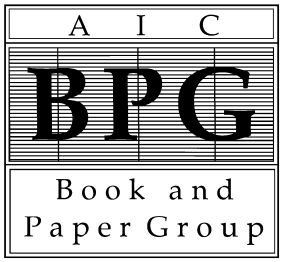

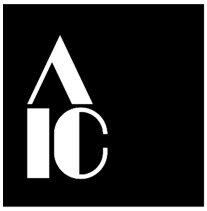

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Article: Varnished Maps Treatment Protocol at the Conservation Center for Art and Historic Artifacts
Author: Heather Hendry
Source: Book and Paper Group Annual: Special Issue on Varnished Wall Maps
Pages: 42-50
Editors: Roger S. Williams, Managing Editor; Amy Crist, Assistant Editor; Angela Andres, Lisa Muccigrosso, and Lindsey Tyne, Editorial Assistants
Editorial Office: bpgannual@gmail.com
ISSN: 2835-7418

The *Book and Paper Group Annual* is published once each year by the Book and Paper Group (BPG), a specialty group of the American Institute for Conservation (AIC). It was published in print from 1982 to 2021, and transitioned to a digital publication in 2022. All issues are available online at https://culturalheritage.org.

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HEATHER HENDRY

Varnished Maps Treatment Protocol at the Conservation Center for Art and Historic Artifacts

INTRODUCTION

The Conservation Center for Art and Historic Artifacts (CCAHA) is a regional laboratory based in Philadelphia, Pennsylvania, serving collections across the United States. Specializing in books, photographs, and paper objects, CCAHA conservators treat objects for a wide range of clients. Our clients include private individuals, large institutions with their own conservation departments, and everything in between. The objects that our clients select to send for treatment may be based on our recommendations through collection surveys but more often come from the client's judgment of their most vulnerable and important objects to be preserved. There is often some plan for display after treatment, although clients' goals may also include digitization or general collections stewardship.

Varnished wall maps are frequently selected for treatment both because of their importance and their precarious condition. For many local historical museums or archives, a historical map of the area is an important grounding framework to understand the rest of their collection. Private clients often feel a great connection to a historic map because of their connection to the area depicted. At the same time, these maps can be extremely fragile due to their history of use. Their size and composite nature make them a challenge for treatment, storage, and display.

In response to the unique needs of varnished wall maps, CCAHA has developed a fairly standard treatment protocol. Our choice to generally treat large maps intact is based on our clients' preferences, but it also allows the map to be experienced as it was intended. Treating a large map in one piece requires adequate space, supplies, and personnel—CCAHA is fortunate to have both large open work spaces and a depth of staff.

Proceedings from the AIC-sponsored event, "Varnished Wall Maps: A Collaborative Seminar to Investigate Treatment Methodology," September 14–16, 2022.

MATERIALS OBSERVED

Although individual examples may differ, a typical wall map is printed on paper, mounted on fabric, hand-colored with watercolors, and varnished with a water-resistant resin. It may be attached to wooden bars at the top and bottom edges and have separate edge bindings (fig. 1).

The paper is typically a medium-weight, machine-made wove paper. It may be either a single sheet or multiple sheets that are joined with approximately a half-inch overlap. The paper would be neither too stiff nor too thin to tolerate repeated rolling and unrolling. The fabric mount would provide additional support for rolling and for hanging a display. Almost universally, the fabric is adhered with a water-based adhesive. In many cases, the adhesive is a quite bulky starch or flour paste that can bridge the gaps between the flat paper and the textured weave of the fabric.

The lined map will be fastened to wooden bars at the top and bottom edges with small nails; in some cases, the edge is inserted between two bars that are joined around it. The upper bar is used to hang the map on the wall, and the lower bar mostly serves as a weight to keep the map from curling up when on display. Frequently, the right and left edges will have an edge binding: a colored ribbon wrapped over the edges and sewn through the paper and both layers of fabric. When the ribbon is made from silk, it may be almost completely disintegrated. This edge binding originally offered protection to the edges as well as an attractive finished appearance. Once removed, there will be a line of perforations along the edges from the sewing.

In the late 19th and early 20th century, wall maps were typically printed with black lithography inks. Colors could be applied either through printing or by hand. Most coloring was executed in flat shapes to distinguish natural features, properties, towns, counties, or states, frequently with a darker edge along these political outlines. After the image was created, the maps would be coated with a protective resin to make them more durable. The coatings are always insoluble in water but are usually soluble in ethanol. If ethanol does

Fig. 1. Wooden bars and edge binding. Map of Jefferson County, West Virginia, 1883. Private client. Courtesy of CCAHA staff.

not dissolve the coating, further testing will be carried out to determine an effective solvent.

CONDITION ISSUES

The most striking condition issue can be described as fragmentation (fig. 2). Wall maps tend to develop a network of horizontal and vertical creases due to their repeated rolling and unrolling. There is also a fundamental incompatibility in a paper-on-cloth lining. In humid conditions, paper will expand whereas cloth (spun threads) will contract, which causes innate tension. Over time, the creases will develop into splits in the paper and eventually split through the cloth backing as well. Where the paper has split or torn, the exposed edges will begin to detach from the cloth, leading to growing areas of loss. A loose weave or heavy cloth will also have many gaps where the rounded threads are not in contact with the flat paper: this may be bridged by a bulky adhesive or may just limit the areas of adhesion.

Typically, there will be a band of extreme damage along the edge that was on the exterior of the roll, reflecting the greater handling and exposure of that section, whereas the interior will be less fragmented. There may also be splitting from increased stress along the attached wooden bars or in areas of tenting. It is also common to see historic repairs of this splitting, which may include pressure-sensitive tape on the verso or adhesives inserted between the cloth and paper in areas of damage. These repair adhesives seem more likely to discolor than the original mounting adhesives.

Overall discoloration can become so severe that the image becomes difficult to read. This can be a combination of both the paper and the varnish yellowing. Even if the black lines remain legible, the overall yellowing can interfere with viewing the colors that are used to distinguish separate areas, particularly if both green and blue were used. Yellow pigments may not even be detectable until after the discoloration is reduced. Fading of the colors is common, and copper-based pigments may discolor to brown, also inducing discoloration of the paper that is visible on the verso.

The varnish may also begin to flake or wear off along creases (fig. 3). These areas will look like whitish marks with

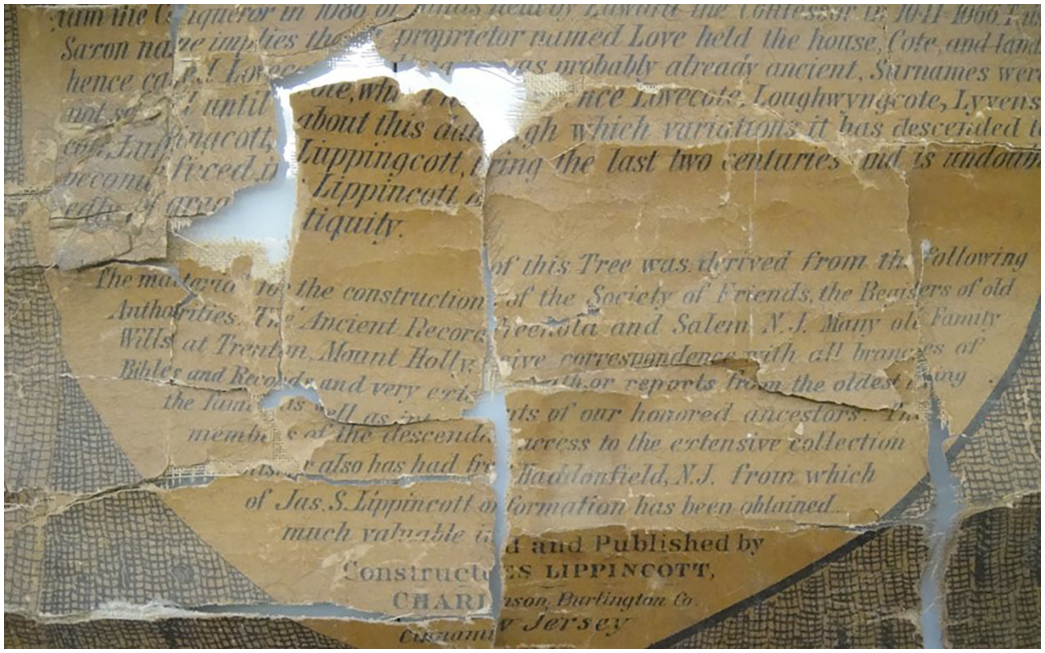

Fig. 2. Fragmentation. Lippincott Family Tree, 1880. Private client. Courtesy of CCAHA staff.

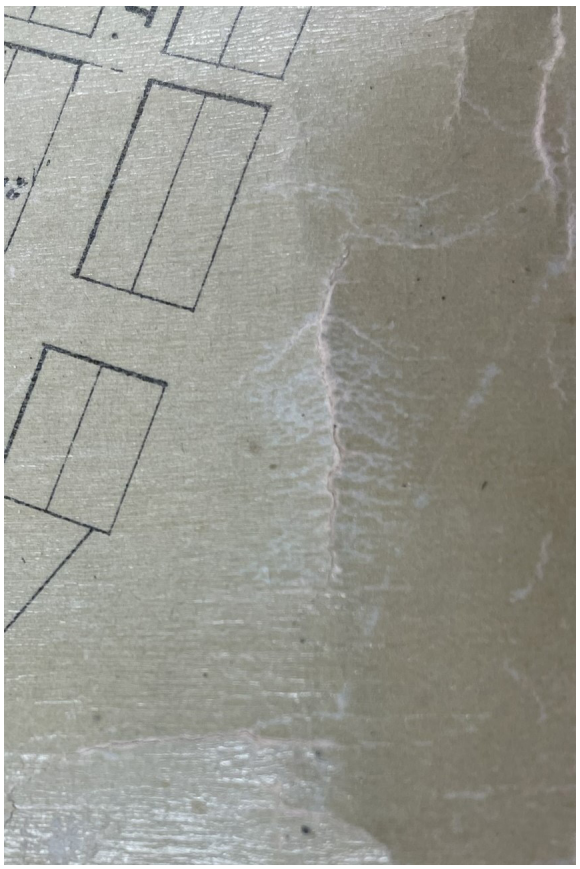

Fig. 3. Varnish flaking along creases, exposing underlying color. Courtesy of CCAHA staff.

many extending white tendrils—this is the underlying paper core color contrasting with the yellowed varnish.

TREATMENT PROTOCOL

Initial Steps

Initial spot testing will determine if a map can undergo CCAHA's standard treatment protocol. If there is a varnish present, the first step is to confirm that the varnish is soluble in ethanol. Ethanol (denatured alcohol) is our preferred solvent for varnish removal because it is effective on most varnishes and usually safe for the media, but it is also considered the least harmful to the conservators. Some varnishes have required acetone or a 2:1 mixture of ethyl acetate to xylene.

Because testing must be carried out before proposing the treatment to a client, we try to test discreetly but thoroughly enough to accurately propose and price the treatment. After testing for varnish removal, the media is tested in both the chosen solvent and the potential wash water solutions. Media testing under a layer of varnish can be challenging. CCAHA conservators generally use a combination of testing in areas where the varnish has flaked, locally removing varnish before testing, and testing existing detached fragments. Even with careful testing, we advise clients that some reduction of the color may occur. Typically, the clarity gained by reducing the varnish and paper discoloration makes the color appear more vivid than before treatment, even if minor pigment loss occurs. In some cases, small areas may also be sealed with cyclododecane or cyclomethicone D5 before washing.

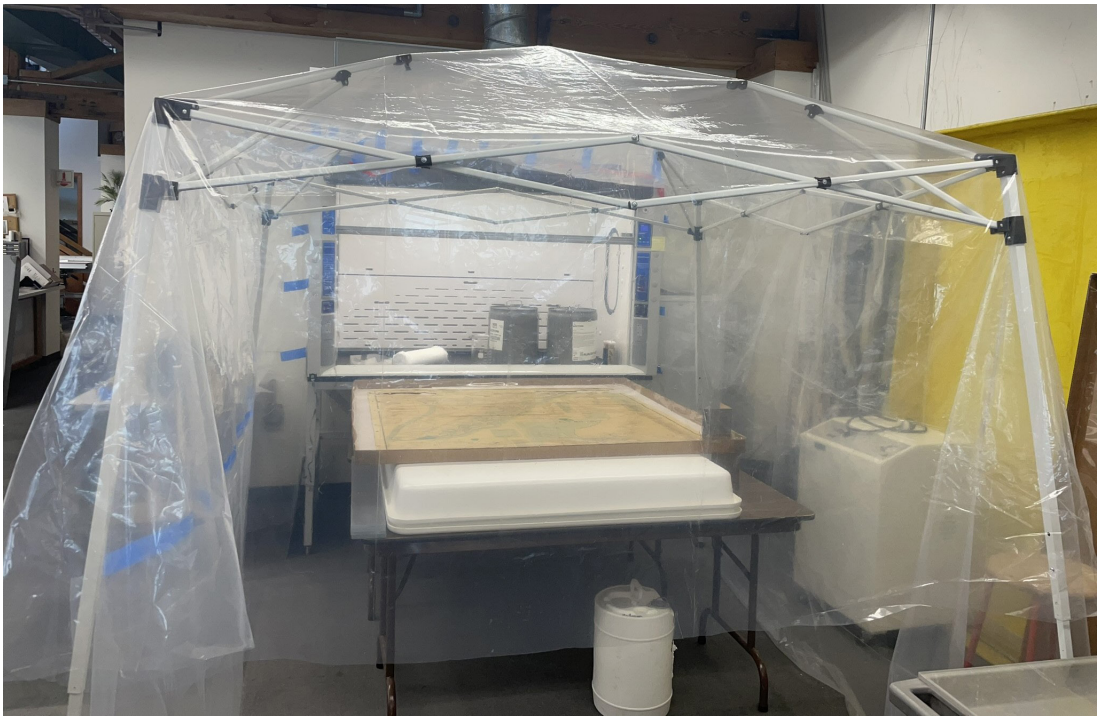

Fig. 4. Pop-up tent frame draped with plastic, with airflow provided by the fume hood. Courtesy of CCAHA staff.

As the first treatment step, the wooden bars and edge binding ribbons will be detached by removing the nails and stitching. Typically, the bars are returned to the client separately. In some cases, the client may request that they be reintegrated into the map's display housing.

Loose surface grime on the recto will be surface cleaned with additive-free polyurethane sponges to the extent possible. The fragmented nature of the surface generally prevents aggressive cleaning or the use of eraser crumbs. However, one benefit of the varnish layer is some protection from engrained surface grime in the paper support.

Varnish Removal

After surface cleaning, the varnish is removed. This step is done with a full immersion in ethanol (or another solvent). During the immersion, the map is still adhered to cloth lining for support, but it is also supported on Hollytex (spun-bonded polyester fabric). If the map is wider than a roll of Hollytex, the Hollytex can be joined with an ultrasonic welder.

Such a large solvent treatment requires some adjustments to normal procedures. CCAHA is fortunate to have a 6-foot-wide fume hood, but most varnished maps are larger than a laboratory fume hood in at least one dimension. To control the solvent fumes, a temporary negative pressure room is built to extend the protection of the fume hood. This is constructed by erecting the frame from a pop-up shade tent against the open fume hood, then draping the tent frame with a polyethylene sheet painter's plastic (fig. 4). The plastic sheet is not airtight, so air is drawn from the laboratory out the fume hood exhaust. Inside the tent, conservators wear solvent respirators. There is no detectable solvent odor outside the tent.

For the actual immersion, a cardboard tray is constructed to fit the object. Polyethylene sheeting is draped over the tray and secured to the walls with binder clips to form a temporary solvent sink. Before using the sink, a small section in one corner of the cardboard tray is removed (fig. 5). This allows the solvent to be drained from the sink without removing the map.

When the map is immersed in the solvent bath, the varnish usually solubilizes quickly. It can be gently agitated without dislodging paper fragments by rubbing with cotton through a layer of thin Hollytex #3249 (15 gsm). The solvent bath usually becomes quite yellow and will be changed at least once until it remains clear. The solvent is removed by draining through the precut hole in the cardboard tray and then blotting the map (fig. 6); the map is left inside the negative pressure room until any residual solvent has evaporated. The drained solvent is collected by a hazardous waste company.

Washing and Backing Removal

Once varnish removal is complete, the map can move immediately to washing, backing removal, and relining, or it can be kept for another day. Once the washing begins, it will cause further damage if the map is allowed to dry, either attached to the cloth lining or with no lining. Treatment must continue until lining is finished, so washing should not be started too late in the day.

Fig. 5. A corner cut out of the cardboard tray. Courtesy of CCAHA staff.

Fig. 6. Draining the sink by pushing the plastic through the hole to a Mylar funnel. Courtesy of CCAHA staff.

Wall maps are generally larger than the sinks available, and immersion washing would also risk displacement of the many fragments. Instead, the map is washed on layers of Tek-Wipe saturated with calcium-enriched deionized water. Tek-Wipe is a nonwoven fabric composed of cellulose and polyester fibers; CCAHA uses Tek-Wipe to blotter wash many fragile objects. To prepare the washing surface, Tek-Wipe fabrics are dipped in the wash water, then spread on a large table and smoothed flat with a squeegee. Tek-Wipe is sold in 34-inch rolls, so usually two sheets are butted together to make a wide enough surface. Two layers of Tek-Wipe provide an adequate reserve of wash water. The level of saturation of the Tek-Wipe can be adjusted to either provide a film of water or capillary washing action.

The map is supported between Hollytex sheets and sprayed with a 50:50 solution of water and ethanol to promote even wetting. It is then transferred to the Tek-Wipe washing surface. The map may need to be smoothed down through the Hollytex to ensure adequate contact with the Tek-Wipe. The first wash is used to soften and release the cloth lining adhesive and may take up to two hours.

When the cloth lining is releasing easily, the face of the map should be covered with Bondina to hold all fragments in their original location. Bondina is a spun-bonded polyester similar to Hollytex but with a very smooth finish. The fragments will be held in place by the surface tension of the water, not an adhesive-based facing. The Bondina must be smoothed down to achieve full contact. A 5-mil Mylar (polyester film, also called Melinex) will be laid over the Bondina on the face to provide additional support during moving. For extremely large maps, an even thicker Mylar may be used. The map is lifted off the washing support with Mylar and Bondina on the face, the map on its cloth lining, and then the Hollytex support on the verso. The map will be flipped over and laid face down on a second table (fig. 7).

With the map face down, the cloth lining can be removed. It should detach easily; if it resists to the point of endangering the map, it should be returned to the Tek-Wipe wash until it can be removed safely. To avoid disturbing the fragments, linings are usually removed in strips; the degraded fabric will tear easily (fig. 8). The fragments should remain adhered to the Bondina facing with surface tension. Adhesive residues on the verso of the paper are removed at this point with cotton wool, microspatulas, and cotton swabs. Adhesive reduction may take up to two hours on highly fragmented maps.

Once the adhesive has been reduced to the extent possible, the Hollytex support is replaced on the verso of the

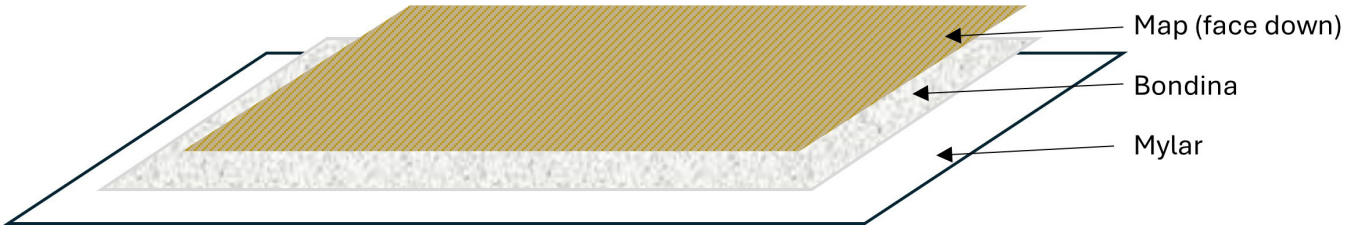

Fig. 7. Laying the map face down on Bondina and Mylar.

paper. Again, the Hollytex must be laid smoothly on the map because any cockles will prevent contact with the Tek-Wipe wash layers. The sandwich of Hollytex, map, Bondina, and Mylar is then flipped to lie face up on fresh Tek-Wipe, again saturated with wash water. The Mylar is removed during washing but is helpful whenever the map is being transferred between washes. Hollytex, not Bondina, is still used below the map, as we have found that water and discoloration move more easily through Hollytex.

One potential pitfall of washing on Tek-Wipe is a tendency for capillary action to draw discoloration to the face of the object during evaporation; this can be reduced by spraying the face with water that will be drawn down into the slightly drier Tek-Wipe. If the media solubility allows, additional saturated Tek-Wipe on the face will also avoid this, as well as encourage faster washing. Capillary action can also be used to advantage by letting the ends of the Tek-Wipe hang over the side of the table so that the water drips away from the map, drawing discoloration with it. The Tek-Wipe are changed for fresh ones approximately every 30 minutes; washing generally continues until little to no discoloration is visible on the Tek-Wipe after 30 minutes of washing.

Fig. 8. Peeling the backing away in strips. Courtesy of CCAHA staff.

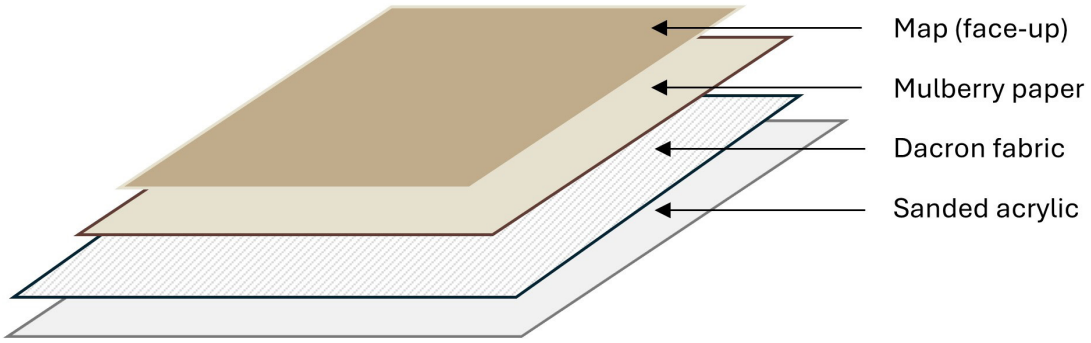

Fig. 9. The layers of a Dacron lining.

Dacron Lining

Once the backing is removed and the map has been washed, it must be lined before drying. Allowing the map to dry before an overall support is attached would risk expanding the tears and losing the position of the fragments.

Lining materials and supplies are prepared during the washing process. This includes presoaking the paste brushes and Dacron fabric; cooking, straining, and thinning a paste; preparing an instant paste; preparing a 50:50 mixture of wheat starch paste and methylcellulose; and preparing the mulberry paper pieces and Mylar supports. For large linings, it may be necessary to use more than one piece of mulberry paper joined by overlapping water-torn edges. CCAHA conservators generally use machine-made mulberry paper on a roll for large linings; the grain direction is with the length of the roll. Some of these tasks could also be completed the day before, especially for a lengthy lining.

The Dacron lining method has been previously described in the *Book and Paper Group Annual* (Albright and McClintock 1982). In a Dacron lining, the object is lined face up, with the lining adhered to layers of Dacron fabric and acrylic that are detached once dry (fig. 9). The original Dacron material, which CCAHA still uses, is no longer available for purchase, but testing has identified a suitable replacement (Cuoco and Hamilton 2008). This lining method is ideal for large wall maps because it dries in plane, avoiding an enormous blotter stack. Having the map face up and uncovered also allows for small adjustments to the fragment alignment after lining.

CCAHA conservators have introduced slight modifications to the Dacron lining method for efficiency. The steps we use are as follows:

1. Soak the Dacron to remove any residual paste.
2. Begin soaking the paste and water brushes early in the day to swell the bristles.
3. Prepare "instant paste," wheat starch 301 from Talas, in a blender to a pourable yogurt consistency.
4. Cook and strain standard jin shofu wheat starch paste, then divide into two parts: one larger and one smaller.
5. Mix the smaller portion of wheat starch paste with an equal amount of 5% A4C methylcellulose in water.
6. Thin the jin shofu wheat starch paste and the 50:50 mixture of paste and methylcellulose to the consistency of heavy cream.
7. When the map is washed and ready to line, it should be flipped between sheets of Mylar to be face up, with the Bondina and Mylar from the face removed. This is the "jigsaw puzzle" step, where any misalignments are corrected. Spraying with water will allow fragments and sections to slide on the Mylar; when they are correctly aligned, blotting with a dry Tek-Wipe will lock them into place.
8. Replace the Bondina and Mylar on the face, then flip the map again to lie face down and remove the verso Mylar.
9. While the map is face down and correctly aligned, lay thin, toned mulberry paper behind zones of large loss. Mulberry paper can be pretoned with acrylics; commercially available toned mulberry papers can bleed color and must be washed before use.
10. Paste out a sanded Plexiglas support with the "instant paste."
11. Stretch the Dacron fabric between two or more conservators, then lay it on the pasted Plexiglas. Smooth the fabric with a stiff-bristled brush, print brayer, or gentle squeegeeing.
12. Paste out the fabric with the 50:50 mixture of paste and methylcellulose.
13. Wet out each piece of mulberry paper, rough side down, on its own slightly larger sheet of Mylar, using a sprayer and a water brush.
14. Drop the mulberry paper onto the pasted Dacron by holding the Mylar between two conservators, lowering it onto the Dacron surface, and smoothing it through the Mylar with a tamping brush. The Mylar is removed by rolling it into a cylinder or peeling at an acute angle, leaving the mulberry paper behind.
15. If more than one mulberry paper is needed for the width of the map, water-torn edges can be slightly overlapped

Fig. 10. Lowering the map onto the pasted-out lining paper. Courtesy of CCAHA staff.

without additional paste. Drop the following mulberry paper in the same way. If an additional layer of mulberry paper will be used, the steps will be repeated with the second layer applied cross-grain to the first.

16. Paste out the mulberry papers (now adhered to the Dacron) with thinned wheat starch paste.
17. Lower the map onto the pasted mulberry paper, using the surface tension of water to hold it to the Bondina and Mylar layers on its face (fig. 10). The Mylar should be held fairly taut. The map may not have enough surface tension to support itself in this stage if it is either too wet or too dry, so use caution. This step may require three or four assistants; if the assistants are not experienced at performing Dacron linings, one person should be clearly instructing their movements. As the map is lowered onto the pasted support, one person brushes through the Mylar with a stiff brush to ensure smooth contact and good adhesion. The surface can also be tamped through the Mylar once it is fully laid down.
18. Peel or roll the Mylar away at an acute angle, separate from the Bondina.
19. Peel or roll the Bondina away, taking care that fragments and tears in the map are not lifting as the Bondina is removed.
20. Allow the map to dry on the Dacron for several days. If the layers dry too fast, cracks in the map may pull apart or the Dacron may detach from the table. The drying can be slowed by building a cardboard and plastic sheet cover, elevated about 6 inches above the surface, that also protects the map. The map can also be covered with felts to slow drying further if needed.
21. When the map is fully dried, any toning and fills may be applied while it is still held in plane by its adhesion to the Dacron and Plexiglas.
22. The Dacron, with the map attached, is removed from the table with a large Teflon spatula.
23. The Dacron and the attached map are flipped face down, and the Dacron is peeled away from the lining.
24. The extending lining edges are trimmed.
25. In some cases, edge strips of mulberry paper may be applied to offer further protection and improve the appearance of highly fragmented edges. To apply these neatly, a remoistenable adhesive of 50:50 methylcellulose and wheat starch paste is applied to the selected mulberry paper. When dry, strips are cut, placed neatly on the edges, and reactivated with either water or additional wheat starch paste.

CONCLUSIONS

Although CCAHA's treatment of large maps may be lengthy to describe, it feels quite simple and straightforward throughout.

Maps up to approximately 6 × 8 ft. can be accommodated with our current laboratory space and supplies. Major advantages of this treatment are the relative time efficiency and the

overall low risk to the object. In particular, the combination of using Tek-Wipe for washing and Bondina as a nonadhesive facing minimizes any movement of the fragments. After washing and lining the treated maps are a great deal more stable, both physically and chemically. Our procedure also allows collections to keep their maps intact. Once treated, they can be digitized, exhibited, or stored safely.

Some disadvantages that we have recognized are the necessary use of solvent, the limits to testing the colored media for solubility before washing, and the risk of leaving some traces of varnish sinking into and remaining in the paper fibers. Additionally, a large map treatment can be a long and labor-intensive day for the conservators. Clients also need to understand and plan for the future transport and storage of the map, whether it is framed, placed in a large folder, or rolled on a large alkaline tube.

Even though this treatment has been successfully executed many times at CCAHA, we continue to evaluate and improve all aspects. New knowledge and techniques from conservation colleagues have suggested additional possible treatment strategies, particularly for maps that are poorly suited to our usual approach. This treatment is well suited to most maps encountered at CCAHA; serves the needs of most of our clients; and can be performed with the equipment, space, and staff available.

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MATERIALS USED

Varnish removal:
- Support Hollytex #3257 (minimum 2 inches larger than map)
- Thinner Hollytex #3249 to lay on the face
- Custom cardboard sink frame
- Polyethylene sheeting
- Binder clips
- Pop-up tent frame
- Fume hood
- Table the height of the fume hood
- Ethanol (denatured with isopropanol, formula SDA 3C) or other solvents
- Appropriate gloves for the solvent selected
- Solvent waste disposal container
- Fit-tested solvent respirators for each conservator

Washing and backing removal:
- Hollytex 3257, minimum 2 inches larger than map, seam with ultrasonic welder as needed (Talas)
- Bondina (Preservation Equipment)
- Tek-Wipe (Polistini)
- Calcium-enriched purified water
- Squeegee
- Cotton wool and swabs
- Two tabletops, each larger than the map

Dacron lining:
- Two sheets of Mylar, 5 mil, minimum 2 inches larger than the map
- One sheet of Mylar for each piece of mulberry paper
- Water-torn Sekishu rolled mulberry paper, weight depending on the size and weight of the map (Hiromi Paper)
- Pretoned mulberry paper pieces for zones of loss
- Bondina: at least enough to cover areas of fragmentation, does not need to be a joined sheet
- 10- to 12-inch-wide paste brush
- 6-inch wheat starch paste brush
- 6-inch Japanese water brush
- Squeegee or tamping brush
- Cooked wheat starch paste (jin shofu or similar)
- Instant precooked wheat starch paste #301 (TALAS)
- A4M methylcellulose, prepared in water
- Dacron or Oxford polyester fabric (Testfabrics), larger than the map
- Sanded Plexiglas (quarter-inch thick), larger than the map

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