the gun itself, control of the fluid flow rate and an incremental or gradual adjustment of the spray pattern from circular to fan-shaped. While these two controls allow for a wide variation in quantity of material delivered and in the width of the spray pattern, in fact, they both ultimately control the film thickness or buildup of material deposition. In contrast, an airless sprayer only has an adjustment for the fluid pressure (volume) and, since there are critical minimum and maximum pressures at which the nozzle will properly atomize material, in reality any change in flow rate, or spray pattern width (and ultimately film thickness) must be accomplished through the selection of different spray nozzles. A wide variety of nozzles are available which vary according to pattern shape, (straight or tapering at the ends), width (normally rated at a standard distance of 12"), and diameter (controlling flow rate). Thus, adjustment of the application rate is accomplished by selection of the appropriate nozzle, made on the basis on one (or a combination) of these variables according to experience or tables provided by the manufacturer (Figure 2). It has been found during the actual application of wax to outdoor sculptures that sometimes adjustments to the flow rate are required because of temperature changes; the wax solution being significantly thinner in consistency the warmer it is, as the solubility of the various wax constituents in the solvent changes with temperature.

The particular model of sprayer and gun used (Graco 390STS with “Contractor” gun) have an internal wire mesh filter incorporated in the handle of the gun to strain out contaminants. It was found during the initial tests that this was not completely effective in straining out particles of undissolved wax and there was a potential for the tip of the gun to clog. In an attempt to rectify this problem, two alterations were made to the system. A Revers-A-Clean™ tip (a “T”-shaped nozzle that can be rotated 180° to clean any stoppage by a quick pull on the trigger which generally flushes it clear — see Figure 3) was installed, as was a second in-line filter, mounted just downstream of the pump.

**Case Study: Low Relief Plaques**

Two low relief plaques mounted on the south side of City Hall in Philadelphia, PA, were used for a test comparison between the spray and brush application of a second wax coat. Both plaques were blasted with walnut shells and washed with detergent and water to clean them of previous coatings and loose/friable corrosion products. They were then treated with 2%
Benzotriazole (BTA), washed again, dried and given a coat of wax using what is commonly called “hot wax treatment” (Veloz 1986; Veloz 1994 describe the process). In both cases they were heated to the melting point of the wax and paste wax was applied using stencil brushes in a scrubbing motion. After the plaques were allowed to cool, the “Swedish Settlements on the Delaware” plaque was masked to protect the stone and a second coat of wax was applied utilizing the airless sprayer. The “Dutch Settlements on the Delaware” plaque was given a second coat of wax using long bristled brushes. In both instances the plaques were then again heated with a torch to level these wax coats and to provide a basic “shine”. They were then cooled with a garden hose utilizing a spray nozzle and buffed using shoe buffing brushes and soft, damp, cloths. The spray coat on the Swedish plaque seemed to buff more easily, and to be more uniform in the appearance of the coating, also, there was no excess wax surrounding the lettering of the plaque as occurred in some areas of the Dutch plaque. The two plaques are shown in Figures 4 and 5.

Case Study: Jacques Lipchitz Sculpture

After the tests were completed on the plaques, the City of Philadelphia Fine Arts Advisory Committee authorized the use of the spray application of the second coat of wax during scheduled conservation treatment of the 35' tall Jacques Lipchitz sculpture, Government of the People, located in the Municipal Services Building Plaza, across the street from City Hall. Figure 6 shows the actual spray application of wax to the Government of the People. As with the Swedish plaque, the sculpture received the following treatment: washing with detergent and water utilizing a pressure washer, blasting with walnut shells (60/200 mesh at approximately 30 psig pressure), again washing with detergent and water, treatment with a 2% solution of BTA, the hot wax application of the first coat of wax utilizing stencil brushes, and finally the application of the second coat of wax using an airless sprayer. This coat of wax was allowed to remain overnight to allow evaporation of the solvent. It was then heated with torches to incorporate into the coating all wax particles left on the surface by the spray. Following this the surface was cooled with hoses and buffed using rags and brushes.

Because of the sheer size of the sculpture it required about 6 gallons of the wax solution for the application. There was a considerable number of incidences of stoppage of the spray nozzle, however these were easily dealt with utilizing the reversible feature of the nozzle. This problem was felt to be significant and would have to be ultimately solved, if for no other reason than to decrease the operator frustration and annoyance level. As before, the wax for this project was a thinned and remixed paste and it was felt that this did not adequately break-up any particles or “clumpages” of the various wax constituents.
Veloz

Additional Experience

Subsequent uses of the technique on several sculptures has utilized a recalculated formula which allows for the additional solvent necessary to make the proper consistency during initial wax preparation, rather than a diluting and remixing of a thicker paste formula. It was also found that if the mixture was stirred for approximately 2-3 minutes each hour during the cooling process there was a significant decrease in the number of times that the nozzle stopped up. In fact, it has been possible to spray a complete life-size or even heroic sculpture without a single stoppage of the nozzle. One of the several sculptures subsequently treated utilizing the airless sprayer for application of the second coat of wax is illustrated in the before (Figure 7) and after (Figure 8) photographs of Victory, located in Frederick, Maryland.

Acknowledgments

Gratitude is expressed to Mr. Paul Dent, Regional Manager for Duron Paint Stores who was responsible for making arrangements to test a new sprayer at the General Greenway Store; and Mr. Tim Powers, spray gun technician, who assisted in providing information and expertise that gave a starting point for the initial tests. Since the first trial Mr. Powers has continued to provide assistance and guidance to improve the system. Without their assistance this technique would not have been developed by this author.

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References


Figure 1. Test/practice application of wax using an airless sprayer. Proper material consistency, speed of application, working distance and nozzle selection allowed a smooth uniform application of wax onto a sheet of kraft paper.
**Veloz**

### Fine Finish Tip Chart

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Selecting the right orifice size for your job depends on the viscosity of the material you're spraying, the minimum pressure it takes to atomize it and the fan size you choose to do the job.

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**Filter Chart**

The Correct Filter Reduces Tip Clogs.

This chart is a guideline only. Filters do not eliminate tip clogs. Some coatings can pack out finer mesh filters. If that happens, use the next coarser filter and a Graco Reverse-A-Clean™ Tip.

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Figure 2. Tip Chart giving Orifice Size, Fan Width, and Flow Rates allows for proper selection of tips based on desired parameters. (Graco, 1992).
Figure 3. Exploded Graco “Contractor” gun showing control fluid hose, handle containing screen or filter, control trigger, and Revers-A-Clean™ tip.
Figure 4. Plaque commemorating the Swedish settlements on the Delaware (Philadelphia).

Figure 5. Plaque commemorating the Dutch settlements on the Delaware (Philadelphia).
Figure 6. Spray application of the second coat of wax to *Government of the People* (Philadelphia, Pennsylvania).
Figure 7. Giuseppe Moretti, *Victory* (World War I Monument), located in Memorial Park, Frederick, Maryland, prior to treatment.

Figure 8. *Victory* after treatment. Sculpture and commemorative plaques were washed with detergent and water, blasted with walnut shells, treated with BTA and waxed. First coat of wax was applied with stencil brushes, second coat was sprayed using an airless sprayer.
DEVELOPING THE AUSTRALIAN SURVEY OF SCULPTURE, MONUMENTS AND OUTDOOR CULTURAL MATERIAL

Donna Midwinter

In 1990, when I last had the opportunity to attend the American Institute for Conservation Annual Meeting, the acronym SMOCM did not exist. At that time the Australian Survey of Sculpture, Monuments and Outdoor Cultural Material (SMOCM) was in its embryonic stage.

A small dedicated group of conservators who recognized their common interest in outdoor monuments was beginning to meet to discuss relevant conservation issues.

Over the subsequent six years this small group of a dozen or so conservators has grown remarkably. We registered ourselves as a special interest group of the Australian Institute for Conservation of Cultural Material (AICCM) in 1990. Now SMOCM has a small operating budget, enabling us to communicate regularly with 1000 people throughout Australia via our quarterly newsletter.

Our main target group for promoting awareness of outdoor sculpture remains the local councils (municipal governments), as they are the custodians of most outdoor heritage items. Under the Australian Heritage Act of 1977 the local councils are responsible for maintaining a register of heritage items. Hence a ventures similar to your Save Outdoor Sculpture! (SOS!) has been created and is gaining momentum across Australia.

The development of a strong conservation network through SMOCM has provided a tremendous forum for sharing ideas. At meetings we have discussed a variety of conservation issues, including identification of materials; the historic and artistic significance of sculptures and monuments; processes of manufacture; causes of deterioration and treatment materials and techniques.

In order to cover all this ground, we have sought advice from other professionals and craftspeople such as architects, archaeologists, curators, artists, engineers, scientists, plumbers and founders.

Custodians of outdoor heritage collections now seek our advice regarding care of their material. This demonstrates that the care of outdoor collections is being viewed as a responsibility warranting professional attention.

The aspirations of conservators interested in outdoor collections has grown and evolved to the point where we are now embarking on a national program to create an Australian database of outdoor sculpture and monuments. Project coordinators are employed in New South Wales and Victoria. Pilot projects have been completed and data, including images and maps, are being entered on computer. A quarterly newsletter is being produced called Monumental Trackings. Volunteers are being taught to carry out survey work and we will soon be running
workshops for councils that have already completed their surveys. The workshops will address management issues for outdoor collections.

I would like to thank Susan Nichols, Director of Save Outdoor Sculpture! She visited Australia in 1994 and acted as a catalyst for the development of the Australian survey of SMOCM. Through Susan's enthusiastic description of SOS!, Australian conservators were able to visualize the many benefits of such a project.

The SOS! project has provided ongoing inspiration for me. I recommend that you find out more about the SOS! survey in your area, and get involved. The networking possibilities in your community, across the country and as far away as Australia are enormous.

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CONSERVATION OF HOWARD FINSTER'S ECCENTRIC BIBLE HOUSE

Anton Rajer

The Bible House (Figure 1) is one of the Reverend Howard Finster's pivotal works of art, created circa 1976-77 as a juncture between his ambition to "collect one of everything in the world" and his calling as a full-time artist. The artifact is a large-scale assemblage - 16 ft. wide by 8 ft. deep by 12 ft. high - composed of discrete elements including found objects, tools, hand-painted signs, gifts, paintings, newspaper and photo collages, as well as a plethora of mirrors and furnishings, all enhanced with Biblical text, that make it a unique example of modern religious architecture. It is a chapel without an altar, a simple vernacular structure transformed by Reverend Finster into a powerful religious statement.

Reverend Howard Finster

Born in Valley Head, Alabama, in 1916, Howard Finster grew up with little education. At the age of sixteen, he became an Evangelical Baptist preacher, and through the years he has pastored at least ten churches. Married to wife Pauline for over sixty years, he has five children and many grandchildren.

What later became known as Paradise Garden sprang from Reverend Finster's hobbies as collector and handyman. Without a specific or long-range purpose, he began collecting pieces of popular culture and repairing bicycles and lawnmowers. Around 1965 he opened his sizable display to the public. Shortly thereafter he began to embellish the Garden with his own unique pieces of assemblage art, hand-painted Biblical texts and architectural environments. Finster, who calls himself "a man of vision", has repeatedly had visions from God, many of which instructed him to build the Garden.

In a vision in 1975, the Lord told Reverend Finster to make sacred art. This vision took place while Howard was painting a bicycle. He saw a tiny painted face on his finger and felt the presence of God, who spoke to him: "Howard, make sacred art to help people with salvation and heaven". Shortly after, he began to transform a simple wooden structure in the Garden into the Bible House. Today it stands as one of the finest examples of Finster's creative genius.

Reverend Finster is not only an active artist, but also an author and musician. His vita is filled with numerous honors, awards and popular recognition, including the album cover he produced for the rock band Talking Heads, all of which show indisputably that Finster is one of this century's most prolific and well-known folk artists. To date he has created more than 39,000 works of art, but his earliest and most important is the Bible House.
Conservation Treatment

Early in 1995 the Bible House was transported from Paradise Garden in Summerville, Georgia, to Atlanta, where it was placed indoors for preservation. Due to swamp-like conditions at Paradise Garden, as well as constant exposure to the elements, the exterior of the house was severely deteriorated (Figure 2). A conservation project was designed to fumigate, clean and stabilize the structure. A wheeled wooden base, painted black, was attached to the underside of the Bible House for structural support. The conservation staff then thoroughly vacuumed each surface and repaired broken eaves with hide glue (Figure 3). The mirrors, furnishings and glass surfaces were cleaned many times with cotton swabs and a 3% solution of Orvus and water. Metal surfaces, like the canteen and iron wrench shown in Figure 4, were cleaned with alcohol. All painted surfaces were stabilized with an application of BEVA D-8 to retard flaking. In addition, insect infestations, dirt and pine needles were removed from the interior and exterior of the structure.

A concerted effort was made to include curatorial input and consultation with Reverend Finster on his house. The glass mirrors (over 45 in number) were cleaned and placed as closely as possible to their original position in the house (Figure 5). Throughout the entire process the aged and weathered appearance of the house was maintained as an integral part of the aesthetic associated with folk art. In addition to standard written documentation, the house was photographed at every stage in the conservation process.

Related Aspects of the Client and Conservator Relationship

The conservation of the Bible House benefitted from flexible, proactive relations between client and conservator. A smooth working relationship was established through frequent meetings, to keep all parties informed. The conservator empowered his staff to do their best and ask frequent questions. Above all, a sense of humor was maintained - along with the personal element of prayer - to manage the respectful and thorough conservation of the Bible House.

Summary

The Bible House is now on permanent display at John Wieland Homes. In their continuing commitment to acquire significant works of art that relate to architecture, Mr. and Mrs. John Wieland procured the Bible House in order to save it for posterity and to assure that future generations will be able to enjoy this unique example of the marriage of art and architecture popularized by Finster's folk art.
Rajar

Acknowledgments

The author would like to thank Mr. and Mrs. John Wieland, Joanne Cubbs, Jennifer Ray, Saskia Benjamin and Jim Allen.

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Figure 1. Howard Finster's Bible House.
Figure 2. Exterior, showing deterioration of surface.
Figure 3. Detail of exterior: vacuumed and repaired.
Figure 4. Detail of interior, with metal canteen and iron wrench.

Figure 5. Interior, showing mirrors.
WHERE EAST MEETS WEST: THE CONSERVATION OF A MODERN, LARGE-SCALE, BLACK LACQUER SCULPTURE EXHIBITED IN A PUBLIC SPACE

Ingrid A. Neuman and James S. Martin

Abstract

A non-representational, black lacquer sculpture by Gyora Novak, entitled "Links, 1965", was examined and treated during the summer and fall of 1995. Fabricated in the 1960s, this sculpture has been exhibited in a public, non-climate-controlled space for twenty years. Minimal maintenance of the sculpture has been performed during this time and although its structural condition appeared sound, its superficial condition was poor: scratches, gouges and losses marred the originally pristine and highly reflective surface.

Technical analysis revealed the materials and method of fabrication, and identified the black finish as urushi, a traditional Asian lacquer. As the artist was known to be living, attempts were made to contact him in order to discuss aspects of the sculpture's fabrication and the artist's preference for its display configuration. Because of the future exhibition plan for the sculpture, non-traditional materials and methods were used for treatment of the lacquer surface. Proprietary materials were ultimately utilized because of their effectiveness, as well as time and budget constraints and the environment to which the object would be exposed. Since consultation with the manufacturers of the materials used in the treatment and the Material Safety Data Sheets (MSDS) were non-conclusive, materials analysis was performed in-house in order to complete thorough documentation of the conservation treatment and to aid in determining the applicability of these proprietary materials for future conservation projects.

This presentation will focus on issues relating to the conservators' rationale and choice of conservation materials based on the scale, the kinetic nature and the future exhibition configuration and site of the sculpture.

Introduction

To conserve a living artist's work of art, it is imperative to attempt to make contact with the artist in order to more accurately ascertain, and to seriously analyze, what role it is that we play as conservators. For this reason, I was determined to pursue Gyora Novak, the artist on whose sculpture this paper focuses. As a conservator of the works of living artists, I continually attempt to define my precise role. Do we not, as advocates for the artwork, have an obligation to record often previously undocumented working methods and materials? As conservators, do we not have more intimate knowledge of this information than, for instance, many art historians? To what extent and how vigilantly should we seek out and establish how living artists envision their sculpture evolving throughout time, in some cases

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intentionally deteriorating either structurally or superficially? Should we not attempt to contact and inform them that their work is undergoing conservation, involving them in the process, pursuing discussion regarding why certain materials and procedures are being utilized? Ultimately what are or should be our ethical and legal protocols, procedures or standards?

In an effort to determine the most "accurate" display configuration for this sculpture entitled "Links, 1965", I sought out the sculptor. A series of photographs existed in the institution's files recording a variety of visual interpretations, and there were unresolved questions that came up during the course of the examination which I felt required answers only the artist could provide. Were there specific curatorial considerations which had gone into the previous display decisions? What role should the conservator have in these choices? And, logically, shouldn't a living artist be consulted if possible to determine the future exhibition configuration if it seems ambiguous? It is interesting to note that throughout the duration of the examination and treatment, we received numerous inquiries regarding the background of, and the exact materials used to create, this sculpture. It became clear that there was ambiguity in the visual reading of the surface and a lack of understanding of the quality of the materials and their execution, as well as of the engineering and mechanical details that had been used in its manufacture. I believe education of the public will always be a large component of our roles as conservators.

History of Acquisition

"Links" is among ninety-two two-dimensional and three-dimensional works of art which were purchased between 1966 and 1973 representing examples of the most important artists living and working in New York State. This concentration of art on permanent exhibition at the Governor Nelson A. Rockefeller Empire State Plaza in Albany was the vision of its namesake and is dedicated to the people of New York State. This collection represents one of the first organized collaborations of modern art for the public in the United States. The above-ground, outdoor space in which numerous sculptures are exhibited measures approximately thirty-five acres, while the below-grade exhibition area is one-quarter mile in length. The chief architect of the Plaza was Wallace K. Harrison, well known for his love of modern abstract art which he incorporated into many of his architectural creations (Empire State Plaza Art Commission, 1987).

An Art Commission, appointed by Governor Rockefeller in 1965, was responsible for the selection of the modern, abstract art which was to ornament the government buildings. Rockefeller and his art commission were dedicated to abstract art, which they believed to be "the most important development in contemporary American art" (Empire State Art Commission, 1987). The collection focuses on art created in the sixties, contemporary with the buildings which house it. No additional acquisitions have been made to the collection since its inception.
Four-fifths of the ninety-two works were purchased directly from New York galleries for the Plaza Art Collection; sixteen art works were commissioned. The artists in the latter instance were provided with architectural blueprints. Several of the artists were personally invited to select sites for their art once it was purchased by the commission (Empire State Art Commission, 1987).

The sculpture "Links" by Gyora Novak was purchased from a New York City gallery in 1967 (Figure 1). The prototype for this sculpture had been previously on display at the Whitney Annual from December 16, 1966 to February 5, 1967 and is documented in the Whitney Museum of American Art 1966 Annual Exhibition of Sculpture and Prints catalog. The entire "Links" collection is comprised of ten sculptures and had been previously exhibited in its entirety at the Poindexter Gallery in New York City in 1956 (Novak, personal communication).

An exact copy of the "Links" exhibited at the Whitney was then commissioned from the artist and sent directly from Japan to Albany, New York (Novak, personal communication). This piece was purchased using funds designated for "Wall Sculpture on the Concourse Level Lobby" (Curatorial files). The sculpture is currently located at the base of the Justice Building which is at one end of the underground or concourse level. This concourse serves as a self-sufficient underground world for the state workers who would rather not venture out for six months of the year due to the harsh upper New York State winters. Trade shows and festivals, florists and exercise demons create an obstacle course on the concourse most days.

The environment in the concourse is set for human comfort. As access to the out-of-doors is located at several points throughout the concourse, sensors which regulate the relative humidity and temperature are only found in the office areas on the higher levels. The sculpture faces a small convenience store and at one time was situated directly above a temporary newsstand.

**History of Exhibition: Placement, Technique and Configuration**

A memorandum regarding the installation of the sculpture, dated September 17, 1974, from the architects Harrison and Abramovitz to the Office of General Services suggests a method of hanging the 12', 360 lb."Links" sculpture. It recommends "the use of an eye bolt and black nylon cord having a 1000# safe working load, using a neatly made and trimmed clove hitch". It then goes on to instruct: "To tie the remaining end of the nylon cord to the sculpture using a neatly made bowline knot. The hanging height of the sculpture was to be determined by the architect" (Curatorial Files).

A letter dated August 23, 1974, states that the architect (Mr. Harrison) will place the sculpture in its exact exhibit location. The artist has indicated that a set of instructions and a
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set of wedges for disassembling the fifty-four parts of the sculpture were originally enclosed when the work was sent from Japan. To date, the whereabouts of these wedges is unknown.

From 1980-1987, "Links" was exhibited in a linear format. In 1986 there was an environmentally unstable period when many urushi fragments were placed in an envelope and subsequently in the object file (Curatorial Files).

The copy label and records on file describe the sculpture entitled "Links" by Gyora Novak as being composed of "lacquer". This term has been known to have been used to refer to a variety of materials such as auto body paint, imitation lacquer or japanning as well as true lacquer, which was used for this sculpture. It is astounding to most spectators, including the author, that this grand sculpture measuring 12' 6" and weighing 360 lbs. could be composed of this ancient and supremely elegant, durable yet sensitive material known as true lacquer or urushi. Interesting enough, many of the people who see the sculpture on a daily basis have assumed it to be composed of plastic or metal.

History of Conservation

Concern over the future conservation needs of the full collection are voiced in the foreword to the 1987 book entitled "The Empire State Collection: Art For the Public". In 1976, instability in both the two-dimensional works on exhibit on the concourse level and the three-dimensional works exhibited on the Plaza outdoors was noted. Many of these works had only been on display for one year. In 1978 conservation attention began to be administered through the Albany Institute of History and Art. Education of the public was considered a major part of the effort to protect the collection and deter vandalism (Curatorial Files). In 1980, the Williamstown Art Conservation Center, formerly the Williamstown Regional Art Conservation Laboratory, began to provide regular maintenance and formal conservation treatments as needed for this collection.

Historical Background

1. The Artist

Gyora Novak, born in Israel in 1934, has been active as a self-taught artist for over four decades in both Europe and the United States. He has worked in soft tissue paper, a variety of metals, terracotta, wood and urushi as well as other media. Early on, many of his ideas were expressed on a large or over life-size scale, culminating in such monumental environmental statements as the following:

"York 1190 Remembered" commemorates the massacre of most and the subsequent suicide of
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the remaining 350 Jewish people in York, England in 1190 A.D. The existing fourth generation stone fortress/tower (Clifford's Tower, managed by the English Heritage) has been blanketed by 200,000 yellow daffodil bulbs which bloom in memory on the anniversary date of the massacre. A cast iron fence, surrounding the monument, will be designed to resemble fire damaged wood symbolizing the burning of the wooden tower which originally stood on the site. As part of this project, the artist wrote a lament and composed a score which has been recorded by musicians from the London Symphony Orchestra and was played on the 805th anniversary of the massacre in 1995. This interdisciplinary project not only focuses on a single tragic event in history, but is symbolic in relating atrocities currently plaguing the world. In point, it is a living sculpture (Novak, personal communication).

Another monumental and uniquely interdisciplinary project currently being directed by this artist is the proposed new Gate to Jerusalem. The gate is to span the new eight lane segment of the main highway leading into the city, and will be constructed out of a contemporary composite material such as that used by NASA as a rocket coating. Nine years in the planning phase (1979-1987), this project has involved several hundred professionals all of whom have volunteered their expertise towards this goal. This project has been in abeyance for some years because of political unrest in the Middle East.

Gyora Novak speaks like a visionary, expressing his beliefs in the "oneness" of humanity. He rejects the notion that his work is political and states that it is simply about the universality of people and what we all have in common, not about what sets us apart. He successfully strives to stretch his ideas to their ultimate goal, treading the parallel paths of a dreamer-realist. His projects typically incorporate numerous highly-regarded professionals including engineers, philosophers and musicians.

2. The sculpture

The "Links" in particular is intriguing and mesmerizing because of its simplicity and elegance. The repeating circular forms, although exactly the same in size, orient themselves by design in completely different spatial planes once hung as a whole, providing the spectator with infinitely diverse three-dimensional compositions. The sculpture is kinetic and creaks as it rotates. The saturated black coloration, the high gloss and ultra-smooth surface of the urushi reflects so brilliantly that it possesses a pristine quality. A set of artist-drawn blueprints exist which graphically represent the artwork and are a part of a larger graphics folio comprised of 160 pages.

Information gleaned in a personal interview with the artist revealed that the complex construction of the fifty-four interlocking units, six units comprising each of the nine interlocking links, provide repetition of line within each link, which is then mirrored in the repetition of the circles. This simplicity, purity and repetition of form and line is symbolic of
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a basic building block, a sort of common denominator that can be found in life and its experiences. In short, there are countless nuances which will continue to enrich the obvious "even-uneven" composition.

Although the sculpture was conceived of in the United States, the search for purity and excellence of lacquer execution, an age-old eastern tradition, led the artist on his first trip to Japan, where he spent six months in the town of Takamatsu on Shikoku island. Through a Japanese artist Novak had met in New York City, he was able to obtain the requisite formal introduction to the governor of that prefecture. Once the proper protocol had been followed, Novak was able to work with a master carpenter and a traditional urushi artisan to execute the final design of the sculpture. While the artist himself had previously worked out the engineering concept of the six overlapping and staggered, bisected and dissected components of each half-ring, held together by pegs and corresponding holes, the master carpenter was instrumental in the final choice of the sekura or cherry wood. This wood was selected for its characteristics such as strength and mechanical stability.

The unusual method of construction, which incorporates three 120 degree arches on the front face interlocking into three 120 degree arches on the reverse face, with one side staggered or pivoted 60 degrees, was designed by the artist himself. Once in Japan, he worked with a master carpenter who designed a machine to create these three-dimensional arched forms; each individual unit being composed of three laminated pieces of cherry wood adhered with the grain oriented perpendicular to the previous and subsequent layers. The master carpenter's stamp can be seen here as N (Figure 2). The incised angular mark adjacent to the N is Novak's name in Hebrew. An artist from a traditional lacquer family executed the urushi application achieving the precise surface typical of the medium. Through an interpreter, Novak discussed the qualities he wished to see reflected in the finished product and made his final selections from a variety of options presented to him by the Japanese artisans. Urushi was selected by the artist, in order to express the sculptural concept for many reasons, including its long-standing historical tradition, the quality of the finished product, the respect the artist had for the skill required in its application and the trust and partnership involving the carpenter, the lacquer artisan and the conceptual artist.

While in Japan the artist came up with five solutions to the "Links" concept, devising ten sculptures, five each in round and square. Of the five round and square solutions there was one black lacquer, one red lacquer, one oiled Japanese oak (keyek) and two of raw cedar (one with a burned, the other with a brushed, surface). Each particular medium was also of a unique size differentiating it from the other sculptures and media. Although the finished sculptures are composed of nine interlocking units, a tenth link was manufactured and left in Japan as a prototype or working model from which the artist or future client could order additional sculptures or subsequent commissions. This sculpture is such a commission; it was ordered directly from Japan and arrived in Albany in 1968.
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Although one might wonder why these simple and repetitive forms had not been cast in molds in a polymer medium such as fiberglass, it is the artist's opinion that in the 1960's the cost of creating art in Japan was relatively inexpensive as compared to working in fiberglass with sculpture fabricators in New York City. The choice of urushi specifically was important because the medium more acutely represented the expression of the sculpture, the simple elegance, the beauty of repeating images mirroring the repetition of the lacquer layers. Urushi simply defined and embodied the purity of the sculptural form and ultimate solutions.

Examination

1. Microscopy

Examination of small samples of the lacquer layers showed three or more dark brown/black coating layers over a thick brown preparation layer. To better resolve the number of coating layers and provide material for transmitted infrared analysis, thin sections (circa 5 micrometers) were cut from an unmounted layered sample using a Sorvall Ultratome MT-1. Examination of the thin-section samples using light microscopy (transmitted polarized and reflected fluorescence illumination) showed seven layers ranging in thickness from 6-19 micrometers, for a total thickness of approximately 0.17 millimeters (Figure 3). The surface layer shows fissuring, and particles are distributed along the surface of each layer, presumably evidence of the urushi process. The brown preparation layer was studied by IR and SEM and appears to be composed of kaolin and a mixture of other iron-earth materials. The analysis of particle samples of the finish and step scans through the thin-section using Fourier transform infrared (FT-IR) microspectroscopy confirmed the presence of urushi.

2. X-radiography

In order to study the fabrication technique (substructure) of the sculpture, one section of a ring was x-radiographed using a Picker portable x-ray unit (Catalogue 805D, SN 284). The tube was 90 cm from the film plane. 'Industrix' film and developer were utilized. Both the cross-section and lateral surfaces were studied. The exposures which yielded the best results were 40 kv and 5 ma at 6 minutes for the lateral view, and 35 kv and 5 ma for 9 minutes for the cross-sectional view. The objective was to determine whether or not traditional methods of manufacture had been employed. The individual lacquered units are each composed of three layers of wood that have been adhered together (Figure 4). No additional methods of reinforcement as referenced in the literature appear to have been utilized. A fabric layer is visible, both in the x-radiograph (Figure 5) and to the naked eye upon close inspection of the urushi surface; this rests directly on top of the wooden substrate (Figure 6). The fabric layer was clearly visible in areas of loss as in most cases the surface losses were limited to the urushi layers only. Other manufacturing details include the centering point from a drill for
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the dowel receivers (holes).

3. Ultraviolet

Longwave ultraviolet visible light fluorescence revealed a slightly orange/brown fluorescence.

Condition

The overall condition of the sculpture when it arrived at the lab was fair. The wood appeared structurally sound and no cracks or other structural insecurities were observed during examination. However, the surface of the urushi was marred with scratches, and white and brown abrasions from unknown sources. Cleaving of the urushi was evident in localized areas. Blisters or pockets had also formed where the urushi was no longer attached to the underlying substrate. Losses in the lacquer layer were noted, especially along the interior edges where the bisected halves met, exposing the underlaying fabric layer that covered the wooden substrate. Old repairs were visible where inpainting had occurred without filling. The surface was grimy overall because of exposure on the underground concourse to two decades worth of air-borne debris, including (until recently) cigarette smoke and possibly accumulated food grease from the surrounding restaurants.

Treatment

1. Proprietary materials: their selection and use in treatment

The treatment of the "Links" involved two components: (1) stabilization of the flaking/detaching urushi layers and (2) cosmetic compensation of the losses, including superficial polishing of the marred surface in order to remove the vestiges of twenty years of exhibition.

Proprietary materials were ultimately selected because of their individual qualities which fulfilled the requirements for display of this sculpture, as well as the time and budget considerations for this treatment.

2. Consolidation

The first step was the consolidation of surface cracks, areas of insecure or cleaving urushi, air pockets and loss areas. Both pigmented microcrystalline wax and Acryloid B-72 were considered. Acryloid B-72 was determined to be the best choice. Varying viscosities of this
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resin, in acetone, were injected into the cracks or pockets using a hypodermic needle and syringe. In other cases, the resin was simply applied by brush and used as an isolation layer prior to infilling. All cracks and losses were isolated with Acryloid B-72 prior to filling. Blisters were filled with Acryloid B-72 resin in order to support the uplifting lacquer without attempting to return the deformed lacquer to plane.

3. Cleaning versus polishing

Prior to beginning the second step, consideration was given to exactly what kind of surface quality should be achieved. After approximately twenty years of display in an open air environment, a significant build-up of air-borne debris was evident on the saturated black surface of the sculpture. Additionally, scuff marks in a variety of colors disfigured the surface, most likely from direct contact with an adjacent marble wall and other surfaces.

Polishing of ancient lacquer would not be considered ethical or necessary in a modern 1990's conservation treatment. What should be the ethical options in cleaning an example of modern 1970's urushi which had once been highly polished? Fortunately the opportunity to meet with the artist and discuss his original intent confirmed my suspicions that this sculpture should be returned to a highly reflective, pristine surface.

Dry methods (such as grated erasers) were tested as well as wet methods including saliva, dilute aqueous solution of Orvus, and organic solvents such as acetone and ethanol. Fine abrasive techniques such as the use of Micro mesh papers (6,000-12,000 grit) and other more traditional fine abrasives such as alpha alumina were also tested locally on areas where disfiguring white scuff marks were present from contact with an adjacent marble wall. The colored scuff marks, from unknown sources, were tested for ease of removal.

Micro-Gloss Liquid Abrasive, a proprietary solution that is marketed for use with the Micro-Mesh papers, was tested and appeared to be the least visually abrasive in that it did not appear to scratch the surface of the urushi. Micro-Gloss is a liquid which according to the instruction booklet does not contain any waxes or silicones. It is advertised as containing a "uniformly graded abrasive grain in suspension" (Information Booklet, p. 2). Its claim to fame is that it removes "hairline scratches, haziness and halos". It also purports to contain "no fillers or cover-ups that cause yellowing" (Micro-Surface Finishing Products, Inc.). Application of the Micro-Gloss product was straightforward per instructions, using lintless pads (Multilith) until no Micro-Gloss was left on the surface detectable to the naked eye. The Material Safety Data Sheet (MSDS) revealed that it is composed of alumina. Discussion with the technical representative at Micro- Surface Finishing Products, Inc. in Wilton, Iowa revealed that the product is composed of alumino-silicate particles suspended in a hydrocarbon-in-water emulsion and that the particle size of the abrasive is supposed to be less than one micron. The manufacturer reiterated that the best way to utilize the product most
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effectively is to use a flannel pad in conjunction with light pressure.

Subsequent analysis at WACC confirmed the presence of alumino-silicates and titanium dioxide in a hexanes-in-water emulsion. Most particles were smaller than 5 micrometers, but a minor proportion of particles in the range of 2-10 micrometers was observed.

4. Filling

Filling of the losses was the next step. For most objects, the optimal fill should be different in chemical composition than the original. In this case, a solution which was chemically different than the urushi while physically imitating the hardness and gloss of this lacquered surface was desired. Ideally, the fill material should be extremely hard and durable, given the types of damage that had been observed on the surface of the sculpture and the fact that the sculpture was kinetic and prone to abrade itself. As the sculpture is not and would not be protected by physical barriers, enclosed in a case or in a filtered environment where air-borne debris would not be an issue, the fill needed to repel potentially damaging dust and dirt. A variety of pastes were concocted including Acryloid B-72 bulked with micro-balloons, Beva bulked with Cabosil, epoxy systems such as the West System epoxy bulked with dry pigments, Milliput, polyesters and high melting point microcrystalline waxes. In the end Milliput, a proprietary two-part epoxy system, heavily bulked with titanium dioxide was selected for durability, ease of application, efficiency and health considerations. This material also fulfilled the requirements of the kinetic nature of the sculpture, the time/budget constraints of the project as well as the nature of the non-traditional museum climate to which the sculpture would return.

Milliput, which is manufactured by the Milliput Company in Mid Wales, is available in four colors (Yellow/Gray, Silver Gray, Terracotta and Superfine White). It is a two-part system composed of an epoxy resin and hardener in putty form, advertised by the company as self-hardening, non-shrinking, highly adhesive and tough. Both the epoxy and hardener are bulked to a pliable modelling clay consistency using inert particles. Numerous requests were made to the company and distributors for a MSDS but to no avail. Although this material appears to be in wide use for the repair of high-fired ceramics, when attempts were made to obtain information on its chemical constituents from users in the conservation field, no one appeared to have either a MSDS or any technical information as to it’s exact constituents. Therefore technical analysis was undertaken at WACC. Two colors of Milliput were analyzed: superfine white and standard yellow-gray. Infrared analysis of acetone-soluble extracts showed the epoxy resin to be a bisphenol A type epoxy, and the hardener to be a polyamide resin. Particle analysis by light, electron and infrared microscopy showed the presence of kaolin in both the epoxy and hardener samples. Titanium dioxide was added to the superfine white components as a whitener.
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Although polyamide resin hardeners are less toxic than amine hardeners, they are less color stable to light exposure (Horie, Materials for Conservation). However, titanium dioxide being a dense, opaque, inert pigment (Mayer, The Artist's Handbook) with a high, refractive index would appear to have a stabilizing effect on the product's aging process. It is said "to be very stable and have the greatest hiding power of any of the white pigments...It is unaffected by heat, by dilute acids and alkalis, and by light and air" (Gettens and Stout, Painting Materials). Therefore the addition and presence of titanium white to this epoxy would appear to have a stabilizing effect on the product's aging process.

Reversibility should always be a primary consideration in any treatment. Our credo, The Code of Ethics and Standards of Practice, states this. However as Objects conservators we know that there are exceptions to the rule as was discussed in Buffalo at the 1992 AIC pre-session which focused on the conservation practices of outdoor sculpture. Other more general practices such as materials used for consolidation and application techniques thereof are theoretically reversible but most likely not in practice.

Milliput, being an epoxy putty, would not be a first choice for fill medium for lacquer-coated wood in most instances. If this object were residing in a climate controlled museum, or were not a kinetic sculpture apt to receive abrasion of its surface, hardness of the fill medium would most likely not have been such an issue. However, the white coloration of the fill medium allows the future conservator to easily identify the location of the fill should mechanical removal be necessary. The Milliput was placed over an isolation layer of Acryloid B-72 and was approximately 0.17 millimeters in depth.

5. Surface Reintegration

The Milliput infill created a fairly glass-like foundation. Allowing siliconized Mylar to lay against the Milliput while it was curing achieved a surface even closer to that of the lacquer. Additional sanding/polishing with the highest grade Micro Mesh papers (8,000-12,000) aided in replicating the surrounding, pristine, urushi surface.

Tinting of the Milliput was experimented with. Tinting the material in advance would be efficient; disadvantages would include the increased difficulty in locating the fills once polished or coated. However, it turned out that Milliput does not tint easily with dry pigments, Orasol dyes or acrylic paints, either prior to combining the two parts or after, and the idea of tinting the fills was abandoned.

It was essential to have a consistently reproducible, thin layer of saturated black pigmentation that was void of brush strokes. The surface of the surrounding urushi begged an ultra-smooth, glossy in-fill. These criteria appeared to be most easily fulfilled by utilizing a spray technique, as opposed to brush. The airbrush technique and a black aqueous acrylic
pigment were ultimately selected (Figures 7 and 8).

All areas to be inpainted were first isolated using Frisket, polyethylene sheeting and Kraft paper to mask out all but the areas to be airbrushed. This process minimized or avoided over spray, a primary drawback of the airbrush technique. The Frisket which was utilized was composed of an acrylic adhesive with a PVC carrier. Although PVC is not conservation-grade and is an inherently unstable material, the carrier was not considered to pose a threat to the surface of the artwork because of its very limited time in contact with the surface.

A clear coating was utilized to protect the paint layer and to simulate the gloss of the surrounding urushi. The product Aqueous Euro Gloss Glaze proved to be very reflective and durable. Multiple attempts were made by telephone and fax to obtain MSDSs for this product were unsuccessful. Although the company claimed to have them, they were never sent. The irony of this is that on the inside cover of the I.P.G.R. catalog they state that "all of our products are extremely researched, developed and tested by Klein Studios" and "artisans the world over have come to rely on I.P.G.R., Inc., products and technical support". I would be very interested to know if anyone else has been successful in obtaining a MSDS for this product. In-house analysis of a dried film of the Aqueous Euro-Gloss Glaze using infrared microscopy showed the presence of an acrylic resin.

Finally, a protective layer of microcrystalline paste wax (Renaissance Wax) was applied to the front surface overall and was buffed off with cotton pads.

Display

Having observed photographs of the sculpture in different configurations in both the curatorial office files and on the cover of various museum annual reports, I was in a quandary about which display tactic to pursue. Additional complications included concerns about its previous security and that of other sculptures hanging in this public space. Having heard stories of how this sculpture literally saved the life of an employee who hung from the sculpture until he was rescued, I wanted to think seriously about the future health and safety of the sculpture.

The artist was queried as to his preference for the sculpture's ideal exhibition configuration and it was determined that the sculpture could be accurately represented in many different arrangements. Therefore, the decision was made to hang the sculpture higher than before. A draped positioning of the sculpture, similar to an earlier example that had been photo-documented, was ultimately settled upon for both safety and aesthetic reasons.

The order in which the individual links were ultimately hung was based upon their condition, with those in better condition hung in the most visible positions. Previous statements by the
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artist had indicated that the links were absolutely identical and interchangeable. During disassembly, it became quite obvious that certain links were easier than others to reassemble. While careful attention was paid to the order in which the interlocking units within each link were arranged, it was observed that significantly varying amounts of pressure had to be utilized during the installation of the link halves.

Once eight of the links were reassembled and hanging in an interlocking fashion, the sixth or final unit of the ninth link simply would not fit into place as the others installed prior to it had. Two of the four pins and corresponding holes were not in alignment and were off by as much as 1/4". After it was determined that this link was "A" in the series and therefore had borne the majority of the weight (360 lbs) for as much as two decades, it seemed possible that the six units comprising the link could have individually distorted enough to have warped the link as a whole, making the fit difficult. Surprisingly, however, the link did not appear visually distorted. Once back on the ground, the six units were able to be reassembled by using equal pressure simultaneously on all surfaces, using a cork sheet as a cushioning interleaf to work all the pegs and respective holes into their original alignment. Because of this distortion the final link had to be hung assembled and not interlocked as the others had been.

Conclusion

This collaboration with the artist and the conservation scientist providing information which will be a useful, practical contribution to the urushi database for future comparisons and related research, given this sculpture’s documented Japanese provenance. In addition, the use of this traditionally Eastern material by a Western artist is an interesting feature.

Collaboration with a conservation scientist allowed three commercially available products (Micro-Gloss, Milliput and Aqueous Euro-Glaze gloss) to be analyzed by FT-IR microscopy and to be used with less trepidation by the conservators. Once again it was confirmed that the usage of proprietary, commercial products is without a doubt a risky business. To use them as viable options and to use them responsibly requires and attempt to obtain all available technical literature, often a frustrating and less than fruitful endeavor. Material Safety Data Sheets may not exist if the product is produced outside of the United States. Information which supposedly exists may not ever materialize despite the most diligent efforts by the researcher. "Trade Secrets" additionally complicate the process of information gathering.

As a result of selecting commercial products for use in this treatment, a useful discovery was made about the best use of Milliput. While it can successfully fulfill requirements for certain treatments, the conservator must be aware of its limitations. Exposure to ultraviolet wavelengths of light could potentially contribute to chemical instability. The application of a
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subsequent paint layer would appear to retard this process.

The ability to analyze materials in-house is a marked asset for the conservator. But even then, as we found in this investigation, the chemical components or percentages contained within a commercial product can change at a moment's notice, as was the case with the Micro-Gloss. For example, between the fall of 1995 and the spring of 1996, the MSDS that was held at the lab became inaccurate. Thus it is incumbent upon all of us as conservators to continually inquire when purchasing new orders of commercial products as to the current formulation of the product and if there have been any recent changes. Updated records should be kept together with the respective products so that an old MSDS is maintained for containers of the older product, and an updated MSDS for new batches of the same product.

A significant factor during the course of this treatment was the budget/time allotment/restriction dictated by the owner/client. Originally a project-cost estimate was proposed at 135 hours. The client responded that funding was available for only 67 hours. Issues such as these are a reality in the current financial climate at both the federal and state government levels. Many conservators are thus encouraged to tailor treatments to budgets while continuing to place the stabilization of the object as the ultimate priority. When the conservator is presented with the "bottom line" first it encourages creative problem solving.

Finally and most importantly, collaborating with a living artist on whose work a conservator is to embark not only updates the artist on its current condition but also broadens the conservator's awareness of the mechanics of manufacture as well as the concepts or principles on which the work of art is based. Building a bridge between the artist and the conservator hopefully demystifies their respective worlds and enables conservators to better serve artists and preserve their work as the artist, and not the conservator, envisioned.

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Figure 1. "Links", by Gyora Novak.

Figure 2. Pencil rubbings of artist and artisan signatures.
Figure 3. Thin section of lacquer.

Figure 4. X-radiograph of cross-section of individual wooden member.
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Figure 5. X-radiograph of top of individual wooden section.

Figure 6. Detail of surface loss, revealing fabric layer.
Figure 7. Detail of masking during airbrushing.

Figure 8. Detail of airbrushing, prior to waxing.
MOUNTING ETHNOGRAPHIC FEATHERWORK ON MANNEQUINS: AN EXOTIC EXERCISE IN COOPERATION

Virginia Greene

In November of 1991, the University of Pennsylvania Museum opened a major exhibit titled "The Gift of Birds: Featherwork of Native South American Peoples". The exhibit included approximately 300 accessioned objects, twelve stuffed birds borrowed from the Academy of Natural Sciences, over a dozen items on loan from curators and consultants, and approximately forty reproduction objects of varying kinds. The exhibit plan also included twenty full-size realistic human figures, seventeen arranged in three dioramas representing ceremonies in which feathered objects play an important role, and the remaining three in individual cases.

The three major groups represented were the Waiwai of Guyana (British Guiana when the objects were collected in 1913-16); the Cashinahua of Peru (the collection made in 1965), and the Bororo of Northern Brazil (1930). The exhibit also included archaeological material from the Andean highlands which was made of or included feathers or represented birds (or both); this material was excavated or purchased by Max Uhle in 1896. Most of the specific examples in this paper relate to the Waiwai scene, which was the first we worked on and the most complex.

As usual, every object in the exhibit was examined by the conservator, photographed, and a condition report and treatment proposal written. The curator and conservator then discussed the extent of the conservation work which would be necessary and/or desirable.

Many of the objects required small structural repairs to secure loose beads and feathers, reinforce fragile support cords, or repair broken elements. The major conservation problems all involved archaeological objects for case display, but we did have to humidify and reshape some armbands for the mannequins. Cleaning was kept to a minimum, and restricted to those objects which clearly had post-collection dirt and grime. The only major cleaning was done on strings of plumose eagle feathers that formed parts of the Waiwai headdresses. This was the only occasion on which there was any real discussion about the extent of conservation, and the only time when the conservation lab was under pressure to do extensive cleaning which involved potential damage to the objects. The curator made it clear that the people involved would never have worn dirty feathers in their headdresses, especially for an important occasion, and the feathers had clearly acquired most of their dirt while in the museum. There turned out to be no possibility of borrowing suitable pieces, and we had other feather strings that would remain uncleared. Vacuuming was totally unsuccessful, and in the end the feathers were wet-cleaned with Igepal non-ionic detergent and deionized water, and rinsed repeatedly. They were then blotted between paper towels and blown dry (a necessity for plumose feathers) using a cool air stream from a hairdrier. The results were more successful than we had hoped as far as appearance was concerned, but there were certainly some losses; this is not a treatment that we would normally recommend.
Conservation treatments, however, were not our greatest problem. Previous exhibits at the Museum had included torso mounts for clothing and an occasional full-size mannequin; most were prepared by the exhibits department and all were dressed by the conservation staff. In every case the clothing concealed all or most of the mannequin or mount, including all the padding and supports needed to safely display the objects. Twenty figures, to be dressed primarily in a few delicate feathered and beaded items (which allowed little or no room for concealment of the mounting technique), was going to be a new experience.

Owing to time constraints, the figures could not be sculpted, but had to be made from body casts taken off live models. To allow mounting of objects such as armbands and belts that were closed circles, some of the figures had to be jointed. In order to establish the exact position of the joints, ensure that the poses were correct and objects held in the hands would fit, and that all the objects would have the proper appearance on the finished figures, everything to be mounted on the figures had to be test fitted on living models before the mannequins were made. The models were primary Asian students at the University of Pennsylvania (chosen for age and body type; the faces were slightly altered on the mannequins where a model was used more than once); a Museum volunteer was the model for two older male figures.

Needless to say, the whole process of test fitting produced great anxiety in the conservator. However, the trial fittings were eventually accomplished without damage to a single object, and the experience pointed out, at a very early stage in the preparation of the exhibit, both curatorial and conservation problems that might not have been fully appreciated for months.

Before the trial fittings on the models, structural repairs were completed for the pieces that would be exhibited on mannequins. Many of these pieces also required time-consuming temporary supports. Bracelets, anklets, and some belts had to be sewn on to cotton twill tape (Figure 1). Ear pendants were provided with loops of cotton string, so they could be hung over the ears of the model and rest in the appropriate position (Figure 2). A temporarily missing frame for a headdress was constructed out of mat board.

Objects which could not be test fitted, but which were suitable for later mounting on a mannequin, were identified. These included, for example, a belt of jaguar skin in good condition but very stiff, which would later be humidified and shaped to the waist of the figure.

It became immediately clear that some items of clothing, such as loincloths worn by the Waiwai men, could be used neither on the models nor on the mannequins. In addition to the unacceptable risk to the objects themselves, the real ones from our collection were much faded, as the loincloths had to be periodically re-dyed to maintain the appropriate color. This early identification of pieces which would require reproductions, either because they could not be safely exhibited on the mannequins (such as the loincloths) or were not available
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(multi-strand bead necklaces, and some earrings from both the Waiwai and Cashinahua), was one of the most valuable benefits of the process, especially as neither of the curators had originally considered the possibility, never mind the necessity, of using any reproductions other than for food items.

A mockup for a reproduction loincloth was prepared, complete with fringe which could be tied in the traditional manner and onto which small feather strings could be tied, exactly as had been done on the originals. (The collection included an ample supply of these small feather strings, which were removed during redyeing and when the loincloth was eventually discarded.) It turned out that even if we could have used some real loincloths, we would have needed one reproduction: when we dressed the seated figure in this scene we discovered that the loincloth had to be cut into two pieces to be put on the mannequin. We had a similar problem with bandoliers made from multiple loops of braided cord: the originals were faded and were slightly too small to be put safely on the mannequins.

For the most complex scene (the Waiwai), all of the models were brought to the museum for a first session, to set the poses. After this, the models generally came in individually, accompanied by the sculptor (then teaching in the Fine Arts Department at Penn) who would make the body casts and assemble and paint the mannequins.

The objects were handled only by the curator and conservator, and pieces which could not be safely put on the model were simply left off (Figures 1-4, 17). The sculptor took numerous photographs of the individual models, and of pairs or groups when they were touching (Figure 2). He also took notes on where figures would be jointed and on any special requirements (e.g. tight binding on legs and arms where bead strings would later be wound). We also considered the problem of the placement of support rods for those figures to be "sitting" on stools (standing figures had rods up the legs), taking exact measurements of the stool height and dimensions of the seat as well as photographs that would approximate the way in which the figure would be seen when on exhibit (Figure 3).

Casts were made in the sculptor's studio, with plaster and bandage applied in sections. When the sections were finished, they were assembled into figures (Figures 5-8).

When the mannequins were finished, they were brought to the Museum. (Finding a place to store 20 life-size human figures for nine months was no small problem.) Before the figures were painted, they were assembled into scenes and we did a second trial fitting for objects which presented particularly critical mounting problems, such as headdresses, closed-circle armbands and items held in the hands (Figure 9). Any needed adjustments were made in the figures: the most complex involved redoing a woman's arm which was supporting a tray, which was at the wrong angle; the size of some heads had to be reduced so headdress would fit easily. The figures were then painted and allowed to dry for several weeks before they were dressed (Figure 10).
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At the same time we were considering mounting methods for specific objects. The wristlets and anklets, which are very light in weight, would be hung from a series of small stainless steel pins painted the same color as the skin, with the original cords tucked out of sight. Extra support cords made of synthetic sinew, running parallel to the original cords, were used to carry the weight of some belts and necklaces. Beaded hip pads, and some belts worn over loincloths, would be tacked down directly to the reproduction loincloths with sewing thread when the figures were dressed. The most elaborate mount was a complete sewn backing for a heavy beaded apron with hook-and-loop fastener along the upper edge for mounting; the other part of the tape had to be recessed into the body of the mannequin so the apron would hang properly (Figures 11, 12). The other heavy aprons were on seated figures and so could be draped over their laps, with a piece of felt between the object and the figure and the cords loosely tied in back (Figures 2).

Fabricating the reproduction objects turned out to be one of the most time-consuming parts of the preparation for this exhibit. The Exhibits Department bought fake banana leaves which were used in several places, and made a large papier-mache "tortilla" that was held by one of the figures (Figures 12). One of the consultant anthropologists made a shallow woven tray for the Bororo scene. All of the other reproductions - clothing, food, and other objects - were made by the Conservation Laboratory. By the time the exhibit was completed, almost half of the total lab time had been spent designing, acquiring the materials for, and manufacturing the reproductions.

The loincloths were sewn from cotton fabric purchased from Testfabrics, selected to match the original as closely as possible. The bandolier cord could not be matched exactly, but we found some heavy woven cord at an upholstery supplier that looked acceptable. The loincloths and bandoliers were dyed (with household dyes) to a color (described by the consultant as approximately the same as some of the red-orange feathers) and achieved by several days of tests. The original bandoliers could not be taken apart, so the elaborate feather bundles (including full birdskins) attached to them were tied to the reproductions, with the original bandolier cords hidden under the birds (Figures 13, 14).

We did not have enough pairs of shell earrings for the Waiwai figures; nor were any of the ones we had in sufficiently good condition to use directly on the figures (Figures 15). Moreover, because of the rigid plaster, it might have been very difficult to get the earrings in the correct position. Instead, we made the "shell" of Sculpey modeling material painted with iridescent Liquitex acrylic paints, with a small section of bamboo stick (which would go through a hole drilled in the ear) stuck to the back with soft wax (Figures 16). This arrangement enabled us to adjust the angle of the earring to compensate for the plaster and for oddly drilled holes. As the original earrings were all made in two parts, the shell and stick part described above, and the bead and feather ornaments which were tied to them, we were able to use the original ornaments.
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We also had to make reproduction earrings for the Cashinahua women: multiple strands of white seed beads with a large black "seed" (actually a wooden bead) on the end of each strand. These were worn by inserting a thin cord directly through the ear, and the holes were easily drilled after the mannequins were finished.

The Waiwai also wore long strings of seed beads wound around their arms and legs, and several had multi-strand necklaces made of seed beads (Figures 18). These were not part of our collection, either because the people had not wanted to part with them or - in the case of the strings - the ethnographer had not seen them as "artifacts". The Assistant Curator and I took a trip to New York to purchase beads, all of which had to be restrung (as the threads they are sold on are very fragile) to make three multistrand necklaces and yards (and yards) of single strands of white and blue beads. Fortunately, we were able to draft some volunteers to help with the stringing.

Several of the figures wore ordinary men's shorts (The Cashinahua scene was set in 1965, and the Bororo in 1971). We could not get the exact style, but we purchased acceptable substitutes at a discount store. The legs were shortened according to the instructions of the consultants, and the shorts were washed several times and then dragged around the lab floor and stepped on until they looked sufficiently worn. We needed a modern dress for one woman in the Cashinahua scene; the consultant provided photographs to show the style, and described the fabric ("cheap cotton with little flowers"). The husband of the Assistant Curator, who happened to be going to Bolivia during the time we were working on the exhibit, offered to purchase fabric for us in a street market. He came back with white cotton fabric printed not only with little pink flowers and green leaves, but also small red penguins. (The consultant refused to try to explain the significance of the penguins, but approved the choice). After we stopped laughing, the fabric was tea dyed to soften the bright white ground; the dress was cut using a modern pattern sized to the model for this figure, partly assembled, and then finished directly on the mannequin.

Pieces of leaf-wrapped 'meat' in a tray were made from small pieces of Ethafoam wrapped in fake banana leaves and secured with toothpicks (Figure 12). One Waiwai chief was holding a bowl with a ceremonial drink (Figures 17, 18). We did not have a suitable bowl in the collection and were fortunate in being able to borrow one from the consultant, who also gave us permission to do as we wished with it. After getting a description of the liquid, we filled most of the bowl with chunks of Ethafoam and poured silicone molding material over the top. This looked perfect and was easily removed at the end of the exhibit without damage to the bowl.

For the Bororo scene, we needed a gourd bowl used for body paint, and a roughly woven tray to hold feathers. The consultant made the tray from dried palm fronds and lent us some loose feathers; her mother sent the proper type of gourd from Brazil. We froze the gourd to dispose of any possible insect life, then cut it into a bowl and filled it with plaster tinted to the right
color for the body paint, artistically dripped over the side. We also needed a jaguar skin for this scene, as the curator discovered rather late that the ones in the collection were not suitable. Unlike gourds, this is not something one can now acquire, and the lack of time made searching for a potential lender a problem. Fortunately, the curator actually owned one (purchased many years ago, when it was still legal) which was the perfect size, and was willing to lend it for the exhibit.

When the figures were painted, the basic construction for the dioramas finished and the backgrounds painted, the figures were placed in the cases and the base plates secured to the floor (Figure 19). The figures were then removed, and the floor finished with plaster, Fiberglas chopped-strand mat, acrylic paint and that ever-useful material, kitty litter.

In the meantime, the wigs were styled. These were ordinary modern wigs purchased by the Exhibits Department and styled by the exhibits staff using ethnographic photos and advice (mostly unsolicited) from the curators, conservator and other staff members. Most of the Waiwai men had long hair which was tightly bound with fiber strands (we used synthetic raffia) and inserted into a decorated bamboo tube; as the tubes were accessioned artifacts these hairdos were done by the conservator (Figure 14).

To minimize handling and movement of the objects, the mannequins were dressed in the gallery, one scene at a time. Modern shorts and loincloths (if any) were put on first, and the figures then put into position on their support rods before the rest of the objects were attached. Extra objects for the scene were then added, along with finishing touches such as down in the hair (supplied by the conservator by sacrificing a bit of insulation out of a winter coat, to avoid buying a whole package of down).

As we were dressing the figures, we had a last-minute crisis as it became clear that we would have to make several reproduction armbands. Although the real armbands fit properly in the depressions that had been molded into the arms of the mannequins, on two figures we could not insert the large upright feather fans at the correct angle because we had not fully allowed for the fact that plaster, unlike flesh, is not compressible. We considered removing some plaster, but were concerned that we might not be able to finish the job properly if it were not immediately successful. Instead, the real armbands with their dangling feathers were put in place, and reproductions of just the bands made to fit over the originals, with an internal support system of narrow channels for the long feathers of the fan. The reproductions had to be flexible enough to wrap around the arm, and have the appearance of the palm leaf used to cover the originals. After some experimentation they were made of 2-ply archival matboard covered with untwisted paper craft tape (Figure 20) which was tinted with acrylic paint. Thin dark cords on the original were made with tightly twisted pieces of raffia. The matboard was flexible enough to wrap around the arm, and the overlap was secured with adhesive and monofilament ties. The crinkled paper tape, dyed brown, was also used to make a reproduction bark fringe for a headdress that had lost most of its original bark - the new
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fringe was not attached to the headdress but just secured to the head of the mannequin and the headdress put on top.

When the curators, exhibit designer and conservator were all satisfied, the case was locked and work started on the next scene. As the scenes were completely enclosed (one of the conservator's original non-negotiable demands), the figures were protected against dust generated by the installation of the remaining parts of the exhibit. The three big scenes each had a tiny door that allowed us to go in and out while the figures were being dressed. The single-figure cases each had a side that came off, but two of the three cases were too small for a person to get inside with the mannequin, making the job rather more difficult than expected. When everything else was finished, the conservator and head of the Exhibits Department did a lighting check, adding screens to the fixtures and refocussing lights.

This exhibit certainly qualified as a Cecil B. DeMille production. In addition to the normal cooperation among the conservator, the exhibits designer and his staff (both permanent, including mountmaker and graphic artist, and temporary, including carpenters and background painters), the curators (two for this exhibit, plus an assistant to the senior curator who did research, helped move objects and kept track of everything), the Publications Department (we published a volume of essays related to the exhibit) and the Public Information Office, we also had three academic consultants (one for each of the main peoples represented), two technical consultants (an ornithologist to identify the feathers and a malacologist to identify shells decorating some objects), the Assistant Registrar for Loans (because of material on loan from another museum, one of the curators and two of the consultants), the sculptor and his assistant, and the models. Also involved (albeit peripherally) by the time the exhibit was put together were the Assistant Curator's husband (who bought fabric in Bolivia), an expert in silicone molding materials (for advice on the silicone pretending to be a ceremonial drink), the owner of a bead shop in New York (who spent a lot of time helping us find the right beads for reproduction items), the mother of one of the consultants (who sent a gourd from Brazil) and a number of patient volunteers who helped string thousands upon thousands of seed beads. We confidently expect future exhibits to be a piece of cake.

Acknowledgements

The author's thanks go to all the people mentioned above, and also to Lynn Grant and everyone else working in the Conservation Laboratory at the time, without whose support the author would have been in very bad shape indeed.

Author's Address

Figure 1. Model for a Waiwai figure, wearing a mockup for a reproduction loincloth, and real feathers. The ankle and knee ornaments have been temporarily sewn onto twill tape. The lip plug is attached with masking tape.

Figure 2. Model for two Waiwai figures. The ear pendants are hung on loops of cotton string. Bracelets and anklets have been stitched to twill tape.
Figure 3. Model for a Waiwai figure. The right-hand armband, not yet conserved, was too distorted to fit on the arm. The model is sitting on a suitcase which is the same height as the real stool. The finished mannequin is shown in Figures 14 & 19.

Figure 4. Model for a female Waiwai figure. The apron (see Figures 11 and 12) is temporarily sewn to twill tape. The completed figure is partly shown in Figure 12.
Figure 5. Applying plaster and bandage to a model. The mold and cast are made in sections.

Figure 6. Applying plaster and bandage to a model.
Figure 7. Sections of a cast before assembly.

Figure 8. Assembled figures. Note the jointed arms on the male, and the depressed area to accommodate the armband. The narrowed area on the arm of the female is for strings of beads to be wrapped around the arm.
Figure 9. The Waiwai mannequins assembled into the scene. The sculptor is marking an area that has to be filed down so that the headdress will fit.

Figure 10. Mannequin with the skin and features painted, getting his body paint. The jointed arms have been removed.
Figure 11. The back of the heavy beaded apron shown in Figure 4, with its full backing and velcro for suspension.

Figure 12. The apron mounted on the mannequin.
Figure 13. Original bandolier, with a set of braided loops and a complex pendant of birdskins and feathers.

Figure 14. Finished Waiwai mannequin. The main support is an iron bar (see Figure 19) but the figure appears to be sitting on the stool. The bandolier (Figure 13) has been hung from the new cords.
Figure 15. Waiwai earrings. The shell disks have separated from the resin, which is crumbing.

Figure 16. Reproduction earrings, made from Sculpey polymer clay, bamboo sticks and soft wax.
Figure 17. Model for a Waiwai chief holding a bowl with a ceremonial drink. The position of the hands are adjusted by the curator, using a vessel with the same size and type of base as the real bowl. See Figures 18 and 19.

Figure 18. Several completed mannequins. The central male figure wears two reproduction multi-strand necklaces.
Figure 19. Completed figures in the Waiwai scene, before dressing. The support rod for the seated figure can be clearly seen.

Figure 20. Two brands of craft paper tape. We used the one on the left, which had a more appropriate appearance, and was thicker and easier to handle.
DOWELS, POWDER AND CRACKS: COLLABORATION IN THE PRESERVATION OF A 12TH-CENTURY PORTAL FROM BORDEAUX

Barbara Mangum and Valentine Talland

Collaboration is defined as working jointly with others, literally laboring with others, one assumes to some common goal. At the Isabella Stewart Gardner Museum, it has become abundantly clear to me over the last ten years that preserving works for the future can never be an isolated process, but requires constant collaboration with anyone who can possibly affect the future of a work. In terms of a late 12th c. stone portal from Bordeaux, I am a collaborator in the preservation of this work with the artist or artisan who designed the work, chose the stone and method of working it; with all past owners, handlers, dealers, restorers and conservators who have written their chapters into the preservation of the life of this work; and with Isabella Stewart Gardner herself, who chose to have it installed within a supporting wall of the museum. But the collaboration does not stop there: preservation of the work requires the direct assistance of staff of nearly every department of the Museum in one way or another. The education staff, special events staff, and others are actively engaged in seeing that the works are exposed to the public. They inform the public of the fragility of the works. The maintenance staff clean up after the visitors and must be careful that their equipment does not damage the stone. They also give any fragments they find to the conservation department. The building supervisor and construction crews who repair the building must be very careful that their intervention does not cause undue vibration and further deteriorate the stone. Finally, our largest group of collaborators in preservation are the visitors themselves, 170,000 of them each year, who are either thoughtfully disposed or not when they visit the piece.

In 1865, an antiquarian named Leo Drouyn published a book entitled La Guienne militaire. Through several engravings, he depicted a Romanesque edifice, a grand house from the late 12th c. known as Maison Seguin or sometimes Maison de la Synagogue, as it appears to have sat opposite to a synagogue in the ancient Jewish quarter of La Reole, a town located on the Garonne some fifty miles upstream from Bordeaux in France. The name of Seguin was of an old influential family of the region, documented at La Reole as early as the 14th c. One engraving showed the entrance portal which crowned the front steps and landing to the house of Seguin. Unfortunately, the building was destroyed only a little after M. Drouyn completed his study.

Not until after 1934 was it realized that the portal of Maison Seguin had been acquired by Isabella Stewart Gardner and installed within the structure of the Isabella Stewart Gardner Museum in Boston. The upper portion of the portal, just under the polylobed arch, is adorned with three heads now thought to be the head of Christ, Mary, and St. John. They are placed over a horizontal lintel, which has been carved with a meander motif. The arch is supported by four pillars of mortared stone, which are further adorned with engaged columns. The columns are capped by two grotesques. The two other piers are capped with simpler capitals,
Man gum and Talland adorned not at the sides, but only under the lintel: one side bears a carved knot in relief, the other a flower. The columns rest on simple curvilinear bases and the piers on rectangular stone blocks. The work has been cut from a pink-yellow sandstone, but the surface in general is nearly black.

The work was purchased for a sum of $14,000, a good sum of money in August of 1914, but was not delivered until two years later, due primarily to the activities and chaos caused by World War I. In 1916, Isabella created her renowned gallery, the "Spanish Cloister", as a suitable setting for the painting, El Jaleo, by John Singer Sargent, which she had just received. Within the newly built western wall of this gallery, she installed the portal. It again functions as a gateway, this time to the courtyard of the Museum.

Now to move on to more contemporary issues with the portal. The first collaboration is a collaboration in time, the documentation left to the conservator to evaluate change of condition in the work since its installation. As we work through the images available to us, it is clear that the sculpture is not deteriorating so much with a bang or a bust, but with a slow rain of powder, and surface exfoliation. In notes in the treatment file of the work, we find listed loss of stone crust to the Head of Christ in 1981. This was linked to a possible concert in the room above the night before. Other sandstone was collected during the following week. The gate was closed off, and it was around this time that efforts were made to consolidate the stone with MTMOS. Some staining occurred and the work was stopped. Deterioration was again noted to the right grotesque in April of 1987. The piece was consolidated locally with 3% B72 in Methyltrimethoxysilane.

This kind of deterioration is very typical of chemical deterioration of limestone objects in the Museum. Gypsum is formed by reaction of the calcium carbonate of the limestone with sulfur dioxide, in the presence of humidity and carbon provided by air pollution. The gypsum is physically larger than the original limestone, due to the incorporation of two molecules of water, as well as the larger sulfur atom. This volume change causes a small explosion to occur on the surface of the stone with a resultant powdering and exfoliation.

In October of 1987, Eugene Farrell and Paul Whitmore, then at the Center for Conservation and Technical Studies (now the Strauss Center) of Harvard University Art Museums, were contracted to undertake petrographic, x-ray diffraction and SEM investigation into the deterioration of the piece. They identified the stone to be a calcareous feldsparic sandstone. Forty to fifty percent of the sample was composed of quartz, another 10% K feldspar, 15-20% CaCO3, with the balance being mica, iron silicates and iron oxide. The overall tan color of the stone was due to the weathered iron oxides and hydroxides which stain the material.

One of the most significant features of the thin section was the revelation that the layer of sulfur-reacted stone (i.e. unstable gypsum) went quite deep, 0.140-1.2 mm in thickness. The layer has incorporated a considerable quantity of soot (i.e. carbon) which accounts for the
Man gum and Talland's overall black appearance.

The recommendations of the scientists were to trace the source of the sulphur contamination and eliminate it if possible. They also stated that the lack of humidity control would remain a critical problem for works at the Gardner. I am now happy to say that by the end of this summer, the Gardner will have full climate control installed and working. Their report was used in the numerous grant applications for funding for this project, and is therefore collaborative in this larger project as well.

In 1989 we decided to undertake a more thorough investigation of the interior dowels of the portal. There was evidence of corrosion in some areas of the stone blocks of the pillars which seemed due to the rusting of the interior dowels. The area of greatest concern in terms of instability, however, was the upper right block of the arch near the head of the right grotesque. This block had a horizontal crack transecting it. In the front (east) face the crack was further transected by a vertical crack. At this juncture, the upper section of the stone appeared offset from the lower by about 1-2 mm, making it suspect that further rusting of an interior dowel was occurring here. There also appeared to be a small area of previous repair at the point of intersection of the cracks.

We considered using a pachometer to locate the metal within the stone, but we wanted more information than that would provide. We also considered investigation by ultrasound; however, this was more expensive than the alternative, gamma radiography, which appeared to give us comparable results.

We went with a firm familiar to the museum, Briggs Associates, and contracted with them to make gamma radiographs of the portal and other works of stone in the museum. Gamma radiography was done in situ using an Iridium 192 source. The galleries both above and below had to be emptied of people during the period of exposure, which lasted about 20 minutes, although the set up between exposures took longer. The entire process of obtaining several exposures with several types of film took about four hours and development was done on site, in order to assure that effective exposures were obtained.

The resulting radiographs confirmed the existence and placement of dowels throughout the stone, presumably put there during installation in the gallery in 1916-17. They also confirmed the presence of not one, but two dowels at the site of the horizontal crack. I must add however, that the radiographs have since been criticized by other corrosion experts for their quality. Although they met our need to know placement, it is difficult to read anything about the condition of the dowels. On reflection, it might have been better to have gone with a firm more experienced in radiographing stone to get better quality radiographs, and to have had the advice of later consultants regarding what is possible to achieve. This leads me to one of my basic tenets in collaboration: go with the best. Usually, you will find that they are intrigued by your problems, and often they will help you for free or at a reasonable rate. They can also
Man gum and Talland often help you with other contacts to experts who can be of help. And in an area where you are not an expert yourself, you need to be able to trust the experience and ability of your collaborator. It is also useful to work with someone with a track record, who will still be there in the future when you need them for follow-up.

Once the presence of interior dowels had been established, the thinking followed that these were corroding during the periods of high relative humidity at the Gardner. The Gardner Museum has not had any means of reducing relative humidity through most of its existence, and has routinely experienced high temperatures and humidity during the months of July and August. There are even two recorded instances of the interior climate actually hitting 100% RH, i.e. condensation.

Most object conservators are familiar with this situation and know that the normal course of action is to take no chances and remove the offending dowels. In this case, however, we were dealing with a very fragile piece of stone, mortared with Portland cement and doweled into a 20" thick brick wall. Since removal did not seem possible, Valentine Talland, Associate Conservator in Charge of Objects at the Gardner, and I began to look into cathodic protection as a means of limiting the corrosion of the interior dowels.

Early in 1990, we contacted Dr. Robert Baboian, a corrosion engineer, who has worked with conservators on issues of preservation, including the corrosion of the Statue of Liberty. Valentine met with him in December of that year, and we were surprised to find that he doubted that active corrosion of an iron dowel could occur within a material from high relative humidity alone. He thought there would have to be a source of water, perhaps from condensation. To settle this issue, he suggested taking a boring through the stone to the dowel, measuring the potential with a voltage meter at the dowel during periods of high relative humidity, and using the core sample for analysis of the different layers by SEM.

He suggested putting together a team of other experts to look at the problem, including Mr. Neil Burke, a corrosion engineer at WR Grace in Cambridge. This was very helpful, and brings me to another point about collaborations: if at all possible, work with someone nearby (within a day's round trip) so that you can get together in front of the object from time to time.

Mr. Burke visited the department in February of 1991 and again looked at the radiographs of the horizontal crack in the portal. He too was not convinced that the crack was related to corrosion of the interior dowels. The steel did not appear so badly corroded to him, and the lateral rather than radial crack pattern suggested to him fluctual or sheer stress. Even if corrosion were occurring, he did not think that cathodic protection would be much of a possibility. At best it would be very localized.

At about the same time, the plans which the Museum had made for the installation of a
Man gum and Talland

full-climate control system began to come to fruition. We were awarded a National Endowment for the Humanities National Heritage Protection Program grant of just over $400,000 to begin the first phase of installation. With the reduction of temperature and relative humidity to acceptable levels year-round, we made the decision to leave the subject of the corrosion of the dowels for the time being, and to concentrate on loss associated with the powdering of the surface.

In March of 1991, Valentine and I decided to consolidate the stone of the portal using ProSoCo Conservare OH, a silicate ester. These silicate esters are both effective and highly toxic in that they react with sources of water to create polymerized silicate networks. In high enough quantities the fumes will cause cataracts to humans, and earlier work in the museum's courtyard had shown that the material will kill plants. Therefore, significant efforts were taken to mitigate the noxious nature of this material during application in the museum gallery.

The building supervisor and Valentine worked together to create a large, ventilated polyethylene box around the portal. The wrought iron doors of the adjacent gate were removed. Wooden two by fours were put up against the brickwork next to the portal, and polyethylene was stretched over them to form a box, large enough for one person to get into with a ladder. The edges of the polyethylene were taped to the wall and the box was sealed shut, except for means of egress, air supply and the attachment port of flexible duct hosing. The hosing extended from the box to the doorway out into the garden, about 20 feet away. In the door to the garden, the hose terminated in an attachment to a fan. The door was sealed up around the fan to provide the maximum draught. Note that in this case the fan was industrial, but not explosion proof. At the time, we counted on the good draught of this fan to keep the vapor pressure of inflammable material down below its flash point. However, we have since obtained and would recommend an explosion proof fan for all such future operations. Valentine was completely suited up for the application of the consolidant including full face mask, gloves, and protective clothing.

It is recommended that the consolidant be applied in three cycles of three applications each. However, due to the difficult nature of the work, we used only one cycle of three applications with satisfactory results. The consolidant was applied by brush to the more stable surfaces and by spray at 10-14 psi to areas of high relief carving, the underside of the lintel and arch, and to the fragile areas of the grotesques. A spot test of the recommended MEK rinse resulted in complete leaching of the consolidant, and therefore was not done.

The work was done on a day when the museum is normally closed to eliminate exposure to visitors. The chamber and fan were left in place to ventilate the area during work hours, when security details could observe the area. At night, the chamber was sealed up and a portable charcoal air-purifier was placed within to absorb the fumes. This was moderately effective. After four days the chamber was disassembled.
The goal of the treatment was to have the consolidant penetrate and polymerize in the fragile layer of sulfation and to tie this layer to the underlying stronger stone. This appears to have been achieved. We know that the consolidation application has worked well, albeit not perfectly, in that we now receive fragments of stone rather than loose powder. The advantage is that these fragments can often be re-adhered in place, whereas powder is lost forever.

A question that continued to haunt us was whether the installation of the portal into a load bearing wall of the museum utilizing an extremely rigid mortar, i.e. Portland cement, was causing further deterioration. This manner of installation is not recommended: preferable would be a free-floating installation that relieves the stone of the stress of support and damage due to settlement of the building, and allows no translation of vibration from the floors above. To answer this question, we contracted for yet another study of the portal in December of 1994 with LeMessurier Consultants of Cambridge, a structural engineering firm. They determined the live load capacity of the Tapestry Room above the portal, but could not determine by nondestructive means either the structural construction of the ceiling directly above the portal or the compressive strength of the stone to know whether it could accept the load.

The results of the analysis showed that the vertical compressive stress in the brick wall on the north and south sides of the portal was well within safe allowable limits. This was good news for it meant that at least the portal was not bearing more of the weight of the building than other areas of brick wall.

The natural vibration frequency of the Tapestry Room floor was calculated and was found to be safe for walking and sitting. They were however, able to measure a displacement in the horizontal crack of the right capital when the room was full of people for a concert. The measured displacement was small, 0.0007 inch, but statistically significant. As a result, the structural engineer, Kenneth Wiesner, has recommended that there be no dancing in this room within a zone of about 300 s.f. around the portal placement below. (Note that there had been dancing in this room in 1993, and in 1988 clog dancing.) In conjunction with this project, Valentine undertook a complete photo documentation of the condition of the portal, to serve as a benchmark for measuring future deterioration.

Last year, the Museum began the second phase of climate control and a new collaboration has developed: between conservation staff and the construction crew. It was difficult, especially during the early phases which involved demolition. We have protected these pieces during demolition by wrapping them in plastic to contain the fragments and supporting them underneath by wooden structures. One fragment was found in this way and has been reattached. The last fragment received showed that the deterioration of the right capital had gotten worse with the construction project. We will still be able to adhere the most recent fragment back in place after conclusion of the project, now slated for September 1, 1996.
Man gum and Talland

In summary, I believe we have make good progress in our attempts to conserve this stone. We have a much better understanding of the underlying problems affecting the portal. We know that the silicate consolidation has helped by giving us larger, better consolidated fragments which can be reattached to the edifice. And we know that vibration, both above, below and in adjacent galleries is a real concern. We have systematically assembled good photographs in both black and white prints and color slides to act as a benchmark in measuring future deterioration. Our next project with this stone will be to fill and inpaint the losses using reversible paper fills, again to serve as a means of monitoring deterioration. Last but not least, with the introduction of full climate control we expect the subject of rusting dowels to be put to rest. Our information and success has been gained through a series of deliberate collaborative efforts. But, in a larger sense, I see a major part of the work of conservation of this piece as letting others know of their role as collaborators in the life of this work.

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STAINED GLASS CONSERVATION AT THE ISABELLA STEWART GARDNER MUSEUM: PUTTING THE PIECES TOGETHER

Valentine Talland and Barbara Mangum

Introduction

In the Spring of 1994 the Gardner Museum began the conservation of nine medieval and Renaissance stained glass windows in its permanent collection. This collaborative project involved the participation of no less than six conservation professionals in addition to five art historians. It has been a rewarding but complicated project. It has taught us a great deal about the very specialized nature of stained glass conservation and about the benefits as well as the demands of collaborative projects.

Among the windows that were treated were: a 13th-century window from Soissons Cathedral in Reims, France; four 15th-century and two 16th-century windows from Milan Cathedral; and two 15th-century Austrian windows. This paper will discuss some of these windows to illustrate some key issues that arose during the project that called for a collaborative approach to their resolution.

Collaborators

Because the participants involved in this project are so numerous, they require a brief introduction. The art historians involved are as follows:

Hilliard Goldfarb, the Chief Curator at the Gardner Museum, was very involved with issues of aesthetic compensation and iconography.

Madeline Caviness, a Professor of Art History at Tufts University and formerly the President of the Corpus Vitrearum, the international organization of scholars formed after WWII for the purpose of cataloguing all European stained glass in Europe and North America.

Marilyn Beaven, a researcher for the Corpus Vitrearum and Madeline's graduate student. She wrote her Master's thesis on the Gardner's Soissons window and knows the window better than any living scholar. Madeline was involved in all aspects of the treatment of all the windows. Marilyn was involved principally with the treatment of the Soissons window. Both reside in the Boston area and their proximity was a real asset in this project because it was relatively easy to meet with them with the windows to discuss the treatment.

Caterina Pirina, an art historian at the Duomo Museum of Milan, first published the Gardner's Milanese windows. Ernesto Brivio, the Director of the Duomo Museum, is very familiar with
the Gardner's Milanese windows. In contrast with Madeline's and Marilyn's proximity, the relative remoteness of our Milan consultants complicated the project. It was very difficult to discuss issues of aesthetic compensation and iconography when the key consultants had only photographs to work with.

A number of conservation professionals were also involved in the project:

**Barbara Mangum** and **Valentine Talland**, conservators at the Gardner, supervised and coordinated the project.

The work was contracted out of the museum to **Bill Cummings** of Cummings Studios, specialists in stained glass restoration. This was done in large part due to the specialized requirements of stain glass restoration and the difficulties in dealing with lead. Bill Cummings in turn, at the Museum's request, then sub-contracted the actual treatment to **Marie-Pascale Foucault**, an independent restorer of stained glass who had previously worked on contract for the Metropolitan Museum of Art and the Cloisters among other clients. She has expertise in the treatment of early glass, and, in particular, French glass as well as being a highly skilled glass painter. She did her work at Cummings Studios in North Adams, MA. Bill Cummings managed the project from his end, coordinating the schedule of completion, overseeing the accounting, and providing high quality and safe working conditions. One major advantage of this arrangement was that it kept the windows fairly close to the Gardner Museum. We could drive out to Cummings Studios on a regular basis to consult on the treatment and monitor its progress. This turned out to be critical during the course of the treatment, because it would have been impossible to make decisions about the scope of structural and aesthetic treatment without seeing the windows in person.

**Dieter Goldkuhle**, an independent stained glass restorer in Reston, VA, was brought in on Madeline's recommendation to consult on the structural treatment of the Soissons window.

**Gene Farrell**, a conservation scientist at the Straus Center at Harvard, was contracted for the compositional analysis of the lead came from some of the windows.

Below is a diagram of how we had envisioned our relationship with our contractors and consultants at the beginning of the project. As the owner, we would manage the project and coordinate communication among all the collaborators. In this way we felt that we would be party to all important discussions and thus be able to make the most informed decisions.
As it turned out, the following diagram more aptly conveys how things actually worked. As the windows were being worked on, and specifically being taken out of their leads, there was a flurry of excited discussion between the contracted conservator and the consulting art historians. Although they were not deliberately excluding the owner, we had to work hard to be kept in the loop. Moreover, although the contractors were working for the Gardner Museum on this project, as stained glass restorers their relationship with the Corpus Vitrearum staff would long outlive the treatment of the Gardner windows. Although the contractors' commitment to the owner was never in question, their relationship with the Corpus Vitrearum staff did complicate our position as the project manager.
Talland and Mangum

Stained Glass Components

Leaving aside the collaborators for the time being and turning to the treatment of the windows, it may be useful to review quickly the various components of stained glass in order to facilitate the discussion. The Gardner windows are composed of individual pieces of colored glass; the color results from metal compounds added to the glass in manufacture. Most of the glass is further decorated with a vitreous dark paint, or grisaille, which is fired onto the glass surface. Some glass is also decorated with a fired yellow silver stain. Most of the grisaille and silver stain is original, although on many of the Gardner panels there are isolated areas of 19th-century grisaille and silver stain. The glass is held in place, or glazed, with lead cames which were originally putied with an oil-based glazier's putty. After restoration, all the panels have been housed in rigid brass frames that are slightly over-sized to allow movement of the glass and lead. Finally, the panels of the Soissons window are installed in a structural stainless steel armature.

Treatment of the Soissons Window

In many respects, the real cornerstone of this project was the monumental Soissons window made in 1205. It is known as the Lives of Sts Nicasius and Eutropia window and it depicts part of the legend of the martyred brother and sister saints whose cult was local to the region of Reims. This window has been identified by the Corpus Vitrearum as probably the largest, most complete medieval window in an American museum collection. It was installed around 1910 by Mrs. Gardner in her Chapel gallery.

At the beginning of this project the glass and paint in the Soissons window were in remarkably good condition. However, this window was in urgent need of conservation because it was structurally unstable. The lead cames had buckled severely out of plane. Figure 1 is a schematic graph of the window. It illustrates the actual measured deformation of the window in 1993. In one area of the window, the maximum deformation was 3.6 cm. In short, the window had buckled substantially out of plane and was severely at risk.
One cause for the planar deformation was the weakened condition of the lead in the cames. The cames are of the 19th century; the entire window was reglazed in the mid-19th century by a French restorer named Didron. On the surface of the lead there was extensive white pitting. It turned out that the corrosion, rather than being just on the surface, had penetrated throughout the cames causing them to be very weak and brittle, and raising the question of the need to re-lead the entire window.

It seemed likely that the degradation of the cames was related to the lead alloy composition. Our collaborators had observed that 19th-century lead cames are frequently much weaker than their medieval counterparts. One explanation for this may be too low a percentage of silver and/or copper in the 19th-century lead composition; that is, there is a critical minimum.
percentage of silver and/or copper essential for the long-term stability of lead cames. It is thought that in 19th-century Europe, silver, naturally present in lead ore, was extracted from the baser metal for other uses in order to exploit as fully as possible the value of the ore. We thought it would be useful to look at the composition of the Soissons window cames. Gene Farrell at the Straus Center did the analysis. As a side note, we have had the leads of most of the Gardner's windows analyzed and hope to begin sometime soon a preliminary study of antique and 19th-century lead cames.

The table below on the left shows the percentage by weight of some of the metals present in the 19th-century Soissons window cames. The table on the right shows the standard specification for copper-bearing lead cames provided by the American Society for Testing Materials. These are specifications for lead predicted to have a lifetime of more than one hundred years. The ASTM standards indicate that silver should be present up to 0.02% by weight and the minimum copper present should be 0.04% by weight. In the Soissons window samples, however, there is no silver present and the copper is present in percentages less than 0.04%. The 19th-century cames in the Soissons window contained below the minimum recommended percentage of copper and silver, they were also visibly very weak and we had serious reservations about their stability.

<table>
<thead>
<tr>
<th>Soissons Window lead composition (%)</th>
<th>ASTM lead composition (%)</th>
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<tr>
<td><strong>sample #1</strong></td>
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</tr>
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<td>copper</td>
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<tr>
<td>antimony</td>
<td>0.02</td>
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A critical aspect in the treatment of the Soissons window turned out to be the decision to remove the 19th-century lead cames and re-lead the entire window with more structurally stable cames. Prior to making the decision, however, we brought in an additional expert stained glass restorer, Dieter Goldkuhle, to examine the leads and consult on the decision. It was extremely important that all possible alternative treatments be explored because of the risks associated with re-leading the window. Re-leading puts the glass at risk for damage and possibly being misplaced; also, each re-leading takes the window one step further from the original; and the appearance of the re-leading might not have been aesthetically as successful as the 19th-century work which was very good. On the other hand, there were also corresponding benefits. There was no question that re-leading the window in high quality lead cames would extend not only the life of the window but also the efficacy of a conservation treatment that in all likelihood the museum could not afford to repeat in the near future. Moreover, it gave the Corpus Vitrearum scholars the opportunity to examine the cut edges of the glass, which resulted in two major discoveries: first, it led the scholars to increase their estimate of the number of pieces of original 13th-century glass and second, their examination allowed them to ascertain the original conformation of the structural armature.

By examining existing windows in the Soissons Cathedral, we had observed a number of armature conformations, but these armatures are not all original. Thus, without the examination of the glass we could not have known conclusively the original shape of the armature of the Gardner window. Since part of the treatment included building a new structural armature at the cost of some $10,000, we were glad to have as much information as possible. Ultimately, all the collaborators were satisfied with the decision to re-lead and agreed that the necessary investigation of choices had been pursued.

Treatment of the Milan Cathedral Windows

In 1865, Mrs. Gardner purchased six windows from Milan Cathedral. Many windows had been removed from the Cathedral in the 1830's in order to be restored. The contracted restorer, Giovanni Bertini, painted some 48 panels de novo to replace the originals while they were being restored. However, Bertini ended up restoring very few panels, preferring to paint new ones. In 1869, the Cathedral stewards called upon Bertini's sons to make an inventory and to restore the original windows which had been piled up in a warehouse for some 40 years. They did complete much of this work, but many of the windows were never re-installed and it is presumably from this cache that Mrs. Gardner's windows emerged.

While studying stained glass windows, the Corpus Vitrearum scholars identify and mark what is original glass and what is restoration. To do their documentation, they take a black and white photograph of the window and then overlay onto each piece of glass various patterned markings. Each patterned marking indicates whether the glass is original or a restoration (see Figure 2). The various restorations are subdivided by type (each has a different patterned
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During our project we were particularly concerned with three types of restorations: first, nineteenth century glass fills with nineteenth century paint; second, the so-called "stop-gaps" which are fills of antique glass contemporaneous with the panel but probably originating from another panel; third, palimpsests that are the same as "stop-gaps" - that is, they are spurious pieces of antique glass - but they have additionally been repainted in the nineteenth century.

![Corpus Vitrearum Restoration Charting Symbols](image)

**Figure 2. Corpus Vitrearum Charting Symbols.**

One of the Gardner windows to be treated was a sixteenth-century window titled *Ruth and Boaz*, attributed to Corrado Mochis. However, the title is a bit of a red herring because the narrative is still unidentified. Figure 3 shows a before treatment view on the left and after treatment on the right. Note the piece identified with the arrow. This piece of glass is an antique piece contemporaneous with the panel, but it did not originally belong in this position and very probably not in this window.
This piece of glass had been identified as a stop-gap and it had the unfortunate effect of turning this female figure into a bearded lady. Madeline Caviness from the *Corpus Vitrearum* was very opposed to removing any stop-gaps during the treatment of the windows. She feels that this stop-gap is a part of the history of the window, that it is contemporaneous with the window and may come from an unidentified panel in the same narrative series, and that it has informational value in its place in the window. The Gardner is respectful of these considerations but at the same time has an obligation to its visitors to make the windows readable, as presumably they originally were. Much effort was made to determine what the original iconography was. It was posited that it might have been a scene of Jacob about to put on the animal pelt given him by Rebecca in order to deceive the blind Isaac. Thus, the central figure would have to be interpreted as a young man; in this case the piece of hair glass might make some sense in the composition. In consulting with the Milan scholars they were unable to concur with or reject this interpretation. They found no parallels by the same painter that might belong to the same narrative series.

Figure 3. *Ruth and Boaz*, before and after treatment.
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At this point the Gardner's Chief Curator decided that the stop-gap was too confusing in its current position and that there was no reason to believe that the piece of glass belonged in the window. So we began to investigate how this part of the window could be reconstructed if the offending piece of glass was removed. Using computer graphics software, several mock-ups of proposed reconstructions were made. These mock-ups were circulated to all the collaborating art historians. Some modifications were made in order to arrive at the after treatment state shown here. The museum is very happy with this treatment. We feel confident that the museum can provide a safe and permanent home for the removed piece of glass where it will be available to scholars for study. Madeline Caviness is less satisfied with the compromise. Incidentally, we offered to give the stopgap to the Duomo Museum in Milan in the event that they might find the panel to which it originally belonged. Their response was that they would be happy to receive the piece of glass and that they would probably use it as a stopgap in another panel. In light of this, the Gardner chose to keep the glass.

In another of the Milanese windows, The Washing of the Feet, a 19th-century restoration raised a perplexing conservation issue. The piece in question is a 19th-century piece of glass with 19th-century paint. It was probably done by Pompeo Bertini sometime between 1869 and 1875. Bertini was an exponent of "historic restoration" and is well known for his efforts to reproduce as best as he was able the style of the 15th and 16th-century painters whose glass he repaired. Indeed, Mrs. Gardner's panels have been praised by stained glass scholars as illustrating "the most important moments in the history of the cathedral's stained glass, from its origin in the 15th century to its wholesale restoration by the Bertini family in the 19th century." 1 So there is clearly historic value to this piece of restoration glass.

Unfortunately, when this panel was re-leaded and the original glass re-aligned, this restoration piece of glass no longer fit. The dilemma was as follows. On the one hand, we could have removed the glass and stored it in toto safely at the museum with the treatment documentation for the window. Then we would have had Marie-Pascale, a highly talented glass painter, cut a new piece of glass that fit and have her paint it in the style of the original or perhaps in the style of the Bertini restoration. On the other hand, this 19th-century piece could be cut down to fit and remain in the panel thus preserving the Bertini restoration, albeit no longer complete, in its historic position. Neither was an ideal solution. In this incidence we bent to the strong urging of Madeline to keep the piece in its historic context in the window, so it was cut down a full inch along one side in order for it to fit.

Treatment of the Austrian Windows

The last two windows in this project are two Austrian panels (Figure 4) which were made to commemorate the marriage of Lienhart Jochl to Dorothea Hungerhausen on the right. They were painted around 1490. They are inscribed along the bottom, "Lienhart Jochl 1490". The photograph below was taken before treatment. The issue of cold-painting in stained glass
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conservation arose during the treatment of these windows.

Figure 4. Austrian panels: Lienhart Jochl and Dorothea Hungerhausen.

Cold-painting had been carried out throughout the treatment of the windows to inpaint epoxy fills. The medium selected was Acryloid B-72 because it is easily reversible, and, although a new medium to Marie-Pascale, one she found easy to use. Moreover, in the Gardner Museum ultraviolet light is filtered by the exterior storm windows, so the B-72 medium can be expected to be relatively stable. In approaching the Austrian windows we knew we would not inpaint areas of damask pattern, because these patterns can be critical in establishing date and provenance. There is an example of one such painted damask being discovered in an actual 15th or 16th-century fabric in a cope from Burgundy. So the damask patterns have to be treated as a document.
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The inscription along the bottom, however, was an area that the Gardner Museum had hoped to recover as a decorative element with some cold-painting. We felt it was important for visitors to be able to interpret this worn area as script. We even have an excellent document of how the inscription looked earlier in the history of the museum: a photo taken in 1959 shows that at that time the original grisaille in the inscription was virtually intact. However, according to the *Corpus Vitrearum* standards, were we to cold-paint in the loss on this original piece of glass - even in a reversible medium - they would reclassify the entire piece of glass as a restoration. Their system has no way of distinguishing between inpainting and repaint on an original piece of glass. Madeline is adamantly opposed to inpainting on this glass. She would prefer using a plating technique in which a modern piece of glass is painted and then is glazed in with the original piece. We at the Gardner are opposed to plating techniques because of the risk of forming a micro-climate including condensation and promoting more damage to the paint and glass. At some point, plating had been put onto these windows in a misguided attempt to protect the glass. In 1990 we removed the plating and discovered severe damage to the back of the glass and paint as a result of moisture that had been trapped behind the plating.

We have not yet fully resolved the issue of cold-painting the inscription. For the time being, we intend to re-install the window without any inpainting and see how it looks. It no doubt will look much better simply as the result of its cleaning and treatment which has, among other things, removed unsightly repair leads.

Conclusion

It is clear that in order to achieve the best possible treatment for the stained glass it was absolutely necessary to consult all the appropriate experts and to make an effort to assure each that their opinions would be respected. On the surface this had seemed simple; after all, we all shared the same objective: the preservation of the windows. On a more profound level, however, it emerged that we did not always share a view of the means by which the objective would be achieved.

We discovered that we had very different perspectives on preservation. Our *Corpus Vitrearum* colleagues were much more interested in maintaining things as they were and we were interested in making the windows beautiful as well as stable. They treated the windows as information and we regarded them as fine art. Moreover, prior experience with a long history of stained glass restorations had made them very wary of all restoration and conservation, and they tended to lump the two together. There was a real communication gap when it came to discussing modern conservation materials and techniques. This perhaps points to a need for our profession to engage in more communication with our affiliated fields. At one point, our *Corpus Vitrearum* colleagues presented us with a copy of the Charter of Venice. It seems that they assumed that we were not already familiar with it. We
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should probably provide them with a copy of the AIC Code of Ethics.

As the owner in fact of the windows we also had to allow that all our collaborators made a claim to an "ownership" in spirit of the project. The positive side of this is that it indicated a real vested interest in the project and a sense that each of us was leaving a permanent legacy to these windows. On the other hand, it also meant that everybody's reputation was also vested in the treatment. Sometimes this attitude resulted in a certain rigidity of position when difficult treatment choices had to be made. In the end, we were able to meet somewhere in the middle on most issues, but it meant addressing each question as a unique situation, opening it up for discussion, and ultimately being very patient.

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Endnote
