

THREE CASE STUDIES IN THE TREATMENT OF PAINTED FURNITURE

Susan L. Buck, Furniture Conservator

The Society for the Preservation of New England Antiquities Conservation Center

Abstract

Ultraviolet light cross-section analysis is used on a routine basis at the SPNEA Conservation Center to provide new insights into painted surfaces and methods of paint application, and to help distinguish early layers from later layers of paint, finish and grime. Once the various layers have been characterized, the aqueous, solvent gel and emulsion cleaning systems developed by Professor Richard Wolbers offer a wide variety of alternatives to traditional solvents for cleaning painted surfaces.

Three objects which differ markedly in the composition of the paint, glaze and metallic powder layers, as well as the cleaning problems posed, are examined. All treatments involved cross-section analysis, pigment identification, and the development of an appropriate gel, resin soap or emulsion cleaning system.

The oldest object, a 1715 Court Cupboard from Hadley, Massachusetts, retained surprisingly intact original surfaces, as well as at least eight generations of shellac and plant resin varnish, two layers of overpaint, and a thick layer of degraded linseed oil dressing. A Masonic Masters Chair ca. 1870 was painted primarily in blue glazes and red paint (in a resinous binder), with the symbols depicted in metallic powders. The painted surfaces were very weathered and had thick accumulations of wax, grime and degraded varnish. A New York Grecian Couch with watergilded, oilgilded and verd antique elements, had a thick coating of modern bronze paint over all the major decorative forms.

Treatment of the Hannah Barnard Court Cupboard

This massive two-tiered Court Cupboard with the name “Hannah Barnard” painted on the two upper front panels was almost an icon of early painted furniture when it was described in *American Painted Furniture* by Dean Fales as follows:

“Since it is so well documented, this press cupboard is the key in the dating of this select group of painted pieces. In them, paint had replaced carving, and inventiveness and expediency joined together to produce an effect which, though outdated, was one of resplendence.”¹

Unfortunately, in recent years the Court Cupboard had become considerably less resplendent. It had been relegated to storage at the Henry Ford Museum because the painted surfaces were so darkened and illegible. When it was requested for loan for a small, but important, show of Hadley chests, there was some incentive to determine what had happened to the sludge brown painted surfaces, and whether it was possible to clean the Cupboard and recover painted designs which were more pleasing and coherent.

The SPNEA Conservation Center was asked to work with the objects conservators at The Henry Ford Museum to conduct intensive cross-section analysis and a series of cleaning tests.² This initial analysis phase took place at the Henry Ford Museum and the first set of 40 cross-sections taken from all the representative areas of the Cupboard indicated that there was an astounding collection of material on top of what appeared to be original paint and glaze layers. All the cross-sections were examined under

reflected visible and ultraviolet light at 100X, 200X and 400X magnification using the Nikon Labophot fluorescence microscope in the Museum Objects Conservation Lab. Binding media identification was conducted using the following biological fluorescent stains: TTC for carbohydrates; FITC and EITC for proteins; Rhodamine 123, DCF and RHOB for oils; and Bromocresol Purple and Bromothymol Blue for pH ranges 5.2 to 7.6.³

The cross-sections differed considerably from area to area. There were comparatively fewer generations of overvarnishes on samples from the case sides and moldings, while samples taken from the two turned columns, drawerfronts and upper panels revealed a complicated history of overvarnishes and overpaints. For example, cross-sections taken from the top drawer, which was considerably glossier than the other drawers, indicated that the first layer was a white oil-bound paint layer, and that the painted geometric, and floral forms were executed in a variety of reddish orange and green plant resin-bound glazes, and maroon, black and red oil-bound paints. Above the earliest layers were at least six layers of plant resin varnish, two generations of dark overpaint, two shellac layers and a thick accumulation of degraded linseed oil dressing. There were also significant accumulations of dirt between the various layers, as well as age cracks in individual layers which indicated that each coating had been exposed for a considerable amount of time before the next layer was applied.

The glossiness of the top drawer was due to a relatively recent layer of shellac, which was very likely applied in an attempt to readhere some cleaving areas of paint. This shellac layer was not present in the samples from any of the other areas of the chest, except for samples from the interior (which was obviously shiny) and from the two recent wood fills intended to compensate for wood loss where earlier hinges were removed and replaced with two modern steel pins at the top and bottom of the door (see the during treatment photograph). The Cupboard was acquired by the Museum in 1936 and it is probable that the most recent shellac layer and the door hinge repair occurred after its acquisition.

What was not immediately apparent from the cross-sections, but was revealed as the treatment progressed, was that this Cupboard had never been cleaned. The various layers of shellac and plant resin varnish were probably applied to resaturate aged surfaces and brighten the painted designs. After each resinous clear coating aged, weathered and darkened, the another layer of varnish was applied. Eventually this thick accumulation of degraded coatings and dirt obscured the painted designs to such an extent that someone felt it necessary to "enhance" them with brown, maroon and black oil paint. This dramatically changed the palette and simply added to the confusion about this object. In fact, there were two generations of overpaint present, both comparatively recent, in the cross-section history of the Cupboard.

So, after determining the volume and nature of the materials on top of the earliest surfaces, it was possible to formulate a method for cleaning which would hopefully remove the most recent layers of linseed oil dressing, shellac, plant resin varnish, and overpaint, but still leave the original painted surfaces, and ideally at least one layer of plant resin varnish intact. The initial cleaning tests conducted at the Museum looked promising, so the Court Cupboard was shipped to the SPNEA Conservation Center for treatment. Before embarking on full-scale cleaning, areas of lifting paint on the top drawer were stabilized with 10% B-72 in toluene. After stabilizing the drawerfront I thought I could remove the layers selectively, using lipase in a buffered stock gel⁴ for the linseed oil dressing, aleuritic acid resin soap for the shellac layers⁵, deoxycholic acid or abietic acid resin soap for the plant resin varnish layers⁶ and perhaps an aromatic, nonpolar solvent gel for the overpaint layers. However, layer by layer removal of these materials turned out to be very slow and inefficient. Experimenting with a variety of solvent gel combinations I found that

depending on the sensitivity of the various areas, I could use a propanol gel⁷, an ethanol gel⁸ or a benzyl alcohol: propanol gel⁹ to remove the varnish layers in a controlled fashion and undercut the oil dressing and overpaint layers.

Seventeen after-test cleaning cross-sections indicated that this cleaning approach could allow me to remove a thick mass of later material in an efficient, controlled manner, yet still retain the lowest layer of plant resin varnish. All after-cleaning samples were examined using the Conservation Center Olympus BH-T Series 2 fluorescence microscope¹⁰ and a fiberoptic visible light source.

The cleaning process revealed surfaces with considerable areas of abrasion and loss, but, most importantly, it also uncovered bright colors and delicate brushwork which had been completely obscured. After more than 285 years the painted designs were still quite brilliant and coherent. The only surfaces where there was very little of the original paint remaining were the turned columns. A bright robin's egg blue remained trapped in the recesses of the turnings, but the more exposed surfaces appeared to have been cleaned aggressively early on in the cross-section history.

This paint removal may simply have been due to a change in taste, or perhaps an early attempt to clean the Cupboard started with the columns and then was halted when it became too complicated. This surprising blur¹ comprised of white lead, prussian blue and blue verditer¹¹ contrasts quite oddly with the white lead background of the front of the case. Working with Michael Ettema, the Henry Clay Ford Curator of Design at the Henry Ford Museum, it was agreed that I would do a relatively minimal level of inpainting to compensate for losses to match the best preserved of the upper panels (which contains the name Barnard), but that evidence of use and aging would be retained. It was also agreed that the columns would be inpainted to match the surviving areas of paint, to reinstate what was believed to be the intended visual contrast between the blue columns and the brightly painted panels and drawerfronts.

All the areas to be inpainted were coated with Liquitex Soluvar Matte Varnish as a barrier coat, and then inpainting on the panels and drawerfronts was done with Winsor & Newton Artists Acrylic colors. The columns were inpainted with winsor & Newton gouache to achieve a matte surface and a somewhat washy quality. After inpainting the front of the case was coated with clear paste wax, and the red-stained case sides and black-stained moldings were coated with brown and black-tinted paste waxes, respectively, to visually enhance the stains which survived trapped in the wood fibers.

This is a treatment I would not have attempted without the information provided by the cross-sections. Not only was it possible to determine that original paint did in fact survive under all the other dark brown layers, I was also able to design cleaning systems specifically suited to the cleaning problems presented by this object after characterizing the binding media of the various layers through fluorescent staining. And without knowing that there were two generations of overpaint, I may well have backed off the cleaning process as soon as I started picking up the first layer of overpaint on my swabs.

Although all painted objects do not require this level of analysis, in general ultraviolet light cross-section analysis and fluorescent staining to characterize binding media can provide valuable information about the number and nature of the layers present on a surface, and can save hours of time, and sometimes, anguish in working out a safe, appropriate cleaning system.

Treatment of an 1870 Masonic Masters Chair

In 1987 an unusual suite of Masonic furniture consisting of an large armchair, two tall pillars and two turned candlestands came into the SPNEA Conservation Center for treatment. Overall this suite, owned by the Museum of Our National Heritage, appeared quite darkened and grimy, and was clearly in need of attention. The armchair, which appeared to be black with red pinstripes, was the focus of the initial cleaning tests because it was the only object painted with Masonic symbols. However, a series of cleaning tests made in an attempt to remove a grimy surface coating from the painted and metallic powder designs on the chair were halted because these areas were so solvent-sensitive, and the suite was sent back to the Museum untreated.

Four years later the rapid technical advances in the furniture conservation field provided the tools necessary to thoroughly understand the structure of the painted surfaces and employ methods other than solvents for cleaning.¹² So in 1991, after five cross-sections removed on-site from the armchair showed that the paint layers and metallic powder layers were actually bound in an alcohol-sensitive plant resin varnish, the suite was brought back to the Conservation Center for treatment.

A series of cross-sections revealed why previous attempts to clean the chair had failed. The resinous layers were sensitive to virtually all solvents, and an application of a nonpolar solvent such as Stoddard Solvent, resulted in a whitish haze. This proved to be the result of an impressive accumulation of wax on every surface of the chair.

Pigment identification through Polarized Light Microscopy (PLM) and microchemical testing showed that the background color was actually Prussian blue; the red pinstripe was a combination of red lead and vermillion; and the chunky blue particles on the "G" at the crest were large small particles.¹³ In addition, scanning electron microscopy analysis (SEM) showed the gold-colored metallic design areas were made of brass particles (80% copper and 20% zinc) and the silver metallic areas were basically pewter particles (primarily tin, with a small proportion of lead and trace amounts of zinc).¹⁴ It became clear that this armchair was intended to be intensely colored and highly reflective -- quite unlike its modern day form.

The first step in the cleaning was removal of the thick accumulations of wax from the surface with Stoddard Solvent. And after testing a variety of pH neutral soaps, ultimately saliva proved to be the most effective grime remover. But it was a slow process and required a considerable volume of saliva! Aqueous cleaning was also problem because there was a risk of promoting more corrosion of the already degraded metallic powder design areas.

Although other aqueous surfactant systems may have worked equally well at the right pH, it was an intriguing problem to develop an artificial saliva which would operate at a slightly faster rate and work equally well as my own. An artificial saliva was mixed up based on formula developed by Richard Wolbers, and then the pH was raised slightly to 8.5 with sodium hydroxide.¹⁵ I also added a corrosion inhibitor to the solution so the metallic powder areas could be cleaned safely as well. After cleaning with the artificial saliva all the surfaces were cleared with odorless mineral spirits.

This cleaning approach effectively removed the wax and grime, and revealed several areas of intact plant resin varnish coating which provided a sense of how glossy and saturated the surfaces had originally appeared. Unfortunately, areas such as the seat, the tops of the arms, and the globe finials, were so abraded and uneven that it was not possible to recover consistent paint layers. The small particles on the

“G” were simply lightly dusted with a soft brush because they were not well-adhered and were too easily jostled loose with a swab.

Working with the Curator and Registrar at the Museum¹⁶ it was agreed that the surfaces would be spray-coated with Soluvar Matte varnish to provide some moisture protection and to be visually consistent with the weathered surfaces. The only inpainting on the chair was done with dry pigments in 10% B-72 in toluene to cover old white fill material on the crest rail.

During this treatment a curious coincidence provided revealing information about the condition of the suite. While the treatment was in progress I briefly appeared, with the chair, on a segment of the WGBH production “This Old House.” About a week after the segment aired I received a call from Mr. J. Denny Kitchen who related the story of how he had discovered this suite 25 years earlier in a ruined Masonic Lodge in rural Ohio. Recognizing the importance of these objects, he negotiated to buy them and brought them home.

All of the objects were wet from roof leaks and covered with bird droppings (which explained the curious white accretions I had found on the chair legs). And the metallic powder designs had already discolored and corroded due to the exposure to rain. With great forethought Mr. Kitchen coated all the objects with a thick layer of beeswax-based polish before he brought them inside to slow the drying process and hopefully reduce the amount of paint loss. He also removed the casters so he could fit the chair in his house, and claimed to still have them stored away in a box.

Needless to say, Mr. Kitchen’s phone call was very timely and helped to explain some of the most puzzling aspects of the chair, such as the thick accumulations of beeswax, the extent of the metallic powder corrosion, the extreme level of paint loss on the most exposed parts of the chair, the missing casters and the presence of bird droppings.

In this treatment the cross-section analysis and the identification of the materials through PLM and SEM not only helped in the design of a mild, but effective cleaning system, it also contributed to a greater understanding of the original visual intent of this object. After cleaning the masonic symbols were more clearly revealed and it became apparent that the background color of the chair was an intense blue, not black. But the extreme degradation of the metallic powder layers and the resinous binding medium means that this object will never truly reflect the brilliance and high contrast of the original intact surfaces.

Treatment of a New York Grecian Couch ca. 1815-1825

In 1992 a recently purchased couch in the Grecian style was sent by the Baltimore Museum of Art to the SPNEA Conservation Center for treatment. This couch frame, depicted after-treatment in the May 1993 issue of “The Magazine Antiques”, provided a considerable cleaning challenge. There was darkened bronze overpaint on the feet, arm supports, swags, and on the rosette and rope turning on the back. In addition, the clear-finished areas of the frame were quite darkened and crackled, and the stencilled and freehand gilded designs on the front rail were almost indecipherable because of losses and what appeared to be linseed oil polish residue.

From the start of the project with cross-section analysis, to cleaning, fabrication of a replacement foot and polyethylene foam seat deck, inpainting and ingilding, this treatment involved every staffmember in the SPNEA Furniture Conservation lab. Cynthia Moyer, a private furniture conservator, also worked as a subcontractor to inpaint and ingild the missing areas of stencilled and freehand design.

Even in its degraded state, this couch frame was still quite beautiful. Wendy Cooper, the Curator of Decorative Arts at the Baltimore Museum of Art, described the form as follows:

“Perhaps the most evocative form borrowed from antiquity is the Grecian sofa popularized by such notable ladies as Napoleon’s sister Pauline Borghese (1780-1825) and Madame Recamier (1777-1849). These fashionable couches were produced in nearly every region of America with ornament that ranged from highly patterned veneers to cut-brass inlay, gilded carving and stencilling, and verd antique suggesting patinated bronze. The example shown in Plate I is an important survival for it retains its original stenciled, gilded and verd antique decoration. The surface was found intact under a later layer of gold and brown paint.”¹⁷

This description of the overpaint layers on the couch greatly simplifies the before treatment condition of the surfaces. In general bronze paint is extremely tenacious and intractable, and depending on the layers below it may not be problematic to remove.

Cross-section samples taken from the different areas of the couch and examined using TTC, FITC, and RHOB, confirmed that all of the gilded and painted surfaces were coated with a thick layer of bronze paint.¹⁸ The cross-sections also provided the first clue that the original surfaces below the bronze paint were surprisingly intact and were separated from the bronze overpaint by an earlier (but not original) bronze powder layer, and two degraded later layers of plant resin varnish. In the clear finished areas such as the rails and the tops of arms, there was evidence of a black-pigmented paint layer and two dark glaze layers which produced the effect of ebonizing. The gold-stencilled areas were created by one layer of leaf gold laid down on an oil size and covered with at least one generation of very thick plant resin varnish.

The verd antique feet were created by a protein-bound chrome green paint layer on top of a traditional gesso.¹⁹ The highlights on the green feet were created with bronze powders, and there were two thick, severely degraded layers of plant resin varnish separating the original surfaces from the relatively modern bronze paint.

Given the variety of original surfaces, a number of different cleaning systems were required to address each specific problem. Because of the stubborn nature of bronze paint, some fairly strong combinations of polar and aromatic solvents were required. Using these solvents in a gel form allowed us to increase the contact time, when necessary, and apply the gel in controlled areas. Cleaning tests and after-cleaning cross-section analysis produced the following successful cleaning systems:

- For removal of bronze overpaint from the watergilded surfaces: An ethanol:xylene:acetone gel²⁰ which was cleared with xylene and rinsed with mineral spirits allowed controlled, effective removal of the bronze overpaint. If any original toning layer over the gilding had survived (which was not indicated by the cross-section analysis) it would not have been possible to save it using this solvent gel system.
- For removal of bronze overpaint from the verd antique feet: A benzyl alcohol:xylene:acetone gel²¹ proved effective for removing the bronze paint and later plant resin varnish coatings and leaving the original surfaces intact. After wiping off the gel the surfaces were rinsed with xylene and cleared with mineral spirits.

- For removing bronze paint from the oil-gilded rope turning: This was the most problematic bronze paint removal because any solvent combination which would remove the bronze paint also intruded into the oil-gilding below. For this treatment it was only possible to somewhat reduce the bronze paint with a xylene:ethanol gel²² which was again cleared with xylene. In subsequent treatments I have used aqueous cleaning system with a chelating agent²³ to remove bronze paint from oil-gilding, and this may have been much more effective in this instance.
- For removing degraded plant resin overvarnish from the ebonized rails and arms: These areas were quite dull crackled and opaque. Deoxycholic acid resin soap²⁴ proved effective in removing surface dirt and the uppermost degraded portion of the oxidized plant resin layer. After rinsing with deionized water the surfaces were cleared with odorless mineral spirits.

After cleaning, a barrier coat of 10% B-72 in toluene was applied to loss areas, and losses in the gilded surfaces were filled with Polyfix, Permafill, or Acryloid B-67 and kaolin. Inpainting was done with 10% B-67 and dry pigments on the verd antique feet, and losses on the watergilded surfaces and the gold decoration on the rails were inpainted to match with B-67, dry pigments and mica-based interference pigments.²⁵ A reversible brush-coat of 10% B-72 in ethanol, dry pigments and Ciba-Geigy Orasol dyes was applied to the watergilded swags and arm supports to slightly tone the cleaned surfaces.

All the ebonized surfaces were brush-coated with a layer of 10% Acryloid B-67 in mineral spirits, and the rope turning was coated with clear paste wax which had been slightly tinted with mica-based interference pigments.

The final result of this treatment is a frame in which all surfaces appear consistent and intact, with evidence of age and use still easily discernible on close examination. Of the three treatments described in this paper, the conserved condition of this couch is probably closest to the original intent of the maker. This is due, in part, to the fact that the original materials were so well preserved under the later layers of varnish and bronze paint, but also to our ability to design cleaning systems which would selectively remove the modern materials without intruding into the earliest layers.



Hannah Barnard Court Cupboard during treatment. The modern fills for the door hinges painted to match the brown, degraded surfaces are evident in this photograph.

Hannah Barnard Court
Cupboard after treatment.
Henry Ford Museum.



Museum of Our National Heritage
Masonic Masters Chair Suite after
treatment.

References

1. Dean Fales. *American Painted Furniture* (New York: Bonanza Books, 1986) p. 20
2. The analysis phase of this project was initiated by Ralph Weigandt, Objects Conservator at the Henry Ford Museum.
3. Richard Wolbers, Nanette T. Sterman, and Chris Stavroudis. *Notes for Workshop in New Methods in the Cleaning of paintings*, (Santa Monica, CA: Getty Conservation Institute, 1990) pp. 58 - 73

Note: The following stains were used for examination of the samples:

- TTC (Triphenyl tetrazolium chloride) 4% in methanol -- to identify the presence of carbohydrates (starches, gums and sugars). Positive reaction color is dark red to brown.
- FITC (Fluorescein isothiocyanate) 0.2% in acetone -- to identify the presence of proteins (animal glue, gelatin, egg and milk). Positive reaction color is yellow-green. Excitation wavelength 490 nm; Emission 525 nm.
- EITC (Eosin isothiocyanate) 0.2% in acetone -- to identify the presence of proteins (animal glue, gelatin, egg and milk). positive reaction color is pink.
- Rhodamine 123 0.2% in ethanol -- to identify the presence of lipids. Positive reaction color is yellow. Excitation 511 nm; Emission 534 nm.
- DCF (2, 7 Dichlorofluorscein) 0.2% in ethanol -- to identify the presence of saturated and unsaturated lipids. positive reaction colors are yellow for unsaturated and pink for saturated lipids. Excitation 512 nm; Emission 526 nm.
- RHOB (Rhodamine B) 0.06 in ethanol -- to identify the presence of lipids. positive reaction color is bright orange. Excitation 540 nm; Emission 625 nm.
- Bromocresol Purple 0.2% in ethanol -- to identify pH range 5.2 to 6.8. Reaction color is yellow to purple.
- Bromothymol Blue 0.2% in ethanol -- to identify pH range 6.0 to 7.6. Reaction color is yellow to blue.

4. Please note: Cleaning system recipes adapted from Richard C. Wolbers recipes.

Buffered Stock Gel:

100 ml. deionized water

1.6 g. Trizma 8.5

5.0 g. hydroxypropyl methyl cellulose

1.1 g. Triton X-100

5. Aleuritic Acid Resin Soap:

2 g. Aleuritic acid

100 ml. H₂O
5 ml. Triethanolamine
0.05 ml. Triton X-100
1.5 g. methyl cellulose (4000 cps)
pH adjusted to 8.5 with HC1

6. Deoxycholic Acid Resin Soap

2 g. Deoxycholic acid
100 ml. H₂O
5 ml. Triethanolamine
0.05 ml. Triton X-100
1.5 g. methyl cellulose (4000 cps)
pH adjusted to 8.5 with HCl

Abietic Acid Resin Soap

2 g. Abietic acid
100 ml. H₂O
5 ml. Triethanolamine
0.05 ml. Triton X-100
1.5 g. methyl cellulose (4000 cps)
pH adjusted to 8.5 with HC1

7. Propanol gel

200 ml. propanol
4 g. Carbopol 934
14 ml. Ethomeen C-25
15 ml. H₂O

8. Ethanol gel

300 ml. ethanol
6 g. Carbopol 934
20 ml. Ethomeen C-25
25 ml. H₂O

9. Propanol:benzyl alcohol gel

225 ml. propanol
100 ml. benzyl alcohol
6 g. Carbopol 934
20 ml. Ethomeen C-25
20 ml. H₂O

10. Olympus BH-T Series 2 Fluorescence microscope with UV (300 to 400 nm. with 420 nm. barrier filter) cubes

11. Pigment identification was conducted using Polarized Light Microscopy (PLM) and microchemical testing techniques.

12. Wolbers, Sterman and Stavroudis, *Notes for the Workshop on New Methods in the Cleaning of Paintings*, pp. 90-149

13. Smalt is a coarsely ground glass colored with cobalt.

14. Dr. Leon Stodulski, Detroit Institute of the Arts, to Susan Buck autumn 1991

15. Modified recipe from Richard C. Wolbers for artificial saliva:

0.50 g. albumen

0.25 g. mucin

0.15 g. glucose

1.80 g. NaCl

0.04g. diammonium citrate

0.01 g. uric acid

0.44 g. sodium phosphate

0.44 g. sodium phosphate dibasic

Trace Amounts: lipase, amylase, lysozyme, protease pH adjusted to 8.5 with NaOH

Water to produce a total volume of 200 ml.

3 g. Hydroxypropyl methyl cellulose

2 ml. Ancor LB-503 Corrosion Inhibitor

(Air Products and Chemicals, Inc., Allentown PA)

16. John Hamilton, Curator and Maureen Harper, Registrar and the Museum of Our National Heritage were both involved in decisions regarding inpainting and choice of a protective varnish coating.

17. Wendy Cooper. "Classical Taste in America, 1800-1840", The Magazine Antiques, May 1993, p. 769

18. See reference number 3.

19. Chrome green was identified through the use of PLM and microchemical testing.

20. Ethanol:xylene:acetone gel

100 ml. ethanol

100 ml. xylene

100 ml. acetone

6 g. Carbopol 954

10 ml. Ethomeen C-25

20 ml. H₂O

21. Benzyl alcohol:xylene:acetone gel

100 ml. benzyl alcohol

50 ml. xylene

50 ml. acetone

6 g. Carbopol 954

10 ml. Ethomeen C-25 10 mL H₂O

22. Xylene:ethanol gel 100 ml. ethanol 100 ml. xylene

6 g. Carbopol 954

10 ml. Ethomeen C-25 10 mL H2O

23. Cleaning system with chelating agent for bronze paint removal:

100 ml. deionized water

0.5 g. deoxycholic acid

5 ml. triethanolamine

1 g. ammonium chloride

0.97 g. EDTA

0.05 ml. Triton X-100

0.5 g. hydroxypropyl methyl cellulose

24. See reference 6.

25. Kremer Colibri gold pigments

Kremer Pigmente, 61 E. 3rd St. New York, NY 10003