

THE BOOK AND PAPER GROUP

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The Book and Paper Group Annual

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Conservation and Encasement: 1297 Magna Carta

Interest in sealed anoxic encasements for long-term preservation has grown in the past few decades, particularly in the United States, where a number of encasements house some of the nation's most historically significant parchment and paper documents. The National Archives and Records Administration recently completed an 18-month project to encase a 1297 Magna Carta. The parchment document with attached pendant seal had been placed in an encasement designed by Nathan Stolow in the 1980s, shortly after it was purchased and brought to the United States. Soon thereafter, the Magna Carta was placed on long-term loan for display at the National Archives building in Washington, DC, where it was on almost continuous display. A team of National Archives conservation and exhibitions staff partnered with staff of the National Institute of Standards and Technology to develop a state-of-the-art anoxic encasement for one of the two copies of the Magna Carta held outside the United Kingdom and the only copy in the Americas.

The collaborative effort provided an opportunity to revisit the exacting standards developed by the two federal agencies during the late 1990s and early 2000s for the encasement of the United States Declaration of Independence, Constitution, and Bill of Rights, and to adapt them to the unique needs of the Magna Carta. The resulting encasement ensures long-term stability of the document and meets additional requirements for security and exhibition.

This paper will discuss various aspects of this project, including a brief overview of the history of this particular copy of the Magna Carta, including its 1980s encasement. However, the authors' primary focus will be on the 2011 and 2012 conservation treatment, as well as the design, fabrication, and assembly of the new encasement.

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Flip, Flap, and Crack: The Conservation and Exhibition of 400+ Years of Flap Anatomies

THE ORIGINS OF FLAP ANATOMIES

Books with movable parts exist as far back as the 13th century with the invention of volvelles, sliding circular charts used for mathematical calculations in early astronomy and geometry volumes.¹ The popularity of this genre gained major strength in the 16th century with works of astronomy, mathematics, and anatomy. There was another increase in the use of movable parts in books in the 18th century, in children's literature such as the *Harlequinade* "lift the flap" books. Other examples of this genre include 18th- and 19th-century landscape books; 19th- and 20th-century science, technology, and veterinary medicine books; and 19th-century moral "toilet books."² Today, pop-up books for children remain in constant publication.

Flap anatomies are a specific genre of printed materials that contain movable parts. For the purpose of this publication, a "flap anatomy" is defined as any paper-based printed image containing more than one layer, illustrating any part of human anatomy. There is no standardized vocabulary for flap anatomies; over the years they have been referred to as "movable books," "fugitive sheets," "pop-up books," "cut-out overlays," "anatomy-atlases," and "images with superimposed parts."

During the past 400 years, there have been variations on the design and construction of printed flap anatomies; this paper will review some of these structures and highlight issues that have determined whether these items survived or perished. When the Duke University Libraries displayed anatomical flap prints and books in 2011, the exhibition raised many conservation concerns. This paper will summarize some of the completed treatments and exhibit display solutions.

THE HISTORY OF FLAP ANATOMIES

The earliest flap anatomies are called "fugitive sheets," a term coined by 19th-century German physician and medical historian Ludwig Choulant.³ This genre of flap anatomy has been studied by many Western scholars of Renaissance printing and remains a popular subject of research today. There is much conjecture about where and how these sheets were made; the earliest were printed primarily in Germany but also in France, England, Flanders, Italy, Sweden, and Bohemia.⁴ They were created during a time when dissection was neither commonplace nor legal in many places. It is believed by many scholars that these were created for barbers and surgeons to place on their walls like informational broadsides.⁵ Even Andreas Vesalius included this idea in his 1543 *Epitome*, inviting medical students to cut and paste together their own flap anatomies from his illustrations.⁶

Not many of these fugitive sheets have survived, and most scholars believe Heinrich Vogtherr's Strasbourg edition of 1538 was the first to be published (fig. 1). His sheets all contain a single paper layer, often called a "base sheet," bearing a printed outline of the body with the torso, head, arms, and legs. The internal organs were printed on a separate sheet, cut out, and adhered to the base sheet at the top of each organ. These additional pieces were usually covered by a larger piece of paper printed with the outer, skin layer of the figure.

One reason these sheets survive is because of the size of the top layer: this skin layer is much larger than the smaller pieces underneath, and therefore protects them all. The sheets' other strength lies in how much of the top skin layer was adhered: the pieces below have a small surface area and a small amount of adhesive, but the top skin layer is adhered over a larger area and overlaps the smaller pieces by a few millimeters on each side, effectively protecting them. The quality of the paper is also excellent and the adhesives have not deteriorated over time; after 400 years the paper is still flexible and the adhesive is still intact.

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Fig. 1. Not a first edition, but produced in 1539, soon after the first printing. Heinrich Vogtherr, [*Anothomia, oder abconterfetzung eines Weyblyb / wie er innwendig gestaltet ist.*] (Strasbourg: 1539). Rubenstein Library, Duke University

INNOVATION

The first real innovation in the production of these sheets is seen in the works of Johann Remmelin, a German physician who produced detailed, anatomically correct prints of male and female figures, first published in 1613.⁷ His anatomies are composed of several layers of engraved, letterpress printed, and etched papers. Adaptations of his images were reprinted, republished, and stolen for more than 200 years. The anatomies are very technical in nature, and scholars believe they were produced primarily for students and professionals; in 1618 they were listed as part of the collection of the anatomy theater at Leiden.⁸

In his 1991 bibliography of Remmelin’s works, Kenneth Russell calls the top print a “surface layer,” which is cut to form flaps and adhered to the blank sections of the printed base layer. The portion with the flap does not have adhesive under it; it is cut before the sheets are adhered together, allowing the printing below to remain visible (fig. 2). Multiple

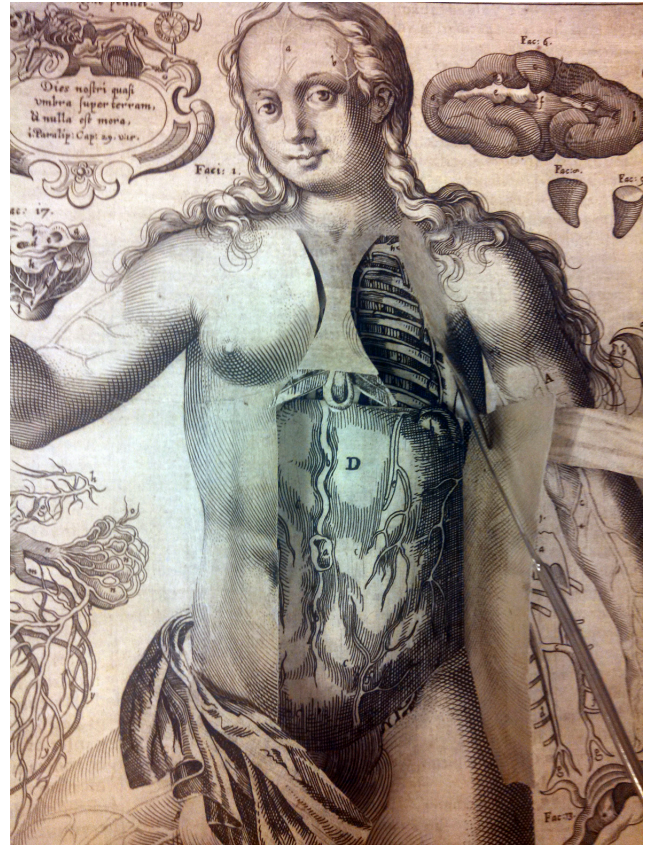


Fig. 2. The “surface layer” has been cut so that the printing of the layer below can be seen. Johann Remmelin, *Catoptrum microcosmicum, suis aere incisus visionibus splendens, cum historia, & pinace, de novo prodit ...* (Augustae Vindelicorum [Augsburg]: Typis Davidis Francki, 1619). Rubenstein Library, Duke University

“body parts” can be placed inside these flaps, held in place by tabs adhered between the two layers. In some cases, they are not adhered at all, so that the viewer can pull them out and inspect them. Russell notes finding 17th-century instructions to the printers regarding this construction. He also discusses how two extra plates were required to print the flaps, since they were applied so carefully and exactly to the base print.

Using a full surface sheet means that the top flap has no adhesive and the bottom image layer need not flex at all. This gives great strength to the flap layers inside, as they are sandwiched together with a fair amount of adhesive between the surface and base layers. Many of these Remmelin publications are still in very good condition.

19TH-CENTURY FLAP REVOLUTION

Few major flap anatomy works are found after Remmelin and his forgers until the great work *Myology* by Edward Tuson in 1828 (fig. 3). Tuson was a surgeon who taught lectures in anatomy, and his publication is very technical in nature and rich in detail. A review of this work from 1829 states: “In the

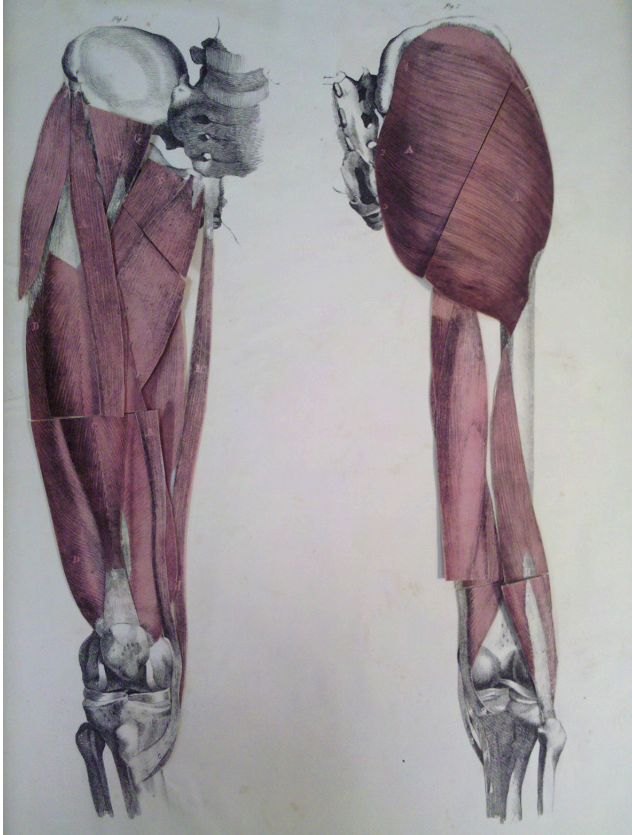


Fig. 3. This image shows the many layers of muscle in the Tuson flaps. Edward Tuson, *Myology, Illustrated by Plates*, 2nd edition (London: Callow and Wilson, 1828). Rubenstein Library, Duke University

study of these dissected plates, the sense of touch is exercised as well as that of sight; hence their vast superiority over every other description of graphic illustration.”⁹

The lithograph images are hand colored and, like the R Emmelin works, *Myology* includes a surface layer. However, it also includes multiple pieces that represent veins and muscles, and does so with small tabs that are visible under the top layer. In the other works discussed here, all of the flaps are attached in one place, at the top. Tuson’s work has each of the tabs facing in a different direction; this allows the flaps to interlock, and they actually feel as though they are intertwined, as in the pull of human muscle.

In 1847, not long after Tuson, a surgeon and printer named George Spratt produced a flap book for educating midwives, who at that time had little formal training available to them (fig. 4). This book of hand-colored lithographs is an instruction manual for delivering babies, with very graphic details. Images show how to use obstetrics tools such as forceps, how to pull a baby out by hand, and how to perform a C-section.

This work is another variation on R Emmelin’s surface layer construction; there are two pages adhered together, but the bottom paper is a blank sheet that is used only to hold



Fig. 4. George Spratt, *Obstetric Tables: Comprising Graphic Illustrations, with Descriptions and Practical Remarks: Exhibiting on Dissected Plates Many Important Subjects in Midwifery* (Philadelphia: Wagner & M’Guigan, 1847)

the flaps, which are placed in slits cut in the top illustration sheet. There might be as many as five flaps per sheet to show either sequences of steps or different variations in the birthing process. The registration on these is quite perfect, as it is often impossible to see any layers until the flaps are lifted. This method is extremely sturdy, due in part to the rectangular shape of the flaps and in part to the large size of the tabs adhered between the layers.

A MOVE TO THE MASS MARKET

It is important to mention the flap anatomies associated with Frederick Hollick, a physician who published works considered “home health manuals.” Although these anatomies are similar in structure to others mentioned here, they mark a change in flap anatomies from those made for professionals to those mass marketed for the general public. It is interesting to note that these mass-marketed anatomies often include an additional top layer that shows the figure fully clothed, although the naked flesh is still visible beneath.

Another physician, Gustav Witkowski, began making flap anatomies to educate the general public and created an entire “atlas” of the human body in flaps. This was part of a general movement popularizing science and medicine. These books were a great opportunity to use contemporary technologies such as double-sided color printing and die-cuts, which allowed for cutting and folding a page so that many of the flaps were from one sheet, with minimal adhesive needed. Like Spratt’s anatomies for midwives, some of Witkowski’s images employ the method of slotting within layers. Also, many have complicated, interlocking structures that allow layers to look more dimensional. For example, the torso anatomy has overlapping horizontal flaps that begin with the skin and muscles, then proceed through the bones and organs and back to muscles and skin. Within each

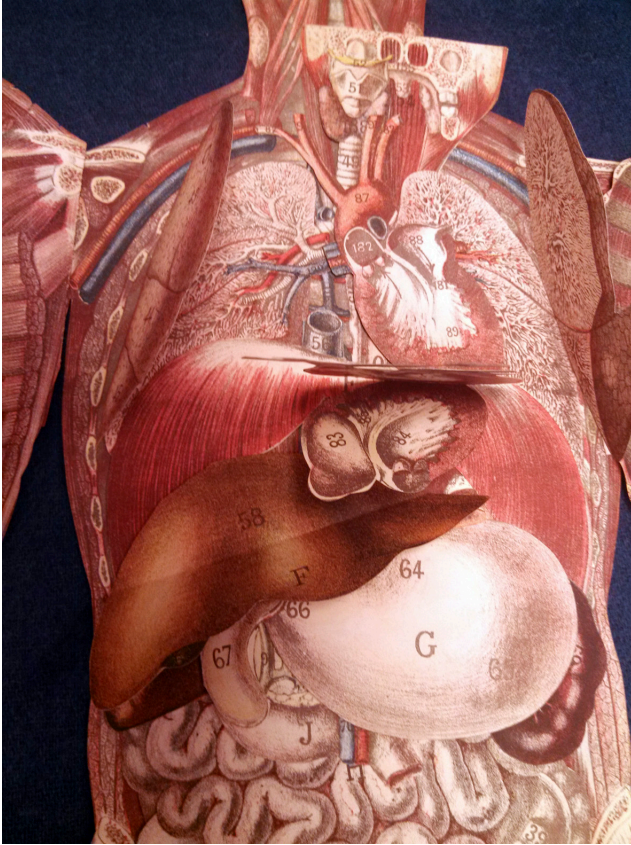


Fig. 5. Here, the rib cage opens left and right, and below is an esophagus that moves upward to reveal a kidney with multiple flaps; below that are more internal organs, each of which can be opened to reveal more layers of flaps. Gustave-Joseph Witkowski, *Human Anatomy and Physiology* (London : Baillière, Tindall & Cox, [1880–1889])

of these layers are more vertical flaps that can be lifted up to reveal detailed pieces of the anatomy, such as the interior of the kidney or the cavity inside the intestines (fig. 5). The structure is quite sound, with one major flaw: the paper is becoming brittle. Even in the areas that only employ folds for the flaps, there is cracking; viewing these requires a very delicate hand.

There are many flap anatomies in popular medical publications from the late 19th century through the early 20th century. For example, *The Physicians' Anatomical Aid* of the 1880s was a volume containing no text, only flap anatomies. Single flap anatomies can also be found inside home medical encyclopedias or popular books on preparing for marriage or taking care of a family. Many of these are simple forms of flaps, not unlike the early fugitive sheets, but they employ new materials, such as paper lined with cloth, to add strength and flexibility. Many of these works are made cheaply or with inferior materials, and many are in worse shape than those from the Renaissance.

TREATMENT, HOUSING, AND EXHIBITION OF FLAP ANATOMIES

In the spring of 2011, the Duke University Libraries displayed more than 30 anatomical flap prints and books in two different exhibition galleries on campus. Many of the materials were from the History of Medicine Collections, now a part of the Rubenstein Library, and some were loaned by the curators of the exhibition, who were faculty members from Duke University and from the University of Padua. The exhibition of these items raised many conservation concerns, and the library used this exhibition as an opportunity to review the housing and condition of this collection. Some items were treated as “emergencies” (items too damaged to display), but those that needed more extensive work were treated after the exhibition to have the proper amount of time needed.

FUGITIVE SHEETS

Eight fugitive sheets were treated and rehoused as a part of this project, which including mending, cleaning, tape removal, and flattening. Each fugitive sheet was hinged onto mat board with a cut frame and secondary cover sheet, and the set of matted sheets was housed together in a box. The fugitive sheets are used often in classes and for show-and-tell; this matted configuration will make the objects safe to use in many settings. Each cover sheet has a label with an image of the fugitive sheet inside; since the titles of these objects are not very descriptive, the new label allows for less handling of each object. A label inside the box also instructs users to be careful and to use a microspatula (available at the reading desk) to view the flaps.

One Vogtherr sheet came to the library many years ago with an extra body part in a small paper envelope. The conservator had lengthy discussions with the curators about this item: Should the part be hinged back onto the body? Although researching copies of this fugitive sheet in other institutions proved that the organ could have come from this illustration, the body part was not colored like the rest of the body, and there was no proof that it was from this printing. The decision was made to retain the organ, but to put it in the housing in a polyester sleeve (fig. 6).

BARTISCH

An early flap anatomy of the eye by George Bartisch had been repaired previously with a bit of wax on the top, and inside with some strips of Western paper (fig. 7). The wax repair was not damaging the item, and curators agreed it should be left alone, but the interior paper repairs were problematic. These were removed and mended with Japanese tissue and wheat starch paste to make the flaps easier to manipulate.



Fig. 6. Fugitive sheet hinged on mat board with extra piece in polyester sleeve. Heinrich Vogtherr, [*Anothomia, oder abconterfetzung eines Weybs leyb / wie er innwendig gestaltet ist.*] (Strasbourg: 1539). Rubenstein Library, Duke University

THURNHEISSER

The flap anatomies found within books rarely remain intact; often the layers are too close to the gutter and become damaged. A vellum binding of Thurnheisser contained flap anatomies that folded onto themselves at the shoulder. These had many tears and needed flattening. This item was treated with humidification and flattening as well as mending tears. A special cradle was made to support the sheet of paper and to hold the book open at the best angle for both viewing and the protection of the binding (fig. 8).

TUSON

The Tuson *Myology* volume was a new purchase for the collection at the time of the exhibition, and a piece of anatomy was found loose in the enclosure it arrived in. A loaned copy of the book was consulted to try to find where the loose piece belonged, but the two volumes had different placements of the various muscles and ligaments. Eventually, the two sides of the break in the paper were matched to find the flap's proper placement; it was re-adhered with Japanese tissue and paste. It is interesting to note that there was also a difference in the



Fig. 7. Flaps of the eye with damaging previous repairs, before treatment. Courtesy of Erin Hammeke. George Bartisch, *Ophthalmouoleia, das ist Augendienst...* ([Dresden: Matthes Stöckel], 1583)



Fig. 8. Leonhard zum Thurn Thurnheisser, *Bebaiō sis agō nismou* (Berlin: Im Grauwen Closter, 1576)

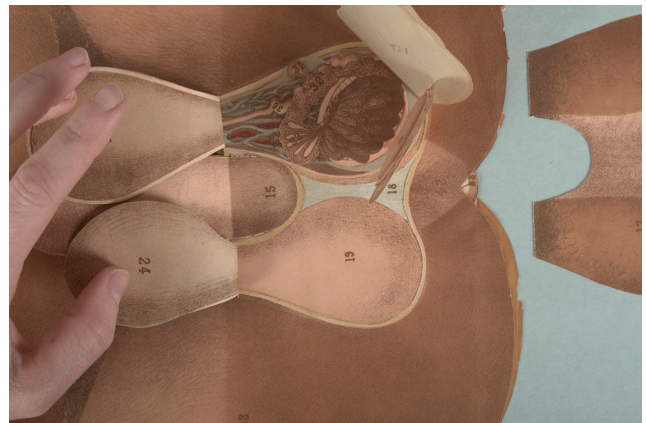


Fig. 9. Gustave Joseph Witkowski, "Male genital organs and perinaeum," in *Human Anatomy and Physiology* (London: Baillière, Tindall & Cox, [1880–1889])

hand-coloring of the two volumes, and that only our copy had hand-written labeling on the individual parts.¹⁰

WITKOWSKI

The flap anatomies in Witkowski's multi-volume atlas, *Human Anatomy and Physiology*, had many structural problems. An anatomy of the male reproductive organs was brittle, with loose parts and many flaps to reconfigure (fig. 9). Adding Japanese tissue hinges would have made the fragile flaps functional, but it would also have essentially changed the way the flaps looked and worked. After conversations with the collection curators, it was decided to make only minor repairs, replacing loose parts as they were and retaining the item in its original form to the extent possible. This treatment was done with the knowledge that future use might cause more damage; retaining the original format was considered more important in this case.

The atlas also presented multiple housing problems. The original anatomies were housed in acidic portfolios and held in place with pieces of string (fig. 10). Almost all of these anatomies had visible damage from the string cutting into the paper; in many cases, the string was very tight against the object. A new housing design was created in which each flap anatomy is supported on a sling of 10-point board, which fits within an envelope attached to a binder. The outside of the binder has a label with a photograph of what is inside. Both the binder and the original portfolio, now housed in a new box of corrugated board, which also has the image label on the outside (fig. 11).

Witkowski's *La generation humaine* is a text volume that contained two flap anatomies in the back. These were held in place with tight ribbons, which were damaging the slightly brittle paper. An anatomy of a pregnant woman had broken at the fold along the buttocks, and one of the inner flaps had also come off (fig. 12). Minor mending was done to repair these flaps. The paper was already starting to delaminate, so it was split further to allow the Japanese tissue to be placed between the layers. Since this object can be viewed from both sides, the repair was less visually distracting than attaching the tissue to only one side. It also proved to distribute the stress of the hinge evenly when the item was used.

An important part of this treatment was rehousing the flap anatomies. Each was placed on a piece of 20-point board that slides into a polyester sleeve. These sleeves are now housed in the front of the box with the volume, which has notes in the back to explain where the illustrations have moved (fig. 13).

PHYSICIANS' AID

The *Physicians' Aid* volume contained multiple flap anatomies on cloth-hinged leaves with metal turn-buttons that held the flaps together when turning a page (fig. 14). The metal was digging into the paper and damaging the surface of the flaps. The curators did not want the metal buttons removed or

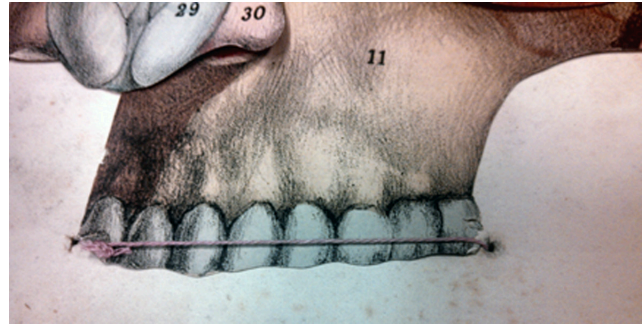


Fig. 10. This figure shows the string digging into the paper at the edge. Gustave Joseph Witkowski, "Tooth," in *Human Anatomy and Physiology* (London: Baillière, Tindall & Cox, [1880–1889])



Fig. 11. Multiple volumes in their new housings with labels to avoid the need to open each one to find proper contents. Gustave-Joseph Witkowski, *Human Anatomy and Physiology* (London: Baillière, Tindall & Cox, [1880–1889])

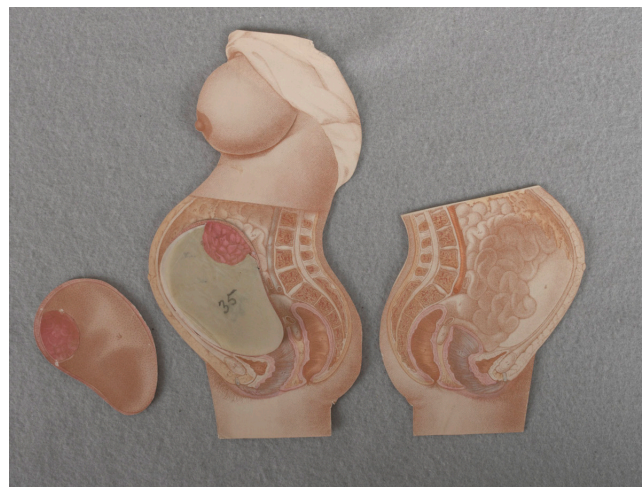


Fig. 12. Flap anatomy of a pregnant woman in pieces, before treatment. Gustave-Joseph Witkowski, *La generation humaine* (Paris: H. Lauwereyns, 1880)

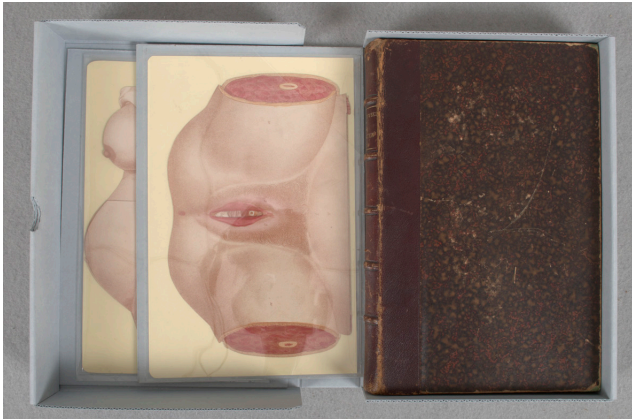


Fig. 13. Sleeve housings for two flaps previously attached to leaves inside the volume. Gustave-Joseph Witkowski, *La generation humaine* (Paris: H. Lauwereyns, 1880)



Fig. 14. Damaging metal buttons are now covered in polyester. *Physicians' Anatomical Aid: Patented* (Chicago: Western Pub. House, [ca. 1880–1890])



Fig. 15: This image shows the very thin esophagus, which is not strong enough to hold the weight of the organs attached to it when the flap is open completely and hanging off the book edge. M. Platen, *Supplement zu Platen, Die neue Heilmethode: Lehrbuch der naturgemässen Lebensweise, der Gesundheitspflege und der arzneilosen Heilweise* (Berlin: Bong, [1900])

replaced, so it was decided to fit each clasp with a folded piece of polyester. A small slit allowed for the polyester to fit tightly over the button, but the loose top layer keeps the metal from cutting into the flap pieces.

PLATEN

A German flap book by M. Platen had a very complicated flap anatomy in the back that was not selected for display because of the extent of damage to the female figure (fig. 15). Many of the internal organs were torn off and found loose in the back of the book. Treatment included mending and re-hinging many parts with Japanese tissue and wheat starch paste, but the esophagus piece was too fragile to withstand opening and closing. Although the esophagus was reattached to the larger organs, due to the poor-quality paper and flawed design, the thin piece could not support their weight when opened completely. After many attempts to repair the piece and multiple discussions with curators, the loose organs were placed inside a polyester sleeve kept in the front of the book.

EXHIBITION

There were many concerns about how to display these items, but a visit to the National Museum of American History for the Smithsonian Libraries exhibit *Paper Engineering: Fold, Pull, Pop and Turn* solved many of these problems instantly.¹¹ The Smithsonian staff had used rolled-up polyethylene book-strapping tape to hold the flaps open. This is a common product used in book exhibits, and it was used to make hundreds of differently shaped triangles, rectangles, and circles to create support where needed during installation (fig. 16).



Fig. 16: This image was taken inside an exhibit case. The arrows show where the polyester rolls are placed to help open parts of the interlocking flaps in one of the volumes of Witkowski's *Atlas*.

This material allows for the flap itself to decide how open it wants to be. The plastic stretches with weight or resistance and therefore, unless it is made too large (which doesn't look good), it cannot force the object to do anything it does not want to do.

In some cases, when the flap was just too big, heavy, or oddly shaped to use a flexible roll, sturdy PETG stands were made in conjunction with some smaller supports. The most difficult items to display were fold-outs from books, which required support for both the book and the anatomy, especially when the flaps were bigger than the books. We made special supports out of PETG to support flaps hanging off the edges of books, and tried to make the shape of the plastic mimic the shape of the flap.

OTHER IDEAS

Duke created an in-house video so that people can see how the flap anatomies work and understand how the parts go together. This video has been very popular and has more than 75,000 hits on YouTube. The video can also be used in future classes that include these materials.¹² Duke is not the only institution that owns or has exhibited flap anatomies:

- A pop-up exhibit at the Smithsonian had many interesting ways to display items, including an interactive turning machine that flipped open the flap on a children's book. (Multiple copies of the book were purchased so that this would not have preservation implications.)
- An exhibition in 2011 at the Art Institute of Chicago used mat-board triangles to hold up flaps of a Rimmelin print.¹³
- A Vogtherr fugitive sheet was enhanced by a physical facsimile as well as an iPad application for the Harvard Fogg Museum exhibit *Prints and the Pursuit of Knowledge in Early*

Modern Europe.¹⁴ For display, a small ethafoam roll and a piece of 10-point board were used to support the organs of the original fugitive sheet.

- The Huntington Library made a paper facsimile of a Vesalius flap anatomy that is so popular it has to be re-made regularly due to heavy use.¹⁵

FUTURE ENDEAVORS

A website was created for the *Animated Anatomies* exhibition at Duke University with a bibliography for flap anatomies as well as secondary materials about flaps.¹⁶ This website continues to be updated, and welcomes any titles or support materials that colleagues are willing to share. In 2014 Duke University Libraries will begin a project to investigate best practices for digitizing flap anatomies and hopes to have many of these materials available digitally in the years to come.

ACKNOWLEDGMENTS

This project included many members of the conservation lab of Duke University Libraries, including Jennifer Blomberg (exhibit preparation and installation, as well as housings for the Witkowski *Atlas*), Grace White (conservation of the fugitive sheets and exhibit installation support), Beth Doyle (exhibit preparation and installation support), and Erin Hammeke (conservation of Witkowski's *Male Atlas*, Thurnhaisser's *Bebaiō sis agō nismou*, exhibit preparation and installation). We are grateful to the curator of the History of Medicine Collection, Rachel Ingold, and two other members of the Rubenstein Library, Will Hansen and Andy Armacost, who worked very closely with the conservation department to assure proper treatment, housing, and exhibition of these materials. The exhibition never would have occurred without the generous spirit of the curators, Valeria Finucci and Maurizio Ripa-Bonati. There are many other people to thank for a variety of reasons, including Vanessa Haight Smith, Theresa Smith, Suzanne Karr Schmidt, Aaron Welborn, Mark Zupan, and Heidi Madden.

NOTES

1. An article about volvelles written by Michelle Gravelle, Anah Mustapha, and Coralee Leroux can be found at the ArchBook website, <http://archbook.ischool.utoronto.ca/archbook/volvelles.php> (accessed 6/30/13).
2. One of the most comprehensive articles about early movable parts publications can be found in an online exhibit from the University of North Texas Archives and Rare Book Library: www.library.unt.edu/rarebooks/exhibits/popup2/introduction.htm (accessed 6/30/13).
3. The first detailed account of fugitive anatomy sheets was written by Ludwig Choulant in 1852; it was translated into English in 1962. His chapter on fugitive sheets was quoted by almost all scholarly

publications that included information about fugitive sheets until the publication of Andrea Carlino's *Paper Bodies* in 1999. Ludwig Choulant, *History and Bibliography of Anatomic Illustration*, trans. Mortimer Frank (New York: Schuman's, 1962), 156–167.

4. In 1999 Andrea Carlino completed a bibliography that surveyed all of the known fugitive sheets at that time. Many fugitive sheets have been discovered since 1999, but this work has a great deal of thoughtful bibliographic research about the items included. Andrea Carlino, *Paper Bodies: A Catalogue of Anatomical Fugitive Sheets, 1538–1687* (London: Wellcome Institute for the History of Medicine, 1999).

5. In this exhibit catalog, Julie Hansen and Suzanne Porter share generic information about fugitive sheets and also give item-level information about specific sheets held by Duke University. Julie V. Hansen and Suzanne Porter, *The Physician's Art: Representations of Art and Medicine* (Durham, North Carolina: Duke University Medical Center Library and Duke University Museum of Art, 1999).

6. Vesalius published *Epitome* after the first fugitive sheets were produced, and he included pages of anatomy parts that could be cut up and turned into a flap anatomy. Roberts and Tomlinson discuss both the *Epitome* and fugitive sheets in this work: K. B. Roberts and J. D. W. Tomlinson, *The Fabric of the Body: European Traditions of Anatomical Illustration* (Oxford: Clarendon Press, 1992).

7. Rummelin was one of the most prevalent creators of flap anatomies and there are many articles and books that concentrate solely on his publications, including this self-published item: Kenneth F. Russell, *A Bibliography of Johann Rummelin the Anatomist* (Australia: J. F. Russell, 1991).

8. In finding evidence that these works were in an educational library collection, Suzanne Schmidt makes the connection that they were probably used in the classrooms there: Suzanne Karr Schmidt, *Art—A User's Guide: Interactive and Sculptural Printmaking in the Renaissance* (2006), www.interactive-prints.org/index.html (accessed 6/30/13).

9. This review, "A Supplement to *Myology*," was found in *The Lancet* 11 (10 January 1829): 468.

10. Perhaps we can infer from this that these volumes were put together and even colored by different artisans, and possibly by different shops altogether.

11. Thanks to Vanessa Haight Smith from the Smithsonian Libraries for giving us a tour and showing us this simple but perfect support system for flaps!

12. The videos of the functioning flap anatomies can be found at Duke University Libraries, "Videos of Flap Books," *Animated Anatomies* (2011), <http://exhibits.library.duke.edu/exhibits/show/anatomy/video> (accessed 6/30/13).

13. Thank you to Suzanne Karr Schmidt for sharing this information. A catalog of the Art Institute exhibition is available: Suzanne Karr Schmidt, *Altered and Adorned: Using Renaissance Prints in Daily Life, with Kimberly Nichols* (Chicago: The Art Institute of Chicago, 2011).

14. Theresa Smith, conservator for Harvard University Libraries, did extensive conservation treatment on Vogtherr fugitive sheets. A video about this treatment can be seen at <http://vimeo.com/31790483> (accessed 6/30/2013). See also Theresa Smith, "Moveable Anatomies and Print Shop Practice in Sixteenth-Century Strasbourg," in

The Renaissance Workshop: Materials and Techniques of Renaissance Art (forthcoming).

15. More information about the facsimiles made by Marieka Kaye at the Huntington can be found in the summary of the Archives Discussion Group in this volume of the *Book and Paper Group Annual*.

16. The *Animated Anatomies* online exhibit can be found at Duke University Libraries, *Animated Anatomies* (2011), <http://exhibits.library.duke.edu/exhibits/show/anatomy> (accessed 6/30/13).

FURTHER READING

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Update on Digital Print Preservation Research: What We Have Learned So Far About the Permanence and Preservation of Digitally Printed Books

ABSTRACT

Many contemporary books and periodicals are now being created with digital printing equipment. These devices use colorants, and often papers, that are different from those used in traditional offset lithography. This raises a question for collections caretakers: Will these materials need a new preservation approach? For the last five years the Image Permanence Institute has been studying the preservation of digital hardcopy materials and developing strategies to maximize their useable lives in cultural heritage collections. Potential deterioration factors for the materials include heat, humidity extremes, air pollutants, light, enclosure materials, handling, and exposure to water (e.g., during floods). In the last two years the Image Permanence Institute has added bound volumes to its studies, in addition to individual prints. Bound pages have been found to behave similarly to individual prints in some ways, but in other ways their construction and use positively or adversely impacts their long-term stability. This is a review of the work to date.

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Presented at the Book and Paper Group Session, AIC's 41st Annual Meeting, May 29–June 1, 2013, Indianapolis, Indiana.

Conservation of Dieter Roth's *Snow*

ABSTRACT

Throughout his career, Swiss-German artist Dieter Roth employed the book format as a key element of his work. Defining "book" as "a community of like-minded things," Roth stretched and challenged conventional ideas about the nature of artists' books, employing new formats and techniques to expand the book beyond its traditional boundaries.

In 1964, Roth began a residency at the Philadelphia Museum College of Art, with the intention of creating a limited-edition artist's book. Over the course of three months, he produced about 6,000 drawings, prints, photographs, and notes, binding several hundred of them into a volume that he intended to photograph and reprint as a paperback. The ill-fated edition was never produced. In the 1970s, Roth constructed a table and two chairs to house and display the book, which he called *Snow*.

Since its acquisition by The Museum of Modern Art in 1998, *Snow* has been exhibited a handful of times, always with the album lying open on the table between the two chairs, and with a small number of works from the book removed and hung, framed, on the wall. The work's complexity and its poor condition have limited the ways in which it can be shown. An exhibition opening in February 2013 provided an opportunity to gain a deeper understanding of *Snow*, employing conservation treatment, scientific analysis, and digital imaging of the work to change and enhance the ways that viewers and scholars can access, interpret, and enjoy one of Dieter Roth's most unique and important book projects.

INTRODUCTION

As conservators, we are forced to consider the long-term implications of our work. Will this material stand the test of time? Will it be easy to reverse? Will my aesthetic choices

be appropriate to an unknown future context? And perhaps most confoundingly: Do my treatment decisions reflect a bias or value judgment about the importance of this work?

In general, these questions are more easily addressed because we make certain assumptions about the original creator. We assume that the work was intended to endure, and that all of the labor that went into its creation was a testament to its value and significance.

In the case of works by some contemporary artists, however, such assumptions cannot be made. These works throw our orderly world of preservation into chaos. If an object is made with materials the artist knew would decay, if indeed that was the artist's intention, what role should we, as conservators, play? Is it appropriate for us to subjugate the creator's vision to our own priorities? How do we preserve and protect cultural heritage, while still respecting the conceptual integrity of an ephemeral object?

These questions weighed heavily on three conservators at The Museum of Modern Art in New York in the months leading up to an exhibition of work by Swiss-German artist and iconoclast Dieter Roth. Best known for his engagement with the concept of decay, Roth created works out of materials including chocolate, cheese, and animal droppings, and allowed them to deteriorate at their own pace. When these works were acquired as part of an institutional collection, Roth considered them to have entered "museum life," a liminal state in which deterioration is slowed, but never entirely stopped. As Roth described it: "There is a general slowing down [of decay]. The images will outlive me. They will retain a certain standard too, though they point to decay The whole putrefying image actually grows and increasingly takes on museum life ... although I have always regarded museums as funeral parlours to varying degrees" (Müller 1989, n.p.).

The role of the conservator, whether as preserver of a cultural legacy or as art mortician, was a central theme in the treatment of one of Roth's creations: a large, varied, and singularly problematic album called *Snow*.

Presented at the Book and Paper Group Session, AIC's 41st Annual Meeting, May 29–June 1, 2013, Indianapolis, Indiana.

DIETER ROTH

Karl-Dietrich Roth was born in Hannover in 1930, the eldest son of a German mother and a Swiss father. In 1943, Roth was sent to live with foster parents in Zurich, where he remained for the next three years. Although he was physically separated from the war, the experience marked him indelibly, emerging in his work throughout his career. After the end of WWII, Roth's entire family joined him in Switzerland. Roth, who had used drawing and poetry as a means of escape during his years as a refugee, now turned his focus to printmaking, dropping out of secondary school at 17 in order to pursue an apprenticeship with a commercial artist. This apprenticeship, and subsequent study at the School of Commercial Art in Bern, exposed Roth to many techniques of printmaking that would become central to his work. Throughout his career in advertising, Roth continued painting, drawing, and making prints, and in 1953 he collaborated on the publication of an "international journal of young art" called *Spirale*. It was during this period that Roth turned his full attention to the making of art, including artist's books. His early projects, which were heavily influenced by the constructivist movement, date from the mid-1950s, and mark the beginning of an engagement with the book-as-artistic-medium that would last for the next 40 years.

SNOW

In September 1964, Dieter Roth came to Philadelphia at the invitation of Eugene Feldman, a professor of art and the proprietor of Falcon Press. Roth was to stay for three months and design a book, which would be printed in a small edition by the press. Feldman's expectation was that Roth would produce a constructivist book of the kind he had shown in New York a few years earlier. Feldman didn't know that, in the intervening years, Roth had begun exploring different expressions of the book form. Defining a book as "a community of like-minded things," (Vischer et al. 2003, 48) Roth entered a realm of book-as-sculpture. He employed everyday materials in works such as the tiny *daily mirror book* (1961), which was made of newspapers. He even challenged the concept of the book format, as with *Literaturwurst* (1961), or "literature sausage," in which ground books were mixed with spices and binders and stuffed into sausage casings. When Feldman saw the direction Roth's work had taken, he rescinded his offer to publish the book. Fortunately Roth was able to get permission to continue his work at the Philadelphia Museum College of Art, with the understanding that the original would be a gift to the College.

Roth produced, by his estimate, 6000 drawings, prints, photographs, and notes over three months, working with an assistant provided by the college, and tacking "every piece of paper [he'd] touched during the day" onto the wall (Vischer



Fig. 1. Dieter Roth (Swiss, born Germany, 1930–1998). *Snow*. 1964/69. Artist's book of mixed mediums, with wood table and two wood chairs. The Museum of Modern Art, New York. Committee on Painting and Sculpture Funds. Courtesy of John Wronn, © 2013 Estate of Dieter Roth

et al. 2003, 92). He called the work *Snow*. Five hundred of the paper works were selected and professionally photographed, to be printed as a limited-edition paperback. This printed edition was never produced. Eventually an exhibition, called an "ending" by Roth, was mounted to show the finished work. Roth signed and gave away many proofs, photographs, and other works created for the project, and took the book with him back to his home in Iceland. In the late 1960s, Roth commissioned a fabricator named Rudolf Reiser to construct a table and two chairs to house and display *Snow* (fig. 1), and had the 1964 photographs printed and bound as volume 11 of his self-published *Collected Works*.

Since its acquisition by The Museum of Modern Art in 1998, *Snow* has been exhibited a few times, always with the album lying open on the table between the two chairs, and with a small number of works removed and hung, framed, on the wall. The recent exhibition of Roth's books and multiples, which opened at The Museum of Modern Art in February 2013, provided an opportunity to devise a new approach to exhibiting *Snow*. Conservation staff worked closely with curatorial colleagues to gain a deeper understanding of the album, employing conservation treatment, scientific analysis, and digital imaging to change and enhance the ways that viewers and scholars can access, interpret, and enjoy one of Dieter Roth's most unique and important book projects.

STRUCTURE AND CONDITION

As it exists now, *Snow* consists of a cardboard cover with four attached sections, and 31 homemade plastic sleeves, which are stab-sewn to the back cover with clear plastic tubing (fig. 2). The spine is divided into two halves joined by a row of bolts. The attached sections, made of tracing paper, cardboard, and clay-coated paper, are stapled and taped to the binding at the front of the book, and the sleeves at the back contain loose items. Materials used in the work include various plastics, pressure-sensitive tapes, photographs, diazotypes, printing proofs, and by-products (including cut

pieces of ink-saturated offset lithography mat, fig. 3), and a tiny wax still life. Oversized sheets, some of which are several feet long, are folded and inserted into the plastic sleeves (fig. 4). The work also includes a collapsed cardboard suitcase, constructed by Roth to house the album.

The work has changed over time, and a few serious condition problems have developed. One of the most readily apparent is related to the artist's abundant use of tape (fig. 5). Until the 1970s, most pressure-sensitive tape adhesives

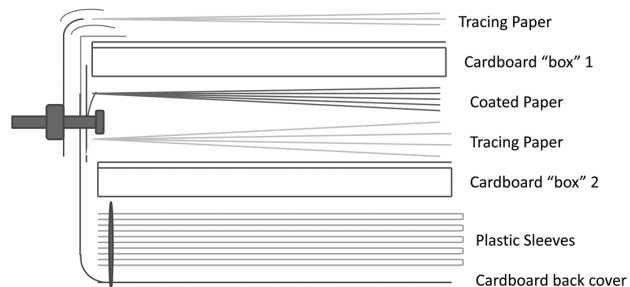


Fig. 2. Cross section showing the structure of *Snow*

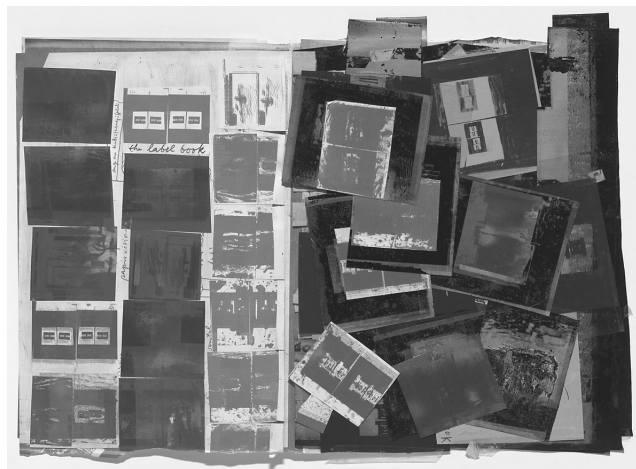


Fig. 3. Spread from *Snow*. 1964/69. Lithograph with offset mats and felt-tip pen, 44.5 x 58.4 cm

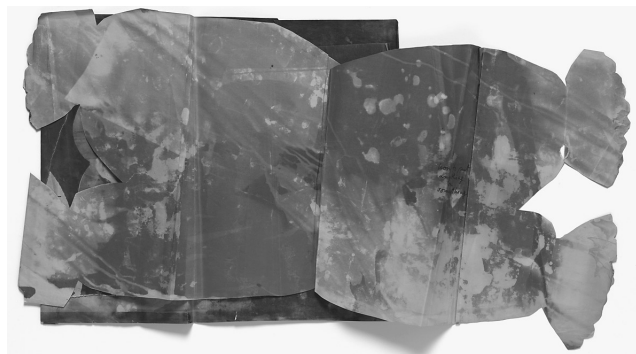


Fig. 4. Spread from *Snow*. 1964/69. Felt-tip pen on cut diazotype, 46.4 x 115.6 cm

were rubber based. Over time, these adhesives spread, discolor, and eventually lose their tack (Smith et al. 1983). This deteriorating adhesive is particularly harmful where tape was used to join the edges of the plastic sleeves—still-tacky adhesive has crept beyond the boundary of the tape carrier, causing the sleeves to stick together.

The sleeves themselves are made from poly(vinyl chloride) or PVC, a rigid plastic that is manufactured in combination with plasticizer to make pliable sheets. As PVC ages, it gives off hydrochloric acid, causing damage to adjacent materials (Shashoua 2002), and the plasticizer migrates to the surface, creating a sticky residue (Shashoua 1996). In *Snow*, this residue made it difficult to remove components housed within the sleeves.

Transparentized or tracing papers, like those at the beginning of the album, are manufactured to be translucent. This translucency is achieved by a variety of methods, all of which weaken the paper (Hofmann et al. 1992). Due in large part to this inherent fragility, the tracing paper sections at the beginning of the album have become brittle and torn (fig. 5). In an apparent effort to provide support to the weak paper, each page was taped to a sheet of clear plastic film. FTIR analysis identified the plastic sheets as cellulose acetate, an unstable material that shrinks and distorts over time and



Fig. 5. Discolored tape on a tracing paper page from *Snow*. 1964/69. Tracing paper, notebook paper, tape and ink, 38.7 x 45.7 cm.

that can give off harmful acetic acid vapor as it deteriorates (Williams 2002). The degraded cellulose acetate posed a structural as well as a chemical danger: Because the tape was failing and the stiff plastic interfered with the turning of the pages, this past attempt at stabilization resulted in further damage to the tracing paper.

“ORIGINAL ORDER”

By comparing the images of *Snow* taken in 1964 with the work as it exists today (figs. 6a and 6b), it is possible to see changes that have taken place in the intervening years. The plastic sleeves, which now comprise a large portion of the binding, were not present when the work was originally photographed. The tracing paper sections, now heavily mended with tape and backed with sheets of cellulose acetate, were once intact and supple. It is also apparent that a few components photographed in 1964 are no longer with the album. Whether they were given away during the ending exhibition in Philadelphia or disappeared at a later date is unknown.

These discrepancies, paired with the fact that many components have been shuffled, raise questions about Roth's intended order for the work. Close examination allowed for a partial recreation of the original order. For instance, cut edges on loose sheets were matched with corresponding stubs left in the binding, indicating where a page had been removed. Roth's artistic process also offered hints: a few sections were marked with a target and shot with a BB gun. The size and position of the resulting holes allowed for reconstruction of the original sequence of pages. Even the deteriorating tape provided clues, as stains from failed adhesive marked locations where loose items were once attached. Roth's published photographs were a valuable, but not entirely reliable, resource. While they revealed much about the original condition of the work, and gave important insights into the overarching meaning and organization of *Snow*, there were instances where the order of the photographs appeared to have been shuffled prior to publication.

Even with all of the evidence collected, the question of “originality” was problematic. An important goal of conservation treatment is to allow the viewer to understand a work in a way that is faithful to the artist's intent. However, a responsible treatment must allow for the possibility that new information could become available in the future, and should not attempt to recreate lost information based on potentially faulty impressions. Roth is known to have revisited many of his works at later dates, and it is certain that he continued to make changes to *Snow* at least through the late 1960s. Indeed, curatorial research revealed that the PVC sleeves and the damaging cellulose acetate sheet liners were added at Roth's request by Rudolf Reiser, the same fabricator who constructed the furniture on which *Snow* is now displayed. The changes were made in preparation for an exhibition at Michael Werner's Cologne

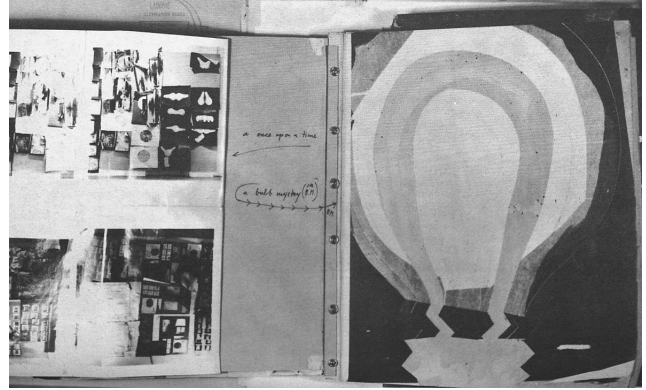


Fig. 6a. Page showing 1964 photograph of *Snow*, from *Gesammelt Werke, Band 11: Snow* (Collected Works, volume 11: *Snow*). 1970, photographed 1964. Artist's book, offset printed, page 22.8 x 16.8 cm.



Fig. 6b. Spread from *Snow* as it exists today, showing PVC sleeves and partial binding structure. 1964/69. 50.8 x 89.5 cm.

gallery in 1969, in which visitors would be able to turn the pages of the album and access its many components. Reiser indicated that the new material was added solely to facilitate handling, and stated that Roth would not have felt that it was part of the work. Nevertheless, it altered the album in ways that could not be completely undone.

Further complicating the treatment was a question inherent to all book conservation treatments—must the book function? If *Snow* were disbound, or if the pages no longer turned, would it cease to be the work that Roth intended? If the work is an object to be exhibited in a museum, does it only need to *look* like a book, rather than actually *be* one? Is this what Dieter Roth envisioned when he referred to museums as funeral parlors?

TREATMENT APPROACH

In planning conservation treatment, it was clear that it would be impossible to return *Snow* to its original state, or even to know definitively what that state would have been. The immediate goals were threefold: first, to stabilize the album

so that it could be handled and displayed safely; second, to gain a better understanding of the artist's process, and the conservation implications of his choices, through identification of materials; and third, to take high-quality digital images of every component of the album. These images will facilitate future access to the work while limiting handling.

TREATMENT PROCEDURE

The treatment plan was made with close consultation between the conservators and with their curatorial colleagues. Given *Snow's* complex history and Roth's well-documented tolerance for change and deterioration in his work, an approach of minimal stabilization was taken, addressing only the most serious condition problems.

The first step was to partially disbind the album. This facilitated access to damage in the gutters of some sections, and allowed multiple conservators to work on the treatment simultaneously. Some taped sections were released from the binding, and the two bolted-together halves of the spine were separated. Loose items from the sleeves were removed and housed in folders.

Based on the information provided by Rudolf Reiser, the decision was made to remove the harmful cellulose acetate linings. Each tracing paper sheet was released by lifting the tape around the edges with a heated spatula. Without the lining, the sheets were able to drape and move much more naturally.

Over time, adhesive from the tape had crept beyond the carrier. Because each page was pressed against the smooth surface of the previous page's plastic lining, this adhesive residue had an extremely shiny surface. Acetone was used to reduce this residue, and xylene removed residual spots of stickiness.

Tears were mended using homemade heat-set tissue. A 1:1 mixture of Lascaux 498 HV and water was brushed through nonwoven polyester onto very thin Japanese tissue on top of Mylar and allowed to dry. Narrow strips were pre-cut while the tissue was still attached to the Mylar, and then peeled off as needed. The adhesive was swollen with ethanol, and then the strip was placed over the tear. The mend was then burnished with a warm tacking iron to improve adhesion and transparency.

Because they are now part of the structure of the binding, the PVC sleeves were left in place. Loose tape carrier from the sleeves was consolidated or removed. In cases where the carrier was removed or already missing, the fore-edge of the sleeve was allowed to remain open. The sleeves were cleaned of excess plasticizer and surface grime using a cotton pad moistened with water and ethanol.

Loose elements that had been attached to pages were re-adhered, using the original tape carrier wherever possible.

Because of the potential for damage, the loose components were not returned to the PVC sleeves. Instead, they will be

stored in individual folders within a custom housing, which will hold all the components of *Snow*.

EXHIBITION

The exhibition opened in February 2013. While the display format borrows from tradition, it also shows many more components of the work, removed from their sleeves and mounted on the wall (fig. 7). A touch-screen monitor in the galleries (fig. 8) allows visitors to view every page of the album and to gain a better sense of the scope and exuberance of Roth's creation.

CONCLUSION

Snow represents a transitional moment in Roth's artistic career, after the constructivist books of his early years but before the chocolate sculptures and rotting food installations for which he later became famous. In devising a treatment plan, it was important to acknowledge and accept the changes that had taken place in the work, and to think about ways to improve its condition without attempting to return it to an "ideal" state that may never have been the artist's intention.



Fig. 7. Installation view of *Wait, Later This Will Be Nothing: Editions by Dieter Roth*. Shown: Dieter Roth. *Snow*. 1964/69. Artist's book of mixed mediums, with wood table and two wood chairs. The Museum of Modern Art. Committee on Painting and Sculpture Funds. © 2013 Estate of Dieter Roth



Fig. 8. Installation view of *Wait, Later This Will Be Nothing: Editions by Dieter Roth*, showing touch-screen monitor in gallery

Dieter Roth's work is a challenge to conservators not only because of its physical and material complexity, but also because Roth directly confronted the traditional role of the museum. By creating art that was likely—and in many cases designed—to decay, Roth left conservators with conflicting responsibilities: to physically preserve the work of art, and to be respectful of the intent of the art's creator. *Snow* seems to particularly embody these conflicts through its problematic structure, its incompatible and incredibly varied materials, and through the numerous messages left for future custodians of the work. Notes in and on *Snow* include the warning “DO NOT DISTURB,” a note on the aging properties of Scotch tape, and—perhaps most presciently—scrawled along the edge of an oversized print: “Wait, later this will be nothing.”

ACKNOWLEDGMENTS

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The Materials, Techniques, and Conservation Challenges of Richard Serra's Oilstick Screen Prints

ABSTRACT

The Gemini G.E.L. (Graphic Editions Limited) Archives at The National Gallery of Art, established in 1981, contains an example from each of Gemini's published editions. Of the more than 1,700 works in the Archives, 21 are screen prints made with oilstick by Richard Serra (b. 1939), published between 1985 and 1991.

Richard Serra's large-scale prints, with their densely layered, rich textural surfaces, expand the boundaries of traditional screen-printing techniques. The screen prints are created on a variety of papers: Japanese and Western, machine- and handmade. Printing begins with a traditional screen print in black ink. Subsequent layers incorporate oilstick, the generic name for a medium often called Paintstick (the Shiva brand of Jack Richeson & Co.), composed of pigment, linseed oil, and melted wax, and molded into large cylindrical sticks.

The printers at Gemini, working with Serra, manipulated the medium by heating the oilsticks, adding linseed oil, and casting the mixture into large bricks. The bricks of oilstick were pushed, in multiple layers, through a screen onto the original key print.

Due to their large format and experimental technique, these works are often challenging to store, handle, and display. The prints exhibit a variety of condition problems, including soft, tacky "inks" and textured surfaces that attract lint and dust. The surfaces are vulnerable to abrasion and deformation, especially during handling. Some prints have a white, hazy appearance from white crystalline particles that develop when free fatty acids migrate out of the oil paint and deposit on the upper layers of the image. The white efflorescence disfigures the prints' velvety black surface.

This research includes a survey and visual examination of Serra's oil stick screen prints from Gemini G.E.L., museums, and private collections. Scientific analysis, including pyrolysis gas chromatography/mass spectroscopy (Py-GCMS), was

used to characterize the media and identify components of the efflorescence. The information gained from this research informed the preservation and storage of these works.

INTRODUCTION

Richard Serra, best known for his large metal sculptures, has been making prints since the early 1970s. The prints are made as an artistic response to a finished sculpture or to Serra's surroundings. Like the sculptures, the prints are overwhelming in size and color. Layers and layers of black oilstick, built up on oversized paper, appear intensely textured and rich. Closely examined, the black topographical surface both absorbs and reflects light, creating an overall matte surface with spots of shine. Serra says, "I want my surfaces to be as anonymous as possible, so that they don't call attention to themselves... I want to avoid a surface which could read as gestural" (Shiff 2008, 59). He says, "You can cover a surface with black without risking metaphorical and other misreadings. The use of any other color would be the extension of coloration, with its unavoidable allusions to nature. From Gutenberg on, black has always been synonymous with a graphic or print procedure. I am interested in the mechanization of the graphic procedure; I am not interested in the paint-allusion gesture" (Serra 1994, 179).

Serra views printmaking as a collaborative process that can be refined over time (Rosenthal 1993). In the early 1970s, the artist began working with Gemini G.E.L. (Graphic Editions Limited), a Los Angeles print studio, to produce lithographs, etchings, and screen prints. Using technically innovative methods, they printed and published 22 oilstick screen-print editions between 1985 and 1991. The National Gallery of Art (NGA) established The Gemini G.E.L. Archives in 1981. Its holdings contain examples from the printed editions, with images and technical information included in The Gemini G.E.L. Online Catalogue Raisonné (National Gallery of Art 2013).¹

Due to their large formats and technically experimental media, Serra's works are often challenging to store, handle, and display. This investigation of the artist's materials and

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screen-print techniques played a vital role in formulating new preservation strategies for works in the NGA's collection.

MATERIALS

PAPERS

The Gemini G.E.L. Online Catalogue Raisonné lists the paper used in each print, though the characterizations are often vague. Papers are described by type (Western, handmade, machine-made, and Japanese) or by manufacturer and brand (Arches Cover). The term "Hiromi Paper" refers to papers specially made for Serra in Japan and commissioned by Hiromi Paper International, Inc., in Santa Barbara, California. The heavyweight (500 gsm), kozo-fiber papers are made by two Japanese paper mills: Fuji Paper Cooperative in Tokushima Prefecture and Igarishi Paper Mill in Fukui Prefecture (Katayama 2012).

The typical sheet size for the prints is 93.98 x 182.88 cm (37 x 72 in.) and the largest print, *Robeson*, is on a paper support that measures 256.54 x 161.10 cm (101 x 65 in.). Prior to use, the papers were coated with either a clear acrylic screen-printing base (T. W. Graphics Series 7000) or a clear urethane. The clear base was diluted with water and sprayed onto the paper support. Coatings were applied to protect the paper from oil penetration and staining. Papers were initially coated only on the front side, but by 1990, both sides of the sheet were treated after printers discovered that oil was penetrating the sheet.

OILSTICKS

Oilsticks were first formulated by French artist Jean-Francois Raffaelli and marketed in the early 1900s by Winsor & Newton as Raffaelli Solid Oil Colours (Winsor & Newton 2011). Other manufacturers and brands include Sennelier Oil Sticks, M. Grumbacher, Inc. Tubeless Oil Paint, and Winsor & Newton Oilbars. In the 1940s, oilsticks were marketed and sold by the Shiva Company under the brand name Paintstik, and the medium is often called by this name. Gemini G.E.L. used primarily Shiva Artist's Paintstik, now manufactured by Jack Richeson & Co.²

Formulations differ between brands, but the medium generally consists of a colorant (pigment), a drying oil (linseed or poppy), and paraffin wax (Ellis and Yeh 1997). The materials are heated, mixed together, and then formed into cylindrical sticks. Oil on the exposed surface of the finished stick oxidizes to form a thin skin that must be peeled back before each use.

TECHNIQUES

Serra worked with Gemini G.E.L. for more than a year to devise the printing process, which was continuously adjusted during the entire period of their artistic collaboration (Wortz



Fig. 1. Half of an oilstick brick, 10.6 x 8.89 x 4.45 cm (4 x 3 ½ x 1 ¾ in.), made by melting oilsticks, adding linseed oil, and cooling in a mold

1986). Initially, Serra's drawings were made using the sticks as they came from the manufacturer. Given the oversized scale of the papers, application using the small sticks was a laborious task. A more efficient process was implemented and used in both the drawings and prints. Multiple oilsticks were melted and linseed oil was added to achieve the desired consistency. The mixture was then poured into bread pans and cooled, creating large bricks designed to be held with both hands (fig. 1). The addition of linseed oil softens the oilstick and allows it to be pushed easily through a tightly stretched mesh screen.

The design for each print was drawn with a brick of oilstick on the screen. The screen was then coated with a photosensitive emulsion and exposed to a light source. Light hardened the non-design areas so they would block ink. Any unhardened emulsion was then washed away and the oilstick was removed to create the stencil or image area.

This key image was screen-printed in black ink onto the paper support to create a base for subsequent layers of oilstick. The screen-printing ink also acted as an additional barrier to prevent oil from staining the paper support (Reid 2011). Oilstick was then applied in long, continuous, vertical strokes, either through the screen or directly over the screen-printed ink foundation. Each oilstick layer was dried for one to two weeks before the next was added. Occasionally, acrylic gel medium was applied by brush between the oilstick layers to create additional texture.

Different methods of oilstick application produced varied textures and surfaces. Oilstick pulled across the surface of the paper support created a smooth and continuous layer. Molten oilstick applied with a paint roller created high peaks when the roller was lifted away from the paper support. The most common method was pushing the oilstick through a screen. The screen texture is apparent when the surface of the print is viewed under magnification (fig. 2). In many prints, a combination of methods was employed. In the 1991 print *Double Black*, the first oilstick layer was applied directly onto



Fig. 2. Screen texture, specular light. Detail of *Clara Clara II* (1985), oilstick screen print on paper, 91.2 x 184.7 cm (35 7/8 x 72 11/16 in.), NGA 1989.55.72, gift of Gemini G.E.L. and the artist

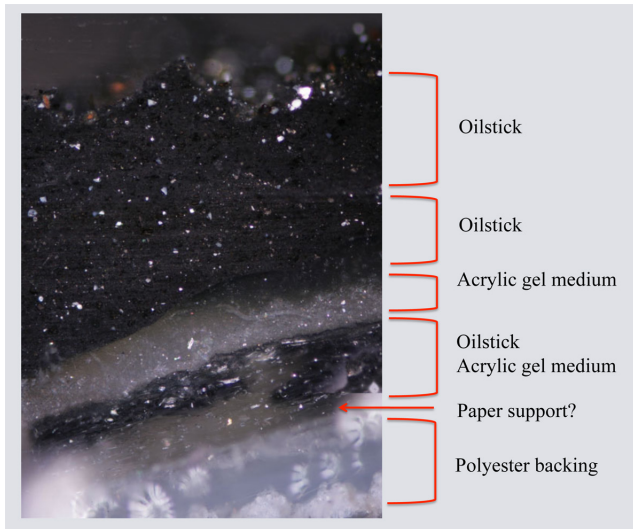


Fig. 3. Print cross section, visible light, polarizing light microscope. Composite of four images, each taken at 20x magnification. Print sample courtesy of Gemini G.E.L.

the black screen-printing ink, and subsequent layers were pushed through the screen.³

The thickness and texture of a print is primarily dependent upon the number of oilstick layers. Within an edition, each impression can vary in construction and have between two and seven layers of oilstick. For example, the catalogue raisonné entry for the 1991 print *Esna* states, “All prints in the edition received as few as two coats and as many as four coats of Paintstik” (National Gallery of Art 2013). In the cross section seen in figure 3, three layers of oilstick and two layers of gel medium are present. A polyester backing is visible as the bottom layer. The coated paper support disappears under the thick seams of oilstick and acrylic gel medium.

The texture variations of the prints are atypical of traditional screen-print surfaces. Because the construction of each print varies, the process more closely resembles monoprinting. Serra calls these works “multiple monotypes” (von Berswordt-Wallrabe and Breidenbach 1999, 28).

ANALYSIS

Analysis was performed to characterize the oilstick medium and to better understand its drying properties. NGA scientist Christopher Maines used pyrolysis gas chromatography/mass spectroscopy (Py-GCMS) to analyze oilstick samples taken from selected prints and from a black Shiva Jumbo Artist’s Paintstik purchased in 2011.

Py-GCMS analysis confirmed the presence of paraffin wax and linseed oil in all the samples (fig. 4). Long-chain hydrocarbons indicate the presence of paraffin wax. Palmitic, stearic, and oleic acid peaks are characteristic of linseed oil. X-ray fluorescence analysis of a black Shiva Jumbo Artist’s Paintstik, performed by Dr. Aniko Bezur at The Menil Collection, verified the presence of potassium and calcium associated with bone black pigments (Bezur 2011).⁴

Theoretically, the oilstick medium in Serra’s prints should be dry, since they were made more than 20 years ago. During the drying process, unsaturated fatty acids in linseed oil combine with oxygen to form hard, cross-linked films. Byproducts of the drying reactions include smaller compounds, the most abundant of which is azelaic acid. Oleic acid oxidizes to azelaic acid, and as oil paint dries, there is a decrease in oleic acid and an increase in azelaic acid (Mills 1966). The samples of oilstick taken from the prints were expected to have a high proportion of azelaic acid in relation to oleic acid.

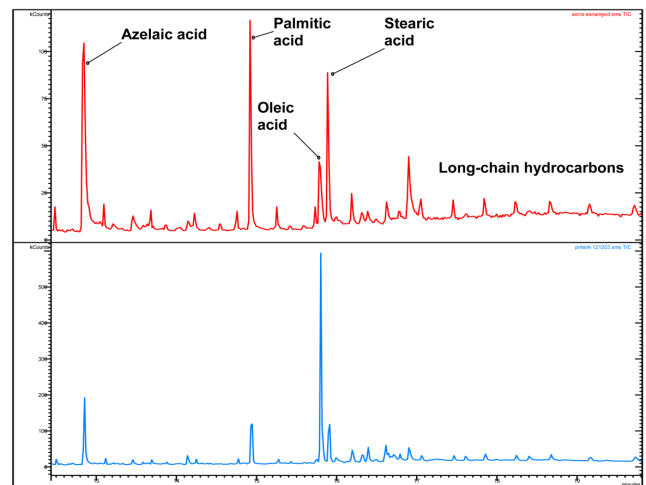


Fig. 4. Py-GCMS chromatograms. Top: Oilstick sample from *Esna* (1991). Print sample courtesy of Gemini G.E.L.). Bottom: Sample of ivory black Shiva Jumbo Artist’s Paintstik purchased in 2011

Py-GCMS analysis of oilstick from selected screen prints showed low amounts of azelaic acid, indicating a medium that is not fully dry. The presence of hydrocarbon waxes and the thickness of the oilstick layers, both of which may prevent oxygen from fully penetrating the paint, may explain this failure to dry completely. In addition, the waxes may act as plasticizers, keeping the oilstick soft and pliable (Maines 2012). As in the oilsticks themselves, a hard, dry film forms on the print's surface, while the interior remains tacky and malleable.

CONDITION ISSUES

Serra's oilstick screen prints present challenging preservation issues. Thick oilstick layers on oversized and heavy supports make handling difficult. Moreover, the tacky and malleable surfaces and interiors are problematic for handling and storage. Any pressure applied during handling and storage can cause surface deformations. Surface sheen is unintentionally created when the thick impasto surfaces become flattened and burnished (fig. 5). Other problematic issues include the textured surfaces' attraction for lint and dust and the yellowing of the acrylic coatings on the paper supports. Oil staining



Fig. 5. Flattened and burnished areas impart an unintended surface sheen. Detail of *Esna* (1991), oilstick screen print on two sheets of coated DHM-14 Japanese paper, overall size: 194.3 x 194.3 cm (76 1/2 x 76 1/2 in.), NGA 2000.177.69.a-b, gift of Lee and Ann Fensterstock

is often visible around the image on the front and back of the paper supports (figs. 6 and 7). It should be noted that Serra does not consider smudges, oil stains, and bleeding at the edges of the image to be disfiguring to the print (Shiff 2008).

Old mounts may also cause problems. The printers at Gemini experimented with several hanging systems for use during installation. A polyester woven material was common-

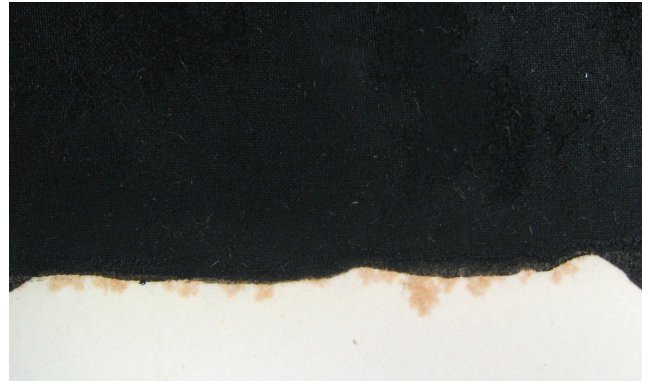


Fig. 6. Oil staining visible along the edge of the image. Detail, bottom right corner, of *Ernie's Mark* (1985), oilstick screen print on coated Exeter paper, sheet: 215.3 x 189.9 cm (84 3/4 x 74 3/4 in.), NGA 1989.55.64, gift of Gemini G.E.L. and the artist



Fig. 7. Oil staining visible on the back of the paper support. Detail of *Esna* (1991), oilstick screen print on two sheets of coated DHM-14 Japanese paper, overall size: 194.3 x 194.3 cm (76 1/2 x 76 1/2 in.), NGA 2000.177.69.a-b, gift of Lee and Ann Fensterstock

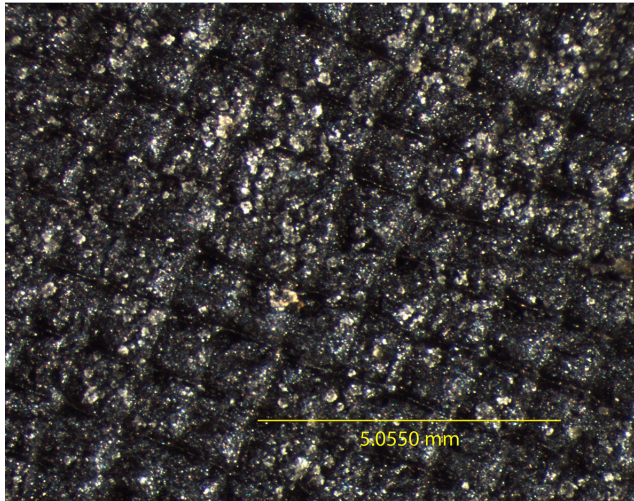


Fig. 8. Photomicrograph of fatty acid efflorescence crystals, 20x magnification, *Clara Clara II* (1985), oilstick screen print on paper, sheet: 91.2 x 184.7 cm (35 7/8 x 72 11/16 in.), NGA 1989.55.72, gift of Gemini G.E.L. and the artist

ly adhered overall to the back of the paper support and used to stretch the paper over a backing board. A second type of hanging system was constructed of polyester tabs attached to the back of the print. The tabs are meant to fit onto a wall hanging device or into slits in the backing board of a frame. The pressure-sensitive adhesives⁵ used to join the polyester fabric and the polyester tabs to the paper supports can be sticky.

The most disfiguring condition for these artworks is the formation of white fatty acid crystals, or efflorescence, which can disrupt their uniformly black surfaces. The white particles on the oilstick prints are similar to the fatty acid crystals that can be found on the surface of oil paintings. At first glance, efflorescence on the surface of the screen prints may look like dust and dirt particles, but under the microscope, small crystals are visible (fig. 8). White, needle-like crystals may develop in small patches (fig. 9). In some heavy deposits, efflorescence appears as a white haze over a large expanse and is apparent when viewed in raking or specular light (fig. 10). Residues found on interleaving sheets have been identified as fatty acids or fatty acid components (Bezur 2011).⁶

Free fatty acids in oils are semi-volatile at room temperature. The fatty acids can migrate into the upper layers of oil paint and deposit on the surface as white crystals (Ordonez and Twilley 1998; Rimer et al. 1999). The semi-volatile free fatty acids are also a cause of the hazing or blooming on the glazing of oil paintings (Williams 1989; Shilling, Carson, and Khanjian 1998). Many conservators and scientists have hypothesized about the formation of fatty acid efflorescence in oil paints, but the actual mechanism is still unknown.

Serra's manipulation of the oilstick—by heating, cooling, and adding oil—changes its manufactured properties and creates conditions that may promote crystal formation.

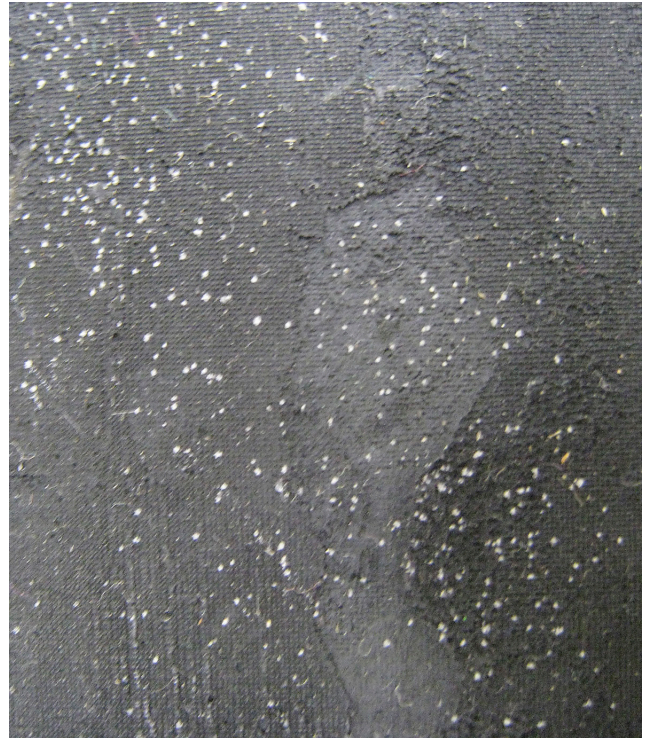


Fig. 9. Clusters of white fatty acid efflorescence. Under magnification, these clusters are visible as white, needle-like crystals. Detail of *Double Black* (1990), right panel of two parts, oilstick screen print on coated DHM-14 Japanese paper, overall (irregular): 179 x 180 cm (70 1/2 x 70 7/8 in.), NGA 2000.177.102.a, gift of Lee and Ann Fensterstock



Fig. 10. Fatty acid crystals appear as a white haze over a large expanse of the print when viewed in specular light. Detail of *Double Black* (1990), right panel of two parts, oilstick screen print on coated DHM-14 Japanese paper, overall (irregular): 179 x 180 cm (70 1/2 x 70 7/8 in.), NGA 2000.177.102.a, gift of Lee and Ann Fensterstock

However, efflorescence also occurs in unaltered oilstick, so its formation seems to be inherent to the medium and/or caused by environmental conditions. Factors such as high heat, moisture, physical/thermal changes in the paint film, pigments with large oil content, unvarnished surfaces, and nonabsorbent substrates may promote or contribute to fatty acid crystal formation (Koller and Burmester 1990; Williams 1989; Rimer et al. 1999). More research is needed to understand the conditions in which the fatty acids migrate through the oilstick medium and deposit on the surface. A complete scientific investigation is beyond the scope of this research.

STORAGE

In 2002, the paper conservation department at the NGA evaluated the storage conditions of the Serra screen prints in the collection. Upon acquisition, the screen prints were housed in folders with cover sheets and stacked one on top of another in flat files. Over time, the cover sheets—made of purified wood-pulp paper—stuck to the surface of the tacky oilstick, and oil stains were observed on the folders. Alternate vertical storage options were rejected because of limited space. At this time, the prints were rehoused in folders with silicone release paper on top and polyester film beneath, where they remain to the present day (Karnes and Walsh 2002).

This study aimed to devise optimal storage for the oilstick prints through a review process of storage and handling practices at other institutions. A survey, conducted at museums and private collections, found a range of storage environments.⁷ Housing methods included:

- Paperboard boxes (Each print was stored individually in a paperboard box with a paperboard lid.)
- Folders (Prints were stored in folders with interleaving papers and stacked in flat files.)
- Frames with glazing (glass or acrylic sheets)
- Frames without glazing
- Frames without glazing, covered with:
 - plastic sheeting wrapped around the frame
 - a paperboard box lid
 - a paperboard box lid with air-permeable inserts
 - an acrylic box lid with vents

Fatty acid efflorescence on the print and/or hazing on the cover sheet or glazing was observed more frequently when the print was covered or enclosed. Of 46 oilstick works examined, 13 works enclosed in frames with glazing or stored in folders had fatty acid efflorescence. Eight impressions of the 1985 *Clara Clara II* were examined in three different types of housing: paperboard boxes, frames covered with plastic, and folders in flat files. The prints had varying degrees of efflorescence, but the print covered with plastic had the most visible and disfiguring deposits.

As part of this study, an experiment was designed to produce the exudate that could develop into the white crystalline deposits similar to those seen on the Serra oilstick prints. Samples of oilstick from a stick of Shiva Jumbo Artist's Paintstick and from manipulated bricks were spread on glass slides. Some samples were covered with glass slips, and some were left uncovered (fig. 11). The slides were placed in an environmental chamber with cycling temperatures and constant humidity.⁸ White residues formed on the surface of uncovered oilstick samples and a white exudate (fig. 12) formed on the underside of the glass slips of those that were covered. Py-GCMS analysis verified the presence of free fatty acids in the exudate from the glass slip. This experiment, while preliminary, informed housing methods.

Storage solutions needed to meet several criteria to mitigate condition issues. Appropriate housings would:

- Prevent dust, dirt, and lint accumulation.
- Prevent physical damage to the oilstick surface and paper support.
- Provide air exchange. Oxygen is needed to promote cross-linking of oils in the oilstick. In addition, semi-volatile free fatty acids will continue to migrate from the oilstick, and

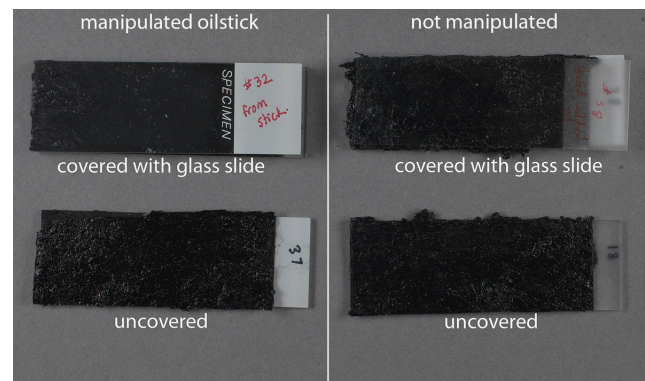


Fig. 11. Oilstick samples applied to glass slides. Slides were placed in an environmental chamber and exposed to fluctuating temperatures and high relative humidity.

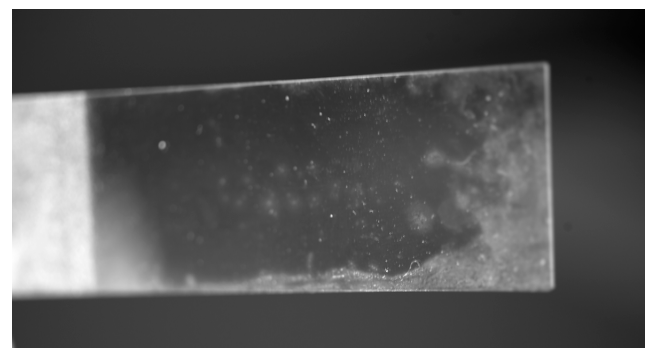


Fig. 12. White exudate formed on the underside of the glass slide covering an oilstick sample.

air movement may reduce their deposition on the print surface (Maines 2012).

- Stabilize temperature and relative humidity. Environments with high heat, high humidity, or cycling temperatures induce hydrolysis and promote fatty acid crystal formation (Williams 1989).
- Provide flat storage. Flat storage can prevent sagging of the paper support. If the print is stored vertically, its weight must be fully supported.

These considerations were kept in mind when preparing two screen prints, *Clara Clara I* and *Muddy Waters*, for storage after exhibition in 2011. The prints were attached to backing boards with Japanese paper hinges, which were adhered with wheat starch paste and distributed evenly around the perimeter of each print.⁹ The framed prints were fitted with custom breathable covers to protect the artwork from dust, dirt, and physical damage (fig. 13).

Custom crafted by NGA framers, each lightweight, sturdy cover fits over the frame, providing approximately five inches of air space above the artwork. The perimeter of the cover is constructed from corrugated paperboard and paper honeycomb panel; both are lightweight materials that provide structural stability over long expanses. Honeycomb panel, which is attached to the interior of the cover and rests against the face of the frame, offers extra stability. The center of the cover is constructed with MicroChamber paper with the carbon side facing away from the art and is reinforced on the exterior with a honeycomb panel cross brace. Microchamber paper was chosen for its ability to allow air to permeate the art and facilitate the drying process of the oilstick. Additionally, the MicroChamber paper may trap volatile fatty acids migrating from the oilstick and prevent deposition on the surface.

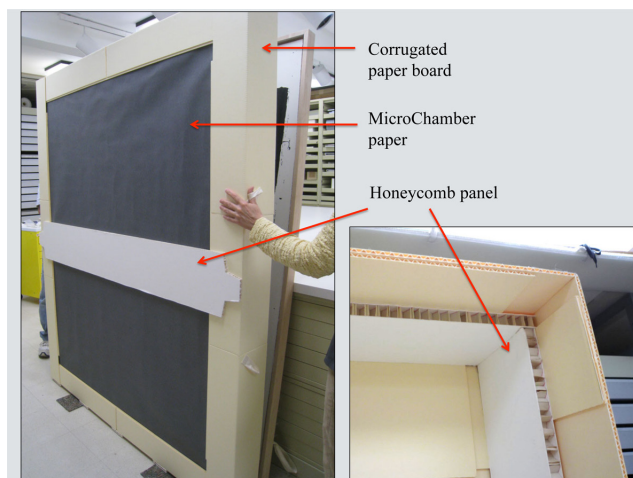


Fig. 13. Left: Custom fitted cover for a framed oilstick screen print. Right: Detail of the interior. Honeycomb panel lines the interior and rests against the face of the frame.

The two prints, now covered, hang vertically on screens in storage. Because of the heavy media, the prints may sag over time. Their condition will be monitored periodically. Space constraints dictate that the other prints in the collection remain in the flat files. Ideally, each print would be stored flat on a shelf or in its own drawer with a permeable covering.

CONCLUSIONS

Richard Serra and Gemini G.E.L. created unique and experimental prints with characteristics that are unlike those of traditional screen prints. This storage survey of oilstick works in museum collections across the country informed decisions about storage of the oilstick screen prints in the National Gallery of Art's collection. Appropriate storage environments should mitigate condition issues associated with the oilstick screen prints. The following are suggestions for storage based upon this research:

- Store each print individually on a flat surface.
- Cover with a permeable material. Provide air space above the artwork.
- Stabilize temperature and relative humidity.

ACKNOWLEDGMENTS

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NOTES

1. www.nga.gov/gemini/home.htm. Many entries in the Catalogue Raisonné may be incomplete.
2. The Shiva Brand was founded by Ramon Shiva in the 1920s. The company was sold in the 1960s and ownership of the Shiva and Paintstik trademark has since transferred between many companies: Standard Brands Paint Company (SB), Delta Technical Coatings, Dick Blick, and Markal/LA-CO Industries. In 2002, Jack Richeson purchased the formulations and the trademarks and now manufactures the Shiva Artist's Paintstik. LA-CO Industries continues to make the Markal Standard Paintstik, though this product is for industrial and agricultural use and does not utilize the same quality of pigments

as the artist sticks. More information about LA-CO Industries and the Standard Paintstik can be found at www.laco.com/documents/lacoindustries_75anniversary.pdf. Michael Skalka, National Gallery of Art, and Darren Richeson, Richeson and Co., Inc. 2013. Personal communication.

3. *Double Black*, 1991, NGA 2000.177.102. See Gemini G.E.L. Catalogue Raisonné entry.

4. XRF analysis was performed by Aniko Bezur at The Menil Collection prior to the exhibition *Richard Serra Drawings: A Retrospective*, March 2–June 10, 2012.

5. 3M product #950, 5mm high-tack adhesive transfer tape. Gemini G.E.L. Online Catalogue Raisonné.

6. Dr. Aniko Bezur identified the efflorescence sampled from an interleaving sheet on a Serra oilstick drawing using FTIR. Results suggest the presence of a compound related to palmitic acid. Palmitic acid may be present, but some aspects of the spectrum suggest that a soap of palmitic acid is present, rather than palmitic acid itself. Smaller quantities of stearic acid are also possibly present.

7. Many thanks to the conservators, curators, and registrars at the following institutions: Bergen Art Museum; Colby College Museum of Art; Cranmer Art Conservation; Gemini G.E.L., Glenstone; Harvard Art Museums/Fogg Art Museum; Hirshhorn Museum and Sculpture Garden; Los Angeles County Museum of Art; Museum of Fine Arts, Boston; National Gallery of Art; Princeton University Art Museum; The Art Institute of Chicago; The Baltimore Museum of Art; The Brooklyn Museum of Art; The Getty Research Institute; The Metropolitan Museum of Art; The Museum of Contemporary Art, Los Angeles; The Museum of Modern Art; and The Philadelphia Museum of Art.

8. The experimental design was based on the experiment performed by B. Rimer et al (1999). Oilstick samples were prepared in replicates of three and exposed to temperatures cycled from 4°C to 38°C at 85% relative humidity for a period of two weeks.

9. In some cases, wheat starch paste cannot be adhered to the coated papers or onto prints where oilstick extends to the edges. Heat set or emulsion adhesives such as BEVA or Lascaux can be used.

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Treatment and Housing Techniques for Pastel Paintings on Paper: Case Studies

INTRODUCTION

Pastel paintings mounted on wooden stretchers are vulnerable to tears and punctures. On the other hand, those adhered to paperboard can warp or become vulnerable to breakage over time. In both cases, pastel works are generally prone to scratches, abrasions, mold damage, and water damage if not properly housed. This paper presents case studies dealing with various pastels mounted on wooden stretchers and paperboard. The object of the paper is to present various approaches for unique treatment and housing situations that may be applicable to other types of pastel works. The first half of the paper discusses various treatment techniques used on pastel works by Micah Williams. The second half discusses a variety of housing solutions developed for works by Micah Williams, Edgar Degas, and Mary Cassatt. The techniques described are the result of the cumulative efforts and experience of many conservators and technicians at the Conservation Center for Art and Historic Artifacts (CCAHA) and of others in conservation who have contributed to the current knowledge about treatment and housing standards and methods for pastels.

PART 1: TREATMENT OF MICAH WILLIAMS'S PASTEL PORTRAITS

This discussion of the treatment of pastels focuses on the pastel works of Micah Williams (1782–1837). This focus owes to the unique format of Williams's pastels, which presents particularly challenging treatment issues. During the past 10 years, conservators at CCAHA have also gained collective insight into Williams's pastels by treating many them in preparation for the 2013 exhibition, *Micah Williams: Portrait Artist*, at Monmouth County Historical Association.

Micah Williams was an American folk artist, mostly known for his pastel portraits of New Jersey and New York

residents. He was originally a silver-plating craftsman, but after a series of misfortunes with his business, he sought out a second career as a self-taught portrait artist (Rogoff 2013). His pastel works were composed with materials that he could afford as an itinerant artist between 1815 and 1835. Williams used wove or laid paper as his primary support for painting, loosely lining it with a secondary support of local newspaper. He glued both supports onto a simple half-lap-joint wooden stretcher. He prepared his paper panels before making trips and used the panels within approximately one year of making them (Rogoff 2013). His use of newspaper as a secondary support is interesting. For Williams, newspaper was an easily accessible and inexpensive material; for later scholars and collectors, it is an important resource for studying the provenance of each painting.

PREPARATION FOR TREATMENT

During treatment, Williams's pastel paintings are usually unframed vertically on a slanted easel, working from the verso. Both the top and bottom of the frame are wrapped with strips of *Vólara* (a flexible closed-cell polyethylene foam) when fastened into the easel. This improves the grip and ensures that the frame does not get scratched on pressure points of the easel. Any shims between the wooden stretcher and the frame are also carefully removed before taking the stretcher from the frame.

Although this is not ideal, when there are tears to mend from the verso, the Williams pastels mounted on wooden stretchers are placed face-down on a horizontal table surface. Because both the primary and secondary supports are constructed from fragile old paper, there is no other safe way to work from the verso. These pastels were also already in direct contact with glass in the frame, and parts of the soft media may already be transferred or compacted to some degree. To minimize further media loss during treatment, a sheet of Bondina (a very smooth, nonwoven polyester release material) is placed between the pastel surface and the table when placing the object face-down. Glassine is a poor substitute for Bondina since glassine can be locally wrinkled or distorted

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from body heat and moisture transmitted to the object during treatment. Such wrinkles and distortions in the glassine can cause unnecessary damage to the media. After gently laying the pastel and its stretcher face-down on the Bondina, the wooden stretcher is secured by placing heavy weights against (not on top of) its four members, ensuring that the pastel does not shift sideways during treatment.

When the pastel must be treated from the recto, a temporary supporting insert is placed underneath the painting. This insert matches the inner height of the wooden stretcher, providing a flat and firm surface to work against when inpainting or performing other surface work. The insert can be made of two or three layers of corrugated board with a sheet of silicone-release polyester film as a facing. If needed, an armrest that bridges the pastel is built from a Plexiglas strip raised on weights. This gives the conservator a place to safely brace her arm while inpainting distant areas of the pastel.

MENDING

Three different kinds of adhesive are used to mend the different areas of Williams's pastels. If tears in the primary support are not approachable from the verso, the newspaper lining is cut and opened in order to mend the primary support, and the cuts in the newspaper are mended with very thin mending strips afterwards.

Klucel-G Pre-Coated Paper

Tears located in the inner areas of the pastel painting (i.e., areas that are not in contact with the wooden stretcher) are mended with thin strips of Klucel-G pre-coated paper from the verso. For this use, Klucel-G has several advantages over other adhesives. First, it adheres only by evaporation of ethanol and does not require the use of weights; secondly, it does not shrink as it dries; and thirdly, it is tacky enough to hold the tears but weak enough to hold together very fragile paper supports without causing tension.

The Klucel-G mending tissue is prepared using the following process, which is a modification of a procedure developed for other adhesives (Brückle 1996):

1. Lay a sheet of polyester film on a table.
2. Lay a sheet of inert plastic screen mesh material over the polyester film.
3. Apply a lump of 3–5% Klucel-G in ethanol to the screen mesh and evenly distribute the adhesive through the screen mesh using a rubber or plastic squeegee.
4. Slowly lift the screen mesh, tilting it from one side to the other before lifting so that the Klucel-G layer is not disturbed and remains even.
5. Hold a sheet of mulberry paper at opposite corners, slowly laying it down on the Klucel-G layer from the center out.
6. Completely air-dry the adhesive.

7. For mending, cut the prepared tissue into narrow strips. As needed, peel them from the polyester film and reactivate the adhesive by rolling a swab soaked with ethanol over it. Apply the mend to the verso of the tear with minimum pressure and let it dry.

Inexpensive, variously gauged black screen mesh for insect-proofing is readily available at most home-improvement centers. The gauge of the screen mesh affects the thickness of final Klucel-G layer; the wider the mesh, the thicker the adhesive layer will be and the stronger the bond it will provide. Also, the percentage of Klucel-G in ethanol affects the final bonding strength. When mixed to 3% in ethanol, Klucel-G makes for somewhat weak bonding, whereas 5% Klucel-G may be quite strong, and 4% appears generally versatile in terms of bonding strength and reversibility.

Wheat Starch Paste

Tears in the support located around the edges of the wooden stretcher are mended with wheat starch paste and lightweight mulberry paper strips. These tears require physically strong mends since they have to wrap around the wooden stretcher. Once the mends have been applied, they are quickly dried with the aid of a warmed metal spatula over silicone-release polyester film, so weights are not necessary. The mending strips are guided underneath the primary support with thin strips of polyester film. If the areas are too tight to allow a mending strip to be inserted, a very thin face mend can be applied to the top surface as a last resort.

Lascaux 498 HV Pre-Coated on Tengujo

Tears in the secondary support or newspaper lining are mended with Lascaux 498HV pre-coated on tengujo and activated with ethanol. Klucel-G cast on lightweight mulberry paper can be used instead, but the result is less transparent, as Klucel-G is harder to cast on tengujo. The preparation of Lascaux 498HV pre-coated tissue and its application methods are described in detail in the article "Practical Application of Lascaux Acrylic Dispersions in Paper Conservation" (Sheesley 2011).

INPAINTING

Pastel paintings may exhibit a wide variety of surface characteristics, even on a single object: some areas are dense and flat, while others are fluffy and soft. Such variation is often intended by the artist to create various effects. As a result, several inpainting materials and techniques are needed to effectively address these surface characteristics. Inpainting can be used not only to fill losses in the pastel media but to cover untreatable stains of various sorts (mold stains, foxing stains, water stains, etc.), since aqueous treatment options are extremely limited.

Ground Pastels Mixed in Ethanol

Soft pastel sticks are rubbed with sandpaper, and the resulting powder is mixed with ethanol to form a solution. This solution is then applied to the surface of the pastel with a double-zero brush. If the applied pastel solution appears dense and solid, the spot is gently touched with the tip of a silicone-tipped blending tool to soften the surface. This action changes the texture and color of the inpainting. In addition, ground pastels mixed in ethanol can help hold down surrounding flaking media when the original pastel is severely desiccated and flaking.

Ground Pigments Mixed in Ethanol

For very fine scratches or for very flat surfaces, ground pure pigments can work better than ground soft pastels because their body is leaner, with no added binder or filler. Ground pure pigments are mixed with ethanol and applied with a double-zero brush.

Pastel Pencils

Pastel pencils are mildly abrasive, and are thus useful when the pastel surface is too hardened and burnished by previous water damage to effectively receive any of the inpainting media described above. In these areas, pastel pencils can be applied in short vertical lines in a manner similar to *tratteggio*.

Blending Tools

Pointed, silicone-tipped blending tools are useful for softening the applied inpainting media to help blend with their surroundings. The blending tool can also be used to gently touch certain stains, effectively creating just enough change in the surface texture and color of the stain that the need to add extra inpainting media is eliminated.

TREATMENT EXAMPLES

Tears Along the Edges

Tears often occur in the paper around the edges and corners of the wooden stretcher. These tears were mended with thin mulberry paper strips and wheat starch paste. When it was impossible to insert a mending tissue below the tightly wrapped edges, a thin face mend was applied to the top surface as a last resort (figs. 1a, 1b).

Mold Damage

Mold deposits were reduced as much as possible using a kneaded eraser molded to a fine point. The remaining stains were inpainted by applying ground pastels in ethanol with a brush (figs. 2a, 2b).

Water Damage and Flaking Media

Water-damaged areas were inpainted with ground pastel mixed with ethanol, as well as with pastel pencils. Ground pastel mixed with ethanol also worked well for inpainting the

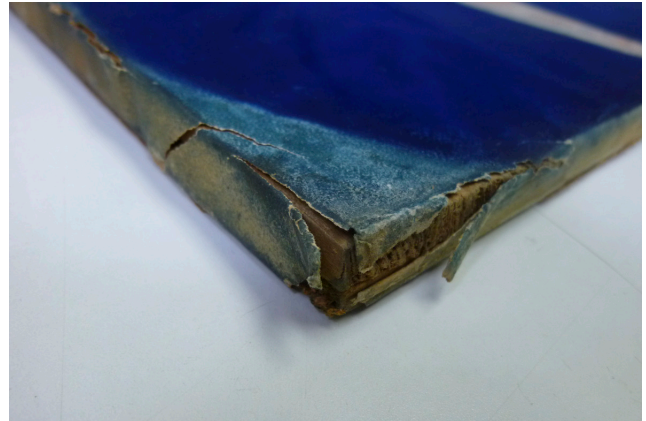


Fig. 1a. Tears around the corner of the stretcher before treatment

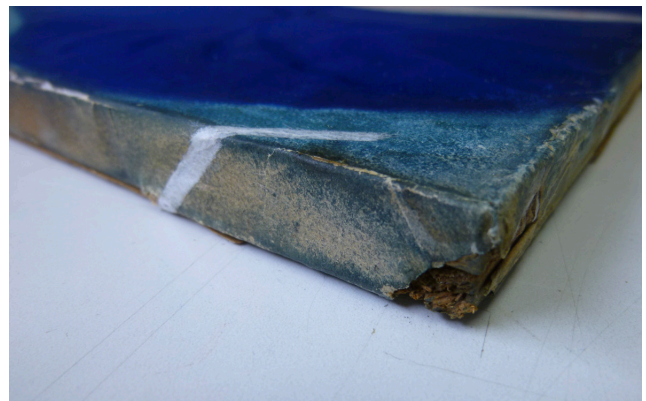


Fig. 1b. Mended tears around the corner of the stretcher after treatment

flaking brown media used in the girl's hair. The ground pastel functioned as both an inpainting medium and as a consolidant for the surrounding loose particles (figs. 3a, 3b).

Complex Tension Tears

This painting (viewed under raking light in fig. 4) suffered long, complex tears solely as the result of a fluctuating environment. As described in the book *Paper and Water*, paper that expands and contracts repeatedly eventually shrinks in size in result (Banik and Bruckle 2011). In this pastel painting, the edges of the paper were firmly glued to the strainer, while the free-standing areas shrank in the repeatedly fluctuating environment, eventually causing the weakest points to rupture. The tears were all in the primary support, and none in the loosely lined secondary support. The tears primarily occurred along the design of the girl's dress, where Williams used rather sharp pastel sticks to depict an elaborate lace design. The severely distorted surface of the paper in the torn areas made it impossible to mend the tears flat in their present condition.



Fig. 2a. Mold damage before treatment



Fig. 2b. Mold damage after treatment

Removing the pastel from the wooden stretcher was briefly considered, but it was determined that the possible gains from this approach were outweighed by the potential risks. CCAHA conservators had treated several Williams pastels in which prior removal procedures had resulted in over-manipulation and severe damage to the artworks. It was decided to find a way to mend the complex tears in situ.

To figure out an effective way of mending this distorted area, a mockup was created using a blank sheet of paper. Several cuts were made in the blank paper, mimicking the tears in the pastel painting, after which the paper was wetted with water and blown dry while the edges were weighted down. The tears sprang open, creating the same kinds of distortions present in the painting. In figure 5, the painting is face-down with the newspaper lining partially removed for treatment; the mockup sample is next to it, with similar tears. In testing, it was discovered that making three small incisions to connect the parallel tears effectively released the distortions



Fig. 3a. Water damage and flaking media before treatment. Private collection



Fig. 3b. Stain reduction and consolidated media after treatment. Private collection



Fig. 4. Complex tears viewed under raking light before treatment. Collection of the Monmouth County Historical Association



Fig. 5. Left: pastel face-down with newspaper temporarily removed. Right: paper mockup replicating complex tears



Fig. 6a. Recto of pastel after treatment. Collection of the Monmouth County Historical Association



Fig. 6b. Verso of pastel after treatment. Collection of the Monmouth County Historical Association

in the paper support, enabling the tears to lie flat for proper mending. The incisions in the pastel painting followed the contour of the existing design. After cutting the support, the tears lay flat, and they were mended with Klucel-G pre-coated mulberry paper and ethanol from the verso.

After mending, the gaps between the edges of the tears were substantial, almost 1/16- to 1/8-inch wide in some areas. Cellulose powder mixed with methylcellulose was tested as a medium for filling the gaps, but this filler was too stiff and bulky to accommodate the surrounding soft pastel media. In the end, it was found that ground pastel mixed with ethanol could also act as filler for the gaps, as it provided enough bulk without causing any stress to the surrounding pastel medium. Finally, the newspaper lining was reattached in its original position with thin mends prepared from Lascaux 498HV pre-coated tissue and activated with ethanol (figs. 6a, 6b).

PART 2: HOUSING

This section of the paper shares the approaches used to house four pastels by different artists. There were four goals in creating each of the following housings:

- To provide the best possible protection from environmental agents of deterioration while minimizing the amount of maintenance required,
- To minimize disturbance of the friable media,
- To design a stable and supportive enclosure for each type of construction, and
- To utilize the existing frames.

The following examples presented similar challenges but are addressed individually here because of the construction of their supports. Most notably, the spacers for each object were built to accommodate its unique structure while creating the necessary airspace between the glazing and the surface of the pastel.

COMMON HOUSING ELEMENTS: ENCLOSURE

Although the spacers and the attachment of the artworks were unique for each housing design, the remaining components—the glazing, backing boards, and barrier film that create an enclosure within the frame—are common to all of the examples. They were intended to support the pastels physically while buffering them against environmental concerns.

Tru Vue Optium Museum Acrylic was chosen as the glazing for each piece because it offers ultraviolet protection, resistance to breakage, an antireflective coating, and an anti-static coating that will not attract particles of the pastel to the acrylic surface.

The rigid protective backing boards included a sheet of Bainbridge Alphasag Artcare alkaline buffered ragboard with zeolites, directly behind the object, and a sheet of Archivart

alkaline multiuse corrugated paperboard for added rigidity. The alkaline ragboard with zeolites was chosen to aid in neutralizing and absorbing acidic compounds released into the package from the aging of the object itself. Use of this material in housing at the Conservation Center has been informed by the work of Seigfried Rempel (1996) and by Cindy Connelly Ryan's studies at the Library of Congress (2011).

The contents of each housing were enclosed with Marvelseal, an aluminized nylon and polyethylene barrier film. A sheet of this film was wrapped around all layers of the housing and bonded to the surface of the acrylic with Scotch brand #415 tape and heat in a manner similar to that developed by Hugh Phibbs (2002) at the National Gallery of Art in Washington, DC. This method is an effective barrier to dust and insects and helps to passively buffer environmental change.

A private client had four framed packages of this construction—containing pastel portraits on paper stretched on wooden stretchers—in the basement of his home during flooding from Hurricane Sandy. The packages are estimated to have been in water for 72 hours. During that time, two of the framed pastels floated and did not leak and two developed minor leaks. These were successfully treated, rehoused, and returned to the client (Client 2012). These packages are not intended to be waterproof, but the protection offered by this housing method helped to minimize the impact of the damage.

FRAME ALTERATION

The reuse of the existing frames offered a recurring challenge in housing the four examples. In three cases, the previous framing left little room around the pastels, either for the expansion of the paper or for the addition of new housing. Frame alteration proved to be necessary in two of the four cases to retain the use of the original frames.

CASE STUDIES

Pastel on Paper

James Martin's 1818 portrait of Garrison Wright is in the collection of the Monmouth County Historical Association in Freehold, New Jersey (fig. 7). Its primary support is a single sheet of Western paper with irregular edges. Before treatment, the pastel suffered from tide lines due to moisture, abrasions from proximity to the glazing, and buckling from a restrictive frame size. Prior to housing, a paper conservator flattened the pastel and reduced the appearance of the tide lines with pigments in ethanol.

The spacers for this object created the necessary airspace between the surface of the work and the glazing, and minimally overlapped the irregular edges of the paper support. They were created from stacked alkaline multiuse corrugated paperboard that was wrapped with alkaline 100% rag paper containing zeolites. The rag paper was toned with washes of



Fig. 7. James Martin's *Portrait of Garrison Wright* before housing. Pastel on wove paper, ca. 1818. 60 x 45 cm. Collection of the Monmouth County Historical Association



Fig. 8. Diagram of the layers of the housing package for Martin's *Portrait of Garrison Wright*. From top to bottom: glazing, spacers, pastel, rigid backing boards, and barrier film that wraps around to the front of the glazing

professional-grade acrylic paints and attached to the spacers with acid-free double-sided polyester tape. The artwork and the spacers were attached to the backing board with individual sets of mulberry paper and wheat starch paste hinges before the glazing and Marvalseal were added to complete the enclosure (fig. 8).

The tight original frame had caused the paper support to buckle when it expanded naturally in response to elevated humidity. As a result, alteration of the existing frame to facilitate its reuse was discussed with the curator. A frame conservator routed out the rabbet of the frame, removing a section of wood behind the lip, to allow for more interior height and width. He then added a second wooden frame to the back, which increased the available depth of the rabbet and offered support for the increased thickness of the new housing (fig. 9).

Pastel on Paperboard

Group of Dancers by Degas is in the collection of the Barnes Foundation in Philadelphia (fig. 10). It was created on three pieces of wove paper that were mounted to a paperboard secondary support. Before housing, a paper conservator consolidated small breaks in the paper fibers along the edges of the artwork and minimally retouched some areas of pastel where it had been disturbed by the previous housing.



Fig. 9. Diagram of frame profile and alteration for Martin's *Portrait of Garrison Wright*. The section below the lip of the frame was removed and a wooden buildup was added to the back.



Fig 10. Edgar Degas's *Group of Dancers* after framing. Oil pastel on wove paper mounted to paperboard, ca. 1900. 57.8 x 41 cm. Collection of the Barnes Foundation



Fig. 11. Diagram of the layers of the housing package for Degas's *Group of Dancers*. From top to bottom: glazing, spacers, pastel, rigid backing boards, and barrier film that wraps around to the front of the glazing

For this object, a set of shaped spacers was created from stacks of alkaline multiuse corrugated paperboard, each with an angle cut into its base. The angle fits against the edge of the pastel and will hold the paperboard secondary support against the backing boards without disturbing the surface media (fig. 11). The spacers were wrapped with toned rag paper containing zeolites and attached to the backing with mulberry paper and wheat starch hinges. After construction of the spacers, the pastel was also hinged to the backing board and enclosed with the glazing and Marvelseal. Since it had previously been a tight fit, the existing frame was altered by a frame conservator to allow room for the new housing.

Pastel on Stretched Paper

Micah Williams's 1821 portrait of John Samuel Holmes is also in the collection of the Monmouth County Historical Association (fig. 12). As is typical with many examples of this artist's work, the pastel was created on wove paper, lined with newspaper, and mounted on wooden stretchers. It exhibited numerous tears and losses that were treated by paper conservators prior to housing.

Two sets of spacers were necessary in this housing design (fig. 13). The first set was constructed from strips of alkaline multiuse corrugated paperboard placed around the perimeter of the wooden stretchers to contain their depth and compensate for any warping. These first spacers also supported the second set, which created space in the housing between the surface of the pastel and the glazing. These were created from hollow acrylic tubing wrapped with acrylic-toned rag paper. As in the previous examples, each set of spacers was attached to the backing board with mulberry paper strips and wheat starch paste. The artwork was held securely in place by the spacers and did not require any further attachment. The housing was then glazed and enclosed with the Marvelseal barrier film.

In this case, the existing frame was a bit large for the piece alone and the artwork had been shimmed into place by the previous framer. The new housing was sized to fit the existing frame height and width to facilitate reframing.

Pastel on Stretched Paper

The Mary Cassatt portrait of Ellen Mary Cassatt titled *The Pink Sash* was brought to the Conservation Center by a private client (fig. 14). The construction of its support was somewhat unique, in that the wove paper primary support was stretched around onto the back of the wooden stretchers and a paperboard panel was glued to the primary support on the verso, covering the hollow formed by the stretchers. Although there was very little space in the frame to accommodate an appropriate housing, it was decided not to alter the existing frame.

Because of the support's construction, wheat starch paste and mulberry paper hinges were attached to the top and sides of the existing paperboard backing, and those hinges were wrapped to the verso of the new backing boards and attached.



Fig. 12. Micah Williams's *Portrait of John Samuel Holmes* after framing. Pastel on wove paper on a wooden strainer, ca. 1821. 66.4 x 56.2 cm. Collection of the Monmouth County Historical Association

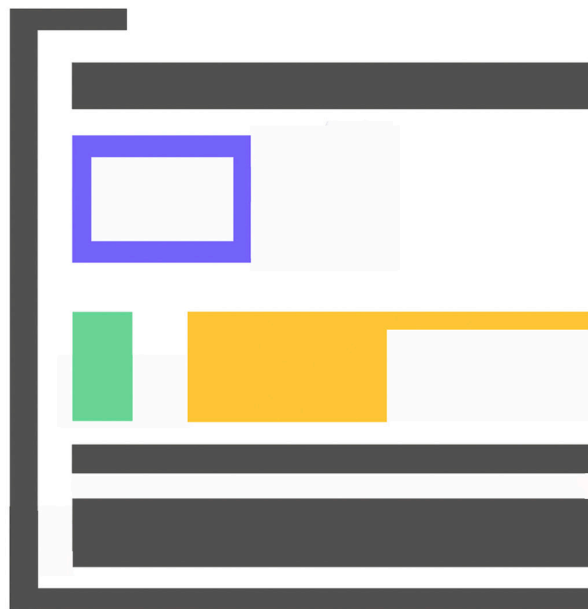


Fig. 13. Diagram of the layers of the housing package for Williams's *Portrait of John Samuel Holmes*. From top to bottom: glazing, spacers, spacers around the pastel, rigid backing boards, and barrier film that wraps around to the front of the glazing



Fig. 14. Mary Cassatt's *The Pink Sash* (Ellen Mary Cassatt) during housing, after construction of the tray and before glazing. Pastel on wove paper on a wooden strainer, ca. 1898. Private collection.



Fig. 15. Diagram of the layers of the housing package for Cassatt's *The Pink Sash* (Ellen Mary Cassatt). From top to bottom: glazing, tray sides around the pastel, rigid backing boards, and barrier film that wraps around to the front of the glazing

This approach will prevent the pastel from moving forward in the housing, towards the glazing. Tall, thin spacers of acrylic-toned Bainbridge Artcare 12-ply alkaline rag board could then be created, which did not cover the edges of the pastel's face and added very little thickness to the overall dimension of the housing (fig. 15). The spacers were attached to verso of the backing boards with mulberry paper hinges, forming a tray that enclosed the object and held the glazing off the surface within the Marvelseal enclosure.

CONCLUSION

Pastels on paper supports are subject to a range of issues that may complicate treatment and housing approaches. Their friable media and fragile supports often make them difficult to work with. They are also vulnerable to condition issues that can arise from handling, storage, and display, which necessitates a variety of treatment and housing approaches based on the nature of the damage and the object's individual construction. These examples of the treatment and housing of pastels with typical condition issues were shared in the hope that they may be applicable to other pastel treatments.

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Watermark Capture and Processing with Contemporary Desktop Applications

ABSTRACT

The *Calendarium*, written by Johannes Regiomontanus ca. 1474 and printed in Nuremberg the same year, is part of the Rosenwald Collection in the Rare Book and Special Collections Division at the Library of Congress. This book is a superb example of block book printing, and is essentially a picture book in which the text and image were carved in relief into a block of wood, inked, and then pressed against paper, leaving an impression of words and pictures. Block-book printing emerged in the 15th century as a form of duplication for the purpose of educating a semi-literate population, in much the same way that stained glass windows rendered the lives of the saints to a religious congregation. In this case, Regiomontanus's scientific observations were intended for an audience of astronomers and astrologers. Block books were originally thought to be the precursor of printing with movable type, but modern research has indicated that these scarce books were created during the same period in which Gutenberg introduced printing to Western Europe.

This block-book edition of the *Calendarium* is printed on 31 leaves of paper, some of which contain watermarks indentifying the paper mill that produced the paper. These watermarks are important to researchers interested in establishing the dates on which various sections of the calendar were printed. Watermarks present on the pages were heavily obscured by diagrams and text, so various techniques were employed utilizing desktop applications to enhance the watermarks for ease of viewing and identification. Initial spectral imaging (reflected and transmitted) captured information in 14 wavebands; the registered images were then stacked and run through a simple principle component analysis (PCA) algorithm to enhance variation between text, diagrams, and paper. Selected PCA bands were then imported into Photoshop layers, and hue, saturation, and brightness changes were made to generate the best composite image. The overlying text was

changed to match the background in tone and coloration. Hue changes included changing reds to yellow, changing blue text to gray to decrease the saturation, and darkening greens. The Photoshop draw tool was then used to connect the segments and reveal the watermark. If watermark sections were on different sheets, these were stitched together to form a rendering of the complete watermark. Similar watermarks could also be overlaid in Photoshop to check for changes in the mold. Four distinct watermarks and variations were captured. In addition, the processing revealed a section of hidden printed text in the gutter of the folio, with the same text present on a number of folio sheets. This technique allows conservators, curators, and researchers to capture and easily manipulate and process watermarks using contemporary software tools, for improved provenance of historic book and paper materials.

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Testing the Waters: New Technical Applications for the Cleaning of Acrylic Paint Films and Paper Supports

ABSTRACT

New techniques for cleaning acrylic emulsion paint surfaces continue to emerge in the practice of contemporary conservation. The discipline is currently in the process of identifying problematic first-generation practices, pursuing improved and alternative treatments, and framing a dialogue to guide future innovations. This paper will present four case studies that illustrate a new aqueous cleaning system for acrylic paint films on paper supports. It will also address this system's potential to treat discolored paper and board.

Driving this evolution in practice is acrylic works' sensitivity to aqueous cleaning methods. Paint film swelling and surfactant or pigment disruption are two primary risks conservators regularly face when cleaning acrylic works of art on paper. The aqueous cleaning system discussed in this paper mitigates these risks by using pH and conductivity meters to test acrylic paint surfaces and to create customized aqueous cleaning solutions—a technique demonstrated at the 2011 Cleaning of Acrylic Painted Surfaces workshop.

Examples of this system will be presented in the treatment of four works. The first case study uses Paula Rego's *In the Garden* (1986), an acrylic painting on paper with embedded dust and dirt. This study will demonstrate the necessity of adapting the cleaning system to diverse pigments and color mixtures, due to their idiosyncratic responses to water. The second case study, *Maquette for Smoking Cigarette Relief* (1983), by Tom Wesselmann, will demonstrate the technique as applied to the removal of active mold growth and associated staining. The final two studies will present successful treatment of stained and discolored paper supports through the use of conductivity and pH adjustment.

TESTING THE WATERS

In 2002, conservators and conservation scientists from the Getty Conservation Institute in Los Angeles, the Tate in London, and the National Gallery of Art in Washington, DC, undertook a groundbreaking collaboration on the study of modern paints. The project was to incorporate three strands of research: assessing analytic methods, studying the physical and surface properties of modern paints, and evaluating cleaning methods for modern paintings.¹ Since 2006, the year of the landmark Modern Paints Uncovered symposium, many more institutions and individual researchers have joined the initiative, contributing numerous technical studies to the subject (Learner et al. 2007).

Throughout this decade of intense study, the conservation community has faced a key challenge: bridging the gap between research and practice (Ormsby and Learner 2009). Many practicing conservators have felt—and continue to feel—unprepared to treat soiled acrylic paint films without a green light from conservation science. On the other hand, scientists are unable to further their investigations without feedback from conservators involved in hands-on treatment. To this end, an investigatory colloquium, Cleaning of Acrylic Painted Surfaces: Research into Practice (CAPS), was held in the summer of 2009 at the J. Paul Getty Museum.

The colloquium incorporated lectures and experimental, hands-on cleaning trials, and was facilitated by several leading figures in the fields of scientific research and paintings conservation. The colloquium has since developed into an annual CAPS workshop. Tiarna Doherty, Tom Learner, Bronwyn Ormsby, Alan Phenix, Chris Stavroudis, and Richard Wolbers have all participated as instructors. Since 2011, the CAPS workshop has introduced greater numbers of conservators to new cleaning systems, while gathering empirical observations in order to further the dialogue between theory and practice.

THE CHALLENGE OF CLEANING ACRYLIC PAINT FILMS

The components of acrylic emulsions are complex and often proprietary, leaving conservators and conservation scientists

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with an imprecise understanding of their chemical makeup. The ingredients of wet acrylic emulsions typically include water (around 65% volume), acrylic polymer, pigments, surfactants, dispersants, biocides, thickeners, and inorganic components, as well as other materials added by artists (Hayes et al. 2007). Paint composition varies from brand to brand, and even from pigment to pigment. Therefore, colors react differently after aging and during cleaning.

Of all these ingredients, surfactants—which stabilize particles floating in the wet emulsion—have garnered the most attention from conservators and conservation scientists. Surfactants migrate to the surface of aging paint films because their unique structure attracts them to the air-water interface. At the surface, surfactants contribute to the problematic character of porous acrylic paint films by creating a coat that readily attracts and imbibes dirt.² Moreover, the small particle size and ready solubility of surfactants contribute to their easy leaching and removal from the paint film during cleaning (Ormsby et al. 2008). Furthermore, surfactants may leach into absorbent substrates from the verso, possibly altering the physical properties of aging acrylic works on paper. However, the effects of this process on the durability of paint films have not yet been explored.

To date, the majority of scientists agree that there is no apparent long-term implication for the removal of surfactants during cleaning.³ By the time the paint film is dry, surfactants have performed their function—the stabilization of particles floating in wet acrylic emulsion. Still, many conservators are legitimately wary of removing original material. Changes to the film on the microscopic scale after aqueous cleaning have been reported (Zumbuhl et al. 2007). To this end, the CAPS aqueous cleaning system mitigates removal of surfactants and other leachable materials during cleaning.

Primary considerations for the cleaning of an acrylic paint film are either immediate—such as swelling and changes in gloss—or have the potential to manifest as future damage, as in the case of paint embrittlement. Conservators are well equipped to manage immediately visible concerns by testing on a micro-scale. However, it is difficult to predict the long-term results of cleaning treatments, especially wet-cleaning treatments.

According to conservators participating in a self-selected survey, acrylic paintings are commonly cleaned with such tools and solvents as sponges, erasers, saliva, distilled water (with or without added surfactant), and aliphatic and aromatic hydrocarbons (Murray et al. 2002). The CAPS aqueous cleaning system adds a safer, more finely tuned technique to the paper conservator's tool box: a method for adjusting distilled or deionized water to the approximate pH and conductivity of the acrylic's surface in order to alleviate swelling and leaching through the use of an isotonic cleaning solution.

Table 1.

2% (w/v) Agarose gel recipe
100 mL deionized water 2.0 g Agarose Type VII, low gelling temperature 2 drops of the preservative Germaben II (optional)
<ul style="list-style-type: none"> - Heat 100 mL of deionized water to 198°F. - Remove from heat and stir in 2.0 g of agarose powder. - Stir by hand until all powder has incorporated and there are no lumps (roughly 5–10 minutes). Replace on hot plate as needed to keep the temperature constant. - Cool to approximately 140 degrees Fahrenheit, then stir in 2 drops of Germaben II for a longer shelf life. - Immediately pour the mixture into 4 sterilized Petri dishes and allow to cool until gelling is complete, roughly 20 minutes. - For use on paper supports, increase the weight of Agarose to make a 4% or 5% w/v gel. Highly concentrated gel delivers moisture at a significantly reduced rate, consequently mitigating or eliminating the formation of tide lines around the test area.

SAMPLING PH AND CONDUCTIVITY OF ACRYLIC EMULSION PAINT FILMS

In this system, pellets of agarose gel are used to evaluate the surface pH and conductivity of an acrylic emulsion film.⁴ Agarose powder is mixed with pure water over heat, transferred to a Petri dish, and cooled until the liquid forms a gel. The recipe for 2% (w/v) agarose gel is provided in table 1. Cylindrical pellets are then extracted from the cooled gel using a 3 mm biopsy punch, which allows for precise and gentle handling of the pellets.

At room temperature, individual agarose pellets are applied to a paint film and allowed to rest on the surface for 45 seconds (fig. 1).⁵ The pellets imbibe the soluble components of the paint film during contact with the surface of the painting by diffusion and capillary action, which shifts their pH and conductivity closer to that of the paint film. While it is possible to perform the sampling more quickly using a droplet of deionized water, this method often results in aggressive localized swelling at the test site. Slower-acting agarose pellets, however, hold moisture in check and do not cause significant swelling.

Two devices from Horiba Scientific are used to analyze the agarose pellets: the B-171 TWIN conductivity meter and the Laqua pH Tester. These pocket-size, user-friendly meters accommodate sampling through immersion in a solution or by a single drop of liquid placed on a flat sensor. For analysis, the 3 mm pellet of agarose is placed into the well of the conductivity meter using blunt tweezers. Using the tweezers, the pellet must be carefully pushed to the back of the meter to allow direct contact with one of the two black sensors.



Fig. 1. An agarose pellet resting on the surface of an acrylic paint film

Table 2. pH and Conductivity Readings from *In the Garden* by Paula Rego, July 12, 2012

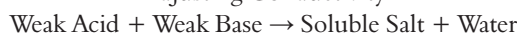
Color	pH	Conductivity ($\mu\text{S}/\text{cm}$)
Control pellet	5.5	40
Deionized water droplet (on black)	6.3	1750
Black	5.6	1330
Dark green	6.2	780
Light green	6.2	130
Red	6.2	380
Orange	6.0	100
Blue	5.8	1120
Brown (A)	6.0	80
Brown (B)	6.0	90

The tweezers must not come in contact with the sensitive glass sensors during this procedure. After placing the pellet, the conductivity may be read and recorded as in table 2. To test pH, the same pellet is then carefully transferred to the pH meter. The pH meter has a different sensor configuration and requires the pellet to be read wet, meaning that a drop or two of deionized water must be added to the well along with the pellet. The deionized water facilitates diffusion—in other words, the release of soluble components into an aqueous solution readable by the Horiba meter. The addition of the deionized water at this stage will not significantly affect the pH of the pellet. After approximately one minute of equilibration time, the pH is read and recorded as in table 2. Ultimately, these readings will be used to formulate isotonic aqueous cleaning solutions.

THE TREATMENT WATERS: CREATING PH- AND CONDUCTIVITY-ADJUSTED AQUEOUS SOLUTIONS

The aqueous solutions presented here consist of three ingredients: deionized or distilled water, glacial acetic acid, and ammonium hydroxide. The CAPS workshop distributed the original recipes for the 12 stock solutions provided in tables 3 and 4. In theory, the formulas are simple, but in practice, they require time and patience to execute. Acetic acid (a weak acid) is first added to deionized water. Then ammonium hydroxide (a weak base), which reacts with the acetic acid to produce a soluble (and volatile) salt, is introduced to set the conductivity. Further addition of ammonium hydroxide raises the alkalinity of the solution to the desired pH.

Adjusting Conductivity



Trials have indicated that these recipes are not 100% reproducible. Factors including the shelf life and potency of the component chemicals will affect the necessary quantity of ammonium hydroxide. To achieve the most accurate values, the pH and conductivity of the solution should be measured after completing the first two steps, and then adjusted as needed. The ammonium hydroxide will likely need to be added in 0.5 mL increments or dropwise until the desired pH is achieved. To maintain accuracy, the Horiba meters must be powered off and rinsed after each reading. By diluting the final solutions 1:1 with deionized water, the conductivity will be halved without a significant change in pH. Large quantities of the solutions will last for several weeks if stored in a refrigerator in sanitized, airtight containers—or if a drop of Germaben II, a preservative, is added to the batch. The solutions should be discarded when they begin to exhibit mold growth.

Recently, these aqueous solutions have been added to various microemulsions, effectively minimizing contact between the aqueous solution and paint film through the addition of an aliphatic hydrocarbon.⁶ The following case studies, however,

Table 3. Recipes for pH-Adjusted Water at 1,000 $\mu\text{S}/\text{cm}$

pH	Recipe
5.0	<ul style="list-style-type: none"> • Drop 0.5 mL glacial acetic acid into 0.5 L of DI H₂O • Set pH to 5.0 by adding approximately 5 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
5.5	<ul style="list-style-type: none"> • Drop 0.5 mL glacial acetic acid into 0.5 L of DI H₂O • Set pH to 5.5 by adding approximately 8 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
6.0	<ul style="list-style-type: none"> • Drop 0.5 mL glacial acetic acid into 0.5 L of DI H₂O • Set pH to 6.0 by adding approximately 9 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
6.5	<ul style="list-style-type: none"> • Drop 0.5 mL glacial acetic acid into 0.5 L of DI H₂O • Set pH to 6.5 by adding approximately 10 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
7.5	<ul style="list-style-type: none"> • Drop 0.5 mL glacial acetic acid into 0.5 L of DI H₂O • Set pH to 7.5 by adding approximately 12 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity

are limited to the application of variable pH and conductivity waters, which are more broadly applicable to paper conservation practices.

CASE STUDY I: PAULA REGO, *IN THE GARDEN*

In the Garden (1986; fig. 2) is a large acrylic painting on paper by Paula Rego (born 1935). Despite having been framed for decades under acrylic glazing, the painting had collected a significant layer of dirt and dust. For this work, Rego used heavily diluted Liquitex acrylic emulsion paint to achieve watercolor-thin washes of color, in addition to thick applications of Liquitex paint to achieve moderate impasto. The thickly painted passages were more significantly affected by the dusty accumulation, manifesting in decreased gloss and saturation across the majority of the painting.

Three primary goals were established for the cleaning of this painting: to reduce surface dirt and dust, to minimize swelling and pigment extraction, and to avoid undesirable changes in surface sheen. An initial attempt to reduce surface dirt by dry cleaning with minimally abrasive, nonlatex cosmetic sponges revealed the following two issues: 1) significant



Fig. 2. Paula Rego, *In the Garden*, 1986, 156.9 x 127.6 cm, acrylic on paper lined to canvas. Image reproduced courtesy of the artist

Table 4. Recipes for pH-Adjusted Water at 6,000 $\mu\text{S}/\text{cm}$

pH	Recipe
5.0	<ul style="list-style-type: none"> • Drop 1 mL glacial acetic acid into 100 mL of DI H₂O • Set pH to 5.0 by adding approximately 6–7 mL 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
5.5	<ul style="list-style-type: none"> • Drop 1 mL glacial acetic acid into 100 mL of DI H₂O • Set pH to 5.5 by adding approximately 10 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
6.0	<ul style="list-style-type: none"> • Drop 1 mL glacial acetic acid into 100 mL of DI H₂O • Set pH to 6.0 by adding approximately 11 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity
6.5	<ul style="list-style-type: none"> • Drop 1 mL glacial acetic acid into 100 mL of DI H₂O • Set pH to 6.5 by adding approximately 12 mL of 10% ammonium hydroxide • Test pH and conductivity • If necessary, add 10% ammonium hydroxide in 0.5-mL increments to raise the pH • Dilute with DI H₂O to reduce conductivity

amounts of surface dirt were embedded in the acrylic paint film and 2) specific colors were sensitive to abrasion.

The brown and dark-green pigments were particularly sensitive to abrasion during dry surface cleaning. However, after a few gentle strokes of the sponge, a threshold of pigment loss would be reached, beyond which pigment particles were no longer dislodged from the surface. It was determined that a percentage of pigment particles were not bound permanently within the acrylic polymer matrix during drying, and therefore remained as a surplus on the surface.

After dry cleaning, seven colors were selected for pH and conductivity testing using 2% (w/v) agarose pellets. While time constraints prevented sampling of all surfaces, the colors chosen were representative of 80% of the pure colors and color mixtures within the painting. The results were used to develop a practical range of pH and conductivity parameters for cleaning the remaining areas.

As an experimental control, pH and conductivity readings were also performed on a blank 2% agarose pellet that had not been previously applied to any area of the Rego painting (table 2). Likewise, to compare the performance of the agarose gel to that of pure water, a droplet of deionized water applied directly to the surface of black paint at the right of the painting was analyzed for pH and conductivity. The readings obtained from the deionized water droplet were significantly greater than those obtained with an agarose pellet applied to

an adjacent location of black paint, confirming that the water droplet acted more quickly and aggressively on the surface of the paint film than the pellet.⁷ Finally, multiple readings were taken from different areas of the same color to confirm accuracy and reproducibility of the readings. Note that the readings from two nonadjacent areas of brown paint (A and B) are very similar.

Cleaning trials began using the premixed stock solutions of pH- and conductivity-adjusted waters. Based on the methodology of Chris Stavroudis and others, a number of specific stock solutions were selected to match the pH and conductivity of the readings taken directly from the surface of the Rego painting. By choosing an aqueous cleaning solution that harmonizes with the paint film, near chemical equilibrium may be achieved at the surface, thus avoiding leaching materials from, or depositing them into, the paint film (Stavroudis and Doherty 2013). Without fail, the solutions whose conductivity and pH most closely matched that of the colors on which they were applied resulted in the least swelling and pigment transfer while maximizing cleaning efficiency. There was no practical difference in cleaning efficacy or swelling when using solutions within a few tenths of the pH reading, and within approximately 500 μS of the conductivity reading, demonstrating that the pH and conductivity need not precisely match. It is usually less disruptive to err on the side of



Fig. 3. Detail of *In the Garden*. Right: embedded dirt and dust are visible despite dry cleaning. Left: dirt and dust significantly reduced after aqueous cleaning

higher conductivity when selecting an aqueous solution to clean an acrylic paint film (Wolbers et al. 2013).

Cleaning of *In the Garden* proceeded for several weeks. Three to four passes with a lightly dampened (preblotted) cotton swab provided just enough moisture for the acrylic paint surface to release its hold on embedded dirt and dust (fig. 3). Hand-rolled cotton swabs were used during this cleaning for their softness and variability in size. Though cotton swabs are not appropriate for all acrylic surfaces, the paint surface was carefully monitored for abrasion during cleaning.

Aqueous cleaning reduced the dusty film that obscured the color and sheen of this acrylic painting. After cleaning, the work appeared more balanced, fresh, and lively. To further refine the understanding of this aqueous cleaning system, it is necessary to experiment with different methods of application and materials such as nonabrasive sponges or brushes.

CASE STUDY II: TOM WESSELMANN, *MAQUETTE FOR SMOKING CIGARETTE RELIEF*

Upon arrival in the studio, *Maquette for Smoking Cigarette Relief* (1983) by Tom Wesselmann (1931–2004) was covered in extensive mold growth (fig. 4). Fluffy, bright yellow mold covered most of the sculpture, its paper-covered wooden base, and the clear acrylic box in which it was displayed.

A soft-bristle brush attached to a HEPA vacuum was used to remove the dry surface mold, but stubborn circular yellow stains remained, marring Wesselmann's flat acrylic emulsion paint surface (fig. 5). The mold stains were embedded in the paint film and appeared matte in comparison to the slight gloss of the surrounding unaffected areas. Initial testing to remove these stains, which included local treatment with triammonium citrate (TAC) and diammonium citrate (DAC), proved unsuccessful.

To further reduce the staining, the work was cleaned using the CAPS aqueous cleaning system. One agarose pellet was



Fig. 4. Tom Wesselmann, *Maquette for Smoking Cigarette Relief*, 1983, acrylic on paper board. Courtesy of the Estate of Tom Wesselmann, licensed by VAGA, New York, NY



Fig. 5. Detail of embedded mold growth. Courtesy of the Estate of Tom Wesselmann, licensed by VAGA, New York, NY



Fig. 6. After cleaning with pH- and conductivity-adjusted water. Courtesy of the Estate of Tom Wesselmann, licensed by VAGA, New York, NY

placed on a discolored area for 60 seconds, then pH and conductivity readings were obtained from the surface of the acrylic paint using the method described above. The results were then used to formulate a pH- and conductivity-adjusted aqueous solution to match the test site. Light swabbing with the appropriately adjusted water removed all the embedded mold stains, resulting in a surface that agreed with the color, texture, and sheen of its surroundings (fig. 6).

CASE STUDY III: HURRICANE SANDY WATER DAMAGE ON PAPER SUPPORTS

Since late October 2012, many conservators have contended with works of art on paper damaged during Hurricane Sandy. These treatments are often very complex and challenging due to the unusual composition of the storm water. (The development of treatments to reduce extensive, widespread damage is a topic unto itself.) However, the CAPS aqueous cleaning system, adapted for paper supports, has the potential to improve treatment results in situations ranging from localized stain removal to overall washing. Of course, there are several variables to be considered when designing an aqueous treatment—pH, chelator, and application method to name a few—but the conductivity of the treatment water has proven to be a decisive influence in each of the following cases.

Internal tide lines that fluoresce bright blue are present within the supports of many Hurricane Sandy-damaged artworks.⁸ Often the affected area does not appear stained to the naked eye, but strong tide lines become visible under ultraviolet (UV) radiation. These tide lines are very difficult and sometimes impossible to remove using standard procedures. While treatment methods utilizing deionized water, calcified and ammoniated water, etc., often reduce visible tide lines, under UV, the blue fluorescence remains unaffected—or has merely shifted along the paper fibers. The source of the blue fluorescence is unclear, though indications suggest that the unusual fluorescence may be caused by residual antibiotics found in the flood waters (Wolbers 2013).

The efficacy of pH- and conductivity-adjusted waters was tested prior to treatment, using a technique modified from the CAPS aqueous cleaning system. Instead of using pure water to formulate the agarose gel, premixed pH- and conductivity-adjusted solutions were used—thereby yielding pH- and conductivity-adjusted agarose. Three test pellets representing different conductivities were applied to a tide line stain and left to rest for 2 to 10 minutes while imbibing the soluble components of the discoloration (fig. 7). The tests were carried out using pellets at 1000 $\mu\text{S}/\text{cm}$, 5000 $\mu\text{S}/\text{cm}$ and 10,000 $\mu\text{S}/\text{cm}$, following recipes shared by Richard Wolbers. For the testing and treatment of paper supports, the adjusted agarose gels may be formulated in concentrations ranging from 2% to 5% (w/v). High concentrations of agarose (4–5%) will yield semi-rigid gels with small pore formation and stronger capillary force.



Fig. 7. The tide line with local tests using conductivity-adjusted agarose pellets. From left to right: 1,000 $\mu\text{S}/\text{cm}$, 5,000 $\mu\text{S}/\text{cm}$, and 10,000 $\mu\text{S}/\text{cm}$

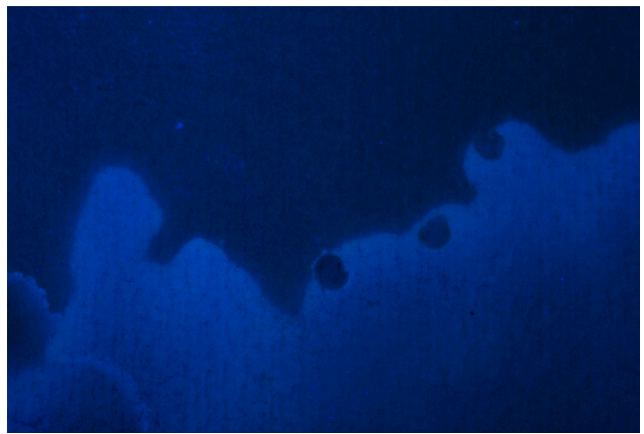


Fig. 8. The same test areas under UV illumination

In all three test cases, the tide line was no longer visible under UV illumination after testing with the adjusted agarose pellets (fig. 8). Furthermore, the test areas differed enough in both visible light and under UV to indicate that 5000 $\mu\text{S}/\text{cm}$ was the most effective approximate conductivity for stain reduction. The local stain removal was performed using fumed silica poultices dampened with a 1% TAC solution. One-percent TAC is a buffered solution with a pH of approximately 7.5 and a conductivity of 4,300 $\mu\text{S}/\text{cm}$, placing it within the conductivity range called for by the agarose test pellets. A barrier solvent (D5 silicone solvent, cyclopentasiloxane) was then applied to avoid the formation of new tide lines while the work was being cleaned with the aqueous solution.⁹ As a result of these preliminary tests, the final treatment removed the tide line, including external and internal fluorescent blue staining.

CASE STUDY IV: REDUCING DISCOLORATION AND STAINING FROM PAPER AND BOARD

Removing staining and discoloration, especially from boards, is uniquely problematic. Treatment is often limited by the board's moisture threshold—that is, the amount of moisture that may be introduced before distortions, delamination, or adulterant migration from the board core begin to occur. By increasing ionic activity at the stain site via appropriate water adjustment, paper swelling is limited and absorbency controlled. The end result offers more efficient stain reduction.

In order to demonstrate the effects of various adjusted waters, a sample of naturally aged two-ply card was dry surface cleaned to prepare for aqueous testing. Three cotton swabs were prepared, each dampened with a different aqueous solution: water at pH 5.5 with a conductivity of 14,000 $\mu\text{S}/\text{cm}$, water at pH 6.6 with a conductivity of 6000 $\mu\text{S}/\text{cm}$, and deionized water (fig. 9). Three light passes were subsequently performed on the card with each of the swabs.

The card surface was delicate, with a fine texture, and fibers were vulnerable to disruption during surface cleaning. The swab dampened with deionized water proved to clean the least effectively, and unevenly at that, altering the surface topography most significantly. The swab with the pH 6.6, 6,000 $\mu\text{S}/\text{cm}$ water glided more easily on the surface, offered more even cleaning results, and felt easily controllable during swabbing. The swab with the pH 5.5, 14,000 $\mu\text{S}/\text{cm}$ water gave the most effective cleaning (perhaps too effective, as three passes were unnecessary). A hypertonic, very high conductivity solution such as 14,000 $\mu\text{S}/\text{cm}$ will swell the paper surface. Swelling facilitates cleaning and the release of discoloration, but swelling can also result in alteration of the paper texture. After drying, the cleaned areas were tested again for pH and conductivity, and all gave similar readings despite having been cleaned with different solutions. By

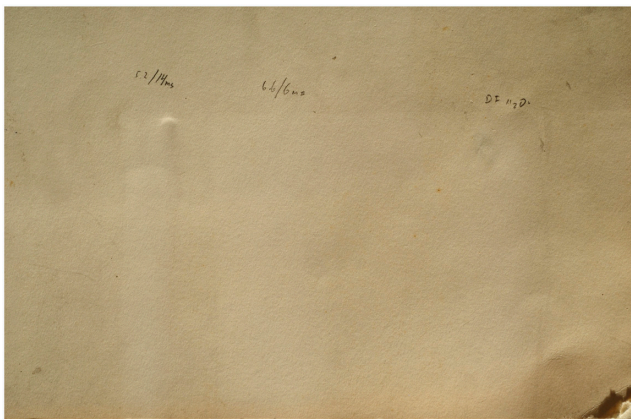


Fig. 9. Test sample of naturally aged 2-ply board, swab-cleaned using three waters. From left to right: water at pH 5.5 with conductivity of 14,000 $\mu\text{S}/\text{cm}$, water at pH 6.6 with conductivity of 6000 $\mu\text{S}/\text{cm}$, and deionized water

using adjusted waters when reducing discoloration on board, satisfactory results may be achieved with less repetition, less wetting out of the substrate, reduced loss of surface texture, and reduced planar distortion.

CONCLUSION

The pH of water has long been adjusted for various uses by paper conservators. By developing a more acute awareness of conductivity, and practicing conductivity measurement and adjustment, we may begin to take full advantage of the properties of our treatment waters. The resulting treatments will be better tailored to the needs of our materials.

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NOTES

1. See the Getty's website for more information: www.getty.edu/conservation/our_projects/science/modpaints/ (accessed 07/14/13).
2. Jablonski et al. provide an excellent literature review and summation of acrylic emulsion paints, including the composition of the paint films, their aging properties, and an explanation of the reasons why they attract and imbibe dirt: Elizabeth Jablonski, Tom Learner, James Hayes, and Mark Golden, 2003, "Conservation concerns for acrylic emulsion paints," *Reviews in Conservation* 4: 3–12.
3. Tom Learner, 2013, personal communication, Getty Conservation Institute, Los Angeles.
4. Measurements should be conducted at a constant temperature because pH and ion electrodes are sensitive to temperature differences.
5. For further readings on the use of agarose in conservation see Jeffrey Warda et al., 2007, "Analysis of agarose, carbopol, and lap-onite gel poultices in paper conservation," *Journal of the American Institute for Conservation* 46: 263–279, and Paolo Cremonesi, "Rigid gels and enzyme cleaning," in *New Insights into the Cleaning of Paintings: Proceedings from the Cleaning 2010 International Conference, Universidad Politécnic de Valencia and Museum Conservation Institute*, ed. Marion F. Mecklenburg et al.: 179–183.
6. Anthony Lagalante, Richard Wolbers, and Amanda Norbutus presented on the use of these microemulsions during the 2013 AIC conference. A. F. Lagalante, R. W. Wolbers, and A. J. Norbutus, "Mass spectrometric imaging of acrylic emulsion paint films: Engineering a microemulsion-based cleaning approach," presented at the 41st

National Meeting of the American Institute for Conservation of Historic and Artistic Works (AIC), Indianapolis, IN, May 29–June 2, 2013.

7. It is important to keep in mind that testing and cleaning methods should cohere in degree of restraint. In this case, the slower-acting agarose pellet is a more appropriate method for testing when used in concert with gentle, damp swab cleaning.

8. The examples used in this case study must remain unspecified to observe legal confidentiality requirements.

9. D5 is a low-polarity, volatile, silicone-based solvent. For more information see Ray A. Cull and Stephen P. Swanson, 2001, “Volatile methylsiloxanes: Unexpected new solvent technology,” in *Handbook for Critical Cleaning*, ed. Barbara Kanegsberg, Boca Raton: CRC Press, pp. 147–156.

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SOURCES OF MATERIALS

- *Glacial Acetic Acid*: Sigma Aldrich #27225-1L
- *Ammonium Hydroxide*: Sigma Aldrich #320145-500ml
- *Agarose*: Sigma Aldrich #A4018-10G -or- Benchmark Scientific #A1701
- *Germaben II*: Personal Formulator #PA005B
- *Horiba Laqua Tester*: Cole Parmer #EW-05754-10
- *Horiba B-171 TWIN Conductivity Meter*: Cole Parmer #EW-05751-10
- *Biopsy Punch*: Harris Uni-Core 3.0 tip Biopsy Punch, www.tedpella.com #15078
- *Disposable Graduated Pipettes*: Grainger #21F249
- *Large Vessel ~2,000ml*: Sigma Aldrich Pyrex Graduated Beaker #CLS100326

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Two New Techniques for Loss Compensation in Art on Paper: Integration of Surface Losses Using Textile Fibers and the Use of Sprayed Cellulose Powder To Minimize Foxing and Other Discoloration

The integration of losses to the media in works of art on paper has traditionally been done using pastel, colored pencils, or paint-based media such as watercolor. This paper discusses the use of colored cotton and polyester fibers derived from machine-made threads to reintegrate losses in design. The technique was developed to treat a large-scale watercolor by William Trost Richards, *Tintagel on the Cornish Coast*, which had sustained gouges and abrasions to the primary support. The textile fibers, obtained from commercially available sources, were processed in various ways to prepare them for placement on the watercolor. To obtain finely divided fibers, the threads were immersed in liquid nitrogen and then cut while frozen. Admixtures of fibers can be made to approximate color tones, or fibers can be layered to build up color intensity. Methyl cellulose was used as the binder for both its adhesive properties and surfactant action. Finely divided fibers tend to remain separated in methyl cellulose, a factor that helps in application. The stability and removability of the fibers were also assessed. Preliminary work indicates that this method has great potential for use with a variety of media where losses are small or linear. It has less potential for success over large areas, although the technique is evolving.

Cellulose powder has long been part of the inpainter's toolbox and is indispensable for certain operations, such as the concealment of foxing. The technique presented here shows how cellulose powder can be made into a slurry with methyl cellulose and sprayed with an external-mix airbrush to create consistent films of certain thickness and opacity. The dried films can then be shaped to the stained areas of the paper and activated in situ with low moisture. The cellulose powder can be toned before or after application to refine the integration. A drawing by Nicholas-Touissant Charlet was successfully treated using this method.

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Going Beyond Appearance: Use of Imaging Technology for the Examination of Hidden Paint Layers in a *Gulistan* of Sa'di from the Freer Collection

Multispectral imaging technology is increasingly important for the investigation of artworks on paper. It is noninvasive and relatively easy to implement, and provides valuable information about the materials and working methods of artists. Its exploitation for curatorial and technical research in the field of Islamic art on paper is not as widely adopted, but it is believed to be particularly promising.

Islamic miniature paintings are complex objects with no set structure, which are often extensively modified throughout their history in response to changes in style and ownership. The *Gulistan* of Sa'di from the collection of the Freer Gallery of Art in Washington, DC, is an especially notable and illustrative example of these practices. The manuscript was copied between 1468–69 in Herat, capital of the Timurid Empire. It then traveled to Tabriz, where lavishly illuminated borders were added during the 1540s at the royal workshop of the Safavid ruler Shah Tahmasb (ruled 1524–76). Under the reign of the Mughal emperor Shah Jahan (ruled 1628–58), the original illustrations were completely repainted by some of the most respected artists of the court. Tantalizing traces of the earlier paintings can be seen on the opposite sides of the folios as discolored areas produced by copper-based pigments.

A thorough imaging campaign aimed at revealing as much as possible of these pre-existing paintings was performed as part of a fellowship funded by the Smithsonian Institution and hosted by the Freer Gallery of Art and Arthur M. Sackler Gallery. The main tool used for this purpose was the VSC 6000, a high-resolution multispectral imaging system manufactured by Foster and Freeman and designed for the forensic investigation of questioned documents. Examinations using reflected and transmitted visible light, UV light, and reflected and transmitted IR light were performed with this instrument. Additional pivotal information was acquired using X-ray computer-generated radiography and a targeted use of X-ray fluorescence spectroscopy undertaken

in the Department of Conservation and Scientific Research at the Freer Gallery of Art.

From an art-historical perspective, the investigation successfully exposed sections of the underlying paintings, allowing comparisons between Persian and Indian depictions of the same subject. From a technical standpoint, it drew attention to the potential and limitations offered by the implemented equipment, and to the specific challenges involved in the investigation of Islamic miniature paintings. This research also offered an opportunity to devise a method that brings together the complementary information obtained in the different spectral regions.

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Technical Study and Conservation Treatment of Roy Lichtenstein's Screen Print on Plastic, *Sandwich and Soda*, 1964

INTRODUCTION

This technical research project studies three impressions of the Roy Lichtenstein print *Sandwich and Soda*, 1964, owned by the Harvard Art Museums. Each impression is screen-printed in blue and red ink on clear plastic (fig. 1). The prints are part of the portfolio *X + X (Ten Works by Ten Painters)*, a set of 10 works made by 10 painters: Stuart Davis, Robert Indiana, Ellsworth Kelly, Roy Lichtenstein, Robert Motherwell, George Ortman, Larry Poons, Ad Reinhardt, Frank Stella, and Andy Warhol. It was published by The Wadsworth Athenaeum in Hartford, Connecticut; 500 portfolios were printed in 1964. The artists were selected by the curator of the Wadsworth Atheneum, Samuel J. Wagstaff, Jr., who states on the back of the title folio, "This portfolio was commissioned and printed in an attempt to extend as much of the visual impact as possible of ten artists to paper and to make these prints available to collectors who might not otherwise have such a vivid slice of the artist."

In this study, the three *Sandwich and Soda* prints owned by the Harvard Art Museums were examined and analyzed to better understand their history, production techniques, and degradation processes. There are many screen prints on paper by Lichtenstein, but few are ink on clear film. The technique and materials that Lichtenstein used for this work are more linked to commercial practice than the fine arts, and many questions arise from this choice: Was *Sandwich and Soda* the first time Lichtenstein made a screen print on plastic, and why? Did Lichtenstein keep using plastic as a support for printmaking after *Sandwich and Soda*? What processes and materials were used to print *Sandwich and Soda*? What are the condition problems conservators can see today?

Sandwich and Soda was selected for an in-depth technical study only in part because of its unusual support material. The prints were also selected because two of the three copies have pressure-sensitive tapes applied to the ink side, presumably as



Fig. 1. Roy Lichtenstein, *Sandwich and Soda*, 1964, blue and red ink screen print on clear plastic, 48.3 x 58.4 cm

hinges. In this case, the inked side is the verso, since the object was meant to be seen through the transparent film (the recto). The tapes are different from each other: two pieces of what appears to be Scotch Magic Tape are on one print, and two pieces of what appears to be Filmoplast Tape are on the other print (fig. 2). The carriers have lifted slightly, and the adhesive is accessible on the sides. A previous attempt to test the sensitivity of the inks caused some visible damage, which prompted the need for more information about the materials before coming up with an appropriate conservation technique.

METHOD

In order to understand the materials and techniques of the objects better and to devise the best conservation treatment options for these prints, analysis was performed in the scientific lab of the Straus Center for Conservation and Technical Studies at Harvard Art Museums. The sampling was challenging since the surface of the object is shiny and very flat.

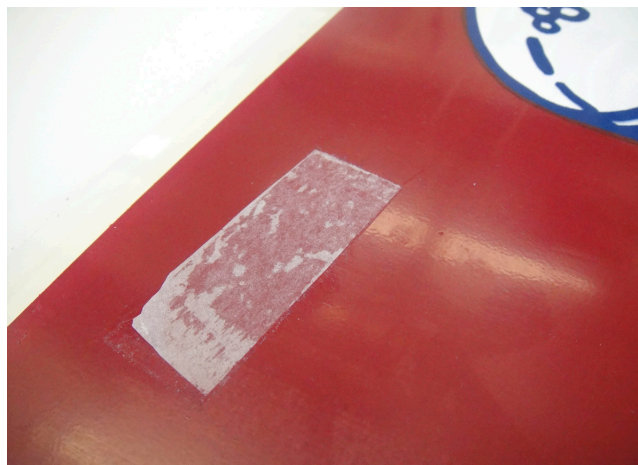


Fig. 2. Filmoplast tape attached to the ink layer on the verso of one of the prints (Harvard Art Museums, M14194)



Fig. 3. Sampling the tape carrier under the microscope

Micro-samples of each ink (blue in the edge of the printed area and red in the overlapping area) were taken under a microscope, as was a sample of the clear plastic support, shaved from the very edge of the object. A sample of each type of tape was also taken at the lifting edges (fig. 3).

Fourier transform infrared spectrometry (FTIR), Raman spectrometry, gas chromatography-mass spectroscopy (GC-MS), and laser desorption ionization-mass spectrometry (LDI-MS) were used in order to determine the composition

of the plastic support, pigments (red and blue), and tapes (carrier and adhesive).

RESULTS

The GC-MS results revealed that the clear support is not made of acetate—as stipulated in all the descriptions and catalogs, and even on the invoices the printing company sent to the Wadsworth Athenaeum—but polystyrene. It is interesting to note that today polyvinyl chloride, polyethylene, polyester, and cellulose acetate have mostly replaced polystyrene as clear, thin plastic printing surfaces. Polystyrene is now mostly sold as extruded white foam.

LDI-MS suggested that the blue pigment was phthalocyanine blue (PB15), which was commonly used in printing inks. The red ink sample contained chrome red (PR63) and barium sulfate. The binder of both the red and blue inks was polystyrene-based: these were plastic inks specifically for printing on plastic. GC-MS confirmed that the carrier and adhesive components of the Filmoplast-like tape were cellulose-based; the office tape was determined to be PVAC-based.

These results led to the development of a specific conservation procedure. Because the support and the ink binders were both based on polystyrene, and were thus probably well bonded, the prints were likely strong enough to support gentle mechanical removal of the tape.

CONSERVATION TREATMENT

After various tests, mechanical removal of the tape and tape adhesive was found to be the best option. In the initial attempts, tweezers held at an acute angle were used to peel back small strips of the tape carriers, and many white vinyl eraser pencils of different hardnesses and shapes were used to try to reduce the adhesive residues. But all the white vinyl eraser pencils tested presented some disadvantages (too hard, white residues, not convenient to use, etc.), and eventually another option had to be considered to reduce the adhesive residues. Every step was carried out under microscopic observation to prevent any scratches or physical damage to the surface of the prints.

On one copy, it was possible to remove the Filmoplast-like tape carrier by first applying warm water with a very small brush; this softened the tape carrier, allowing it to be removed with tweezers without affecting the ink. Cellulose powder¹ was then scattered on top of the sticky residual adhesive, and the resulting mixture could be pushed away with the silicone tip of a Colour Shaper modeling tool² without scratching the surface or removing ink. The tip of the Colour Shaper modeling tool had been cut to obtain the most convenient shape for removing the adhesive residue.

The same treatment (without the application of warm water to the tape carrier) was carried out on the acrylic-based



Fig. 4. Removal of tape adhesive residues with cellulose powder and a Colour Shaper tool

office tape on the other copy with great success. In both cases, the Colour Shaper tool was better than any white vinyl eraser pencils for reducing the adhesive residues. The results were very satisfying (fig. 4).

CONCLUSION

This object had a groundbreaking role in Pop Art and in art history in terms of materials, techniques, and subject matter. *Sandwich and Soda*, printed on thin, clear plastic in 1964, was one of Lichtenstein's first attempts to use an unusual support; he went on to print on other experimental materials. He also kept using plastic as a support, as in *Seascape I* (1964), *Moonscape* (1965), and *Landscape 5* (1967), which are screen prints on Rowlux, a multi-lensed effect film that can create moiré-like visual patterns.

Artworks on plastic and their inherent degradation processes are relevant topics for museum staff. For example, at the Museum of Fine Arts, Houston, a gallery talk was entitled "Spotlight on *Synthetic Supports: Plastic Is the New Paper*" (December 2011), which illustrates the importance of this type of research. Conservators now have to deal with unusual surfaces and materials, which is challenging, interesting, and requires adaptability.

This research project also served to remind the author that collegiality is the most effective approach for understanding a complex object and its condition and for choosing the best option for its treatment. It was very helpful to be able to consult object conservators and conservation scientists at the Straus Center for Conservation and Technical Studies to better understand plastics in general, the objects under study, and the available treatment options.

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- At the Library of Congress: Linda Morenus and Elisa O' Loughlin
- At the Wadsworth Athenaeum: Ulrich Birkmaier
- At the Yale University Art Gallery: Theresa Fairbanks-Harris
- Roy Lichtenstein's assistant, Jerry Simon

NOTES

1. Alpha-cellulose powder, Sigma Chemical Co., No. c-8002
2. Royal Sovereign Ltd UK, Colour Shaper, Firm, Taper Point, #2

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Splintered: The History, Structure, and Conservation of American Scaleboard Bindings

INTRODUCTION

While books are generally considered in terms of their text rather than their bindings, the study of bookbindings—how books were sewn, covered, and decorated—can provide insight into both the historical book trade and trends in readership. Research on early American tooled decoration, like that conducted by scholar Hannah D. French and conservator Willman Spawn, has begun to suggest how many binders there were in the American colonies, how and where they were trained, and how tools were shared or inherited between shops. Such research also describes historical binding styles and how they changed with time and location, according to prevailing tastes. The quality of a book's binding—in terms of materials, workmanship, and decoration—can also reveal something about how the text within it was perceived. Highly tooled, ornate bindings in expensive morocco leather were often reserved for either high-value texts or for gift books. Utilitarian or ephemeral books often received cheap, nondescript bindings in sheepskin or paper. Because of their lesser value and limited visual appeal, these books have received much less attention from scholars, although they represent the vast majority of texts available to the general public. Their materials and construction methods represent the routine work of publishers, binders, and booksellers from the 17th to the early 19th centuries; documenting them will illustrate the book trade's response to expanding literacy and readership.

Quintessentially American scaleboard bindings—which utilized thin, planed wooden boards—are of particular interest because so little is known about their origins and usage (Pickwoad 2009). Recently, conservator and book historian Julia Miller performed a study of 347 scaleboard bindings during a short-term fellowship at the Library Company of Philadelphia, whose collection specializes in “American history and culture from the 17th through the 19th centuries” (Library Company 2006). The Library Company also has the

second-largest collection of American imprints published before 1820, making it an ideal location for the study of American printing and publishing (Library Company History 2006). According to Miller's unpublished report, the bindings were selected chronologically from the library's catalogued and uncatalogued collections, and the imprints they contained ranged in date from 1684 to 1795. While compiling the data from her study, she found numerous departures from the existing assumptions about scaleboard bindings, which state that such bindings prior to the 1760s were sermons in small formats, stab-stitched and bound in full sheepskin with no decoration, and that after the 1760s they were primers in small formats, stab-stitched and bound in quarter leather with paper sides. She also found that Boston imprints predominated, with imprints from New York, Philadelphia, and smaller publishing centers becoming more common in the 18th century, particularly after 1780 (Miller 2010).

This study sought to expand upon Miller's research, building a wider understanding of the imprints selected for scaleboard bindings and of the binding structures printers and publishers used. Miller's list of imprints bound in scaleboard was compared with similar or duplicate imprints at the Historical Society of Pennsylvania, the Library Company, and the Winterthur Library—all of which focus on Americana of the 17th to early 20th centuries—for further evidence about the extent of scaleboard use. The search resulted in the examination and documentation of an additional 85 scaleboard bindings displaying a wide range of imprint dates, binding structures, and decorative schemes.

SCALEBOARD BINDINGS IN THE AMERICAN BOOK TRADE: A LITERATURE REVIEW

Published information about scaleboard bindings is scarce. Books in thin wooden boards are generally mentioned in passing, in discussions of the American book trade or of more valuable (and rare) early American fine bindings. However, a review of the literature on books during the colonial period makes it clear that scaleboard bindings played a significant

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role in the development of an American book culture. In 1904, Clifton Johnson, an author who focused on children's literature and rural Americana, first described scaleboard bindings in the context of 18th- and 19th-century schoolbooks. In the early to mid-20th century, bibliographers such as Thomas Holmes and Hellmut Lehmann-Haupt documented American bindings—including a few references to scaleboard—as part of their examination of printed texts and the American book trade. Slightly later, binding historians Hannah Dustin French and Willman Spawn—the former a librarian, the latter a book conservator—wrote extensively about early American bindings, including the use of scaleboard. In his 1994 article “Onward and Downward,” conservator and binding historian Nicholas Pickwoad discussed scaleboard in the context of the time- and cost-saving practices implemented in bookbinding after the introduction of the printing press. Hugh Amory and David Hall, editors of the series *A History of the Book in America*, provided a context for scaleboard in their work on early American printing, binding, and bookselling. By 2010, when the first draft of this paper was written, the only published work dedicated to scaleboard was Julia Miller's 2009 article “The American Scaleboard Binding: Not Just Another Beautiful Book,” in which she describes the scaleboard bindings she observed as a volunteer at the William L. Clements Library in Ann Arbor, Michigan.¹

The origins of scaleboard as a binding material are uncertain, although they were not unique to colonial America. Some authors, including French and Lehmann-Haupt, assume they developed from the heavy wooden boards used during the medieval period, and functioned as an alternative to expensive imported pasteboard (Lehmann-Haupt 1951; French 1967). According to Pickwoad, scaleboard was common across northern Europe from the early 16th century into the 19th century, especially on less expensive books. There, as in the infant American colonies, “wood was plentiful (and . . . quantities of waste paper from which to make boards were harder to find)” (1994, 80). In the absence of the proper conditions for flax production and papermaking, Pickwoad states, northern European binders turned to beech logs “split into thin sheets with a broad wedge-shaped tool called a froe; the sheets were then smoothed, cut and used like other manufactured boards” (1994, 80). Citing other researchers, Miller tentatively identifies American scaleboard as oak, maple, or birch, and suggests that scaleboard might have been produced by apprentice labor or colonial shingle-makers (2009).

Historical references offer further clues, suggesting that scaleboards were planed rather than split and that they may have migrated from the print shop to the bindery—trades that were closely linked in colonial America. The *Oxford English Dictionary* contains two entries related to scabbards or scaleboards; the former term appears to have preceded the latter. “Scabbard” is defined as “Thin board used in making splints, the scabbards of swords, veneer, etc., and by printers

in making register (now called scale-board).” Its earliest usage is from a 1635 patent record; Benjamin Franklin refers to it in a 1753 letter to J. Bowden, saying, “I place them in loose rims of scabboard” (Simpson and Weiner 1991, 1663). “Scale-board” is defined as “Thin board used for hat-boxes, silk hats, veneer, etc., and used by printers for justifying.” Its earliest usage is in a 1711 act concerning the exportation of “Paper Pastboard Mildboard or Scaleboard”; an 1821 customs record describes “202 Scaleboards, from Germany, . . . packed in Bundles, weighting 50 st each Draught” (Simpson and Weiner 1991, 1664). A “scabbard-plane” or “scaleboard-plane” was used to produce scaleboards; “scabbing” refers to the spacing of lines of type (Simpson and Weiner 1991, 1663). Well into the 19th century, scaleboard was being used for a variety of purposes, including book boards. The “board” entry of the 1823 *Encyclopaedia Britannica* describes the importation of “mill and scale-boards, &c. for divers artificers. Scale-board is a thinner sort [of board], used for the covers of primers, thin boxes, and the like. It is made with large planes; but might probably be sawed with mills to advantage” (757).

Whether these thin boards were standard printers' equipment, pressed into usage as book covers when paper goods were expensive and scarce, or a common-sense adaptation of traditional wooden boards for smaller texts, they became far more common in the American colonies than they were in England. They were also used differently, with the wood grain running horizontally. Citing David Pearson's *English Bookbinding Styles 1450-1800*, Miller writes, “European examples of extremely thin wooden covers contemporary with early American scaleboard tend to have a vertical grain. Scaleboard was used in England in the late 18th century for cheap binding, but much less so than in America” (2009, 199).

In the colonies as in northern Europe, the use of scaleboard was likely due to the lack of a local paper supply. The first paper mill in America was established near Philadelphia in 1690, but colonial binders elsewhere had to rely on pasteboard, marbled lining papers, and endleaves shipped from Europe. French writes:

Wood was plentiful where paper and pasteboard were not, and board covers of birch, maple, and oak were used throughout the colonial period, in New England in particular. These boards were planed very thin until they were no heavier than pasteboard and served their purpose admirably. The slim volumes of sermons, tracts, and controversial pamphlets, which together with various printings of the Psalm Book made up the bulk of the products of the earliest presses, called for thin covers where the thick folios of the fifteenth century had called for heavy ones. In the parlance of the day these thin covers were known as “scabboard,” a contraction of “scaleboard.” Although boards were used in Pennsylvania, too, pasteboard came into general use earlier there. Paper manufacturing had flourished since its start in 1690. [According to his account

books,] Benjamin Franklin . . . supplied Philadelphia binders and an occasional New York and Boston craftsman with paper and pasteboard as well as scabboard, milled boards, skins, and gold leaf. (1967, 13-14)

Here Franklin's sale of scaleboards and other binding materials provides evidence of the overlapping roles of printer, bookseller, and binder in the colonies, all of which relied on—or competed with—expensive materials or finished goods imported from England. During the 17th and 18th centuries, the London Stationers' Guild controlled the copyrights, and most books distributed in the colonies were imported from England already bound (Reese 1990; Amory 1993; Amory and Hall 2000). According to Amory, these imports included all of the books that sold steadily, including Bibles, technical literature—such as law books and navigation charts—and chapbooks (1993). By law, American printers could print only locally produced literature and works not covered by copyright, and these were the imprints that found their way into the hands of local binders. While in theory scaleboard might have been used on a few of the imported volumes, Miller notes that its use is far more evident on the products of the colonial American presses: sermons, captivity narratives, and execution-day confessionals in the late 17th century, joined by primers, psalm books, catechisms, music books, almanacs, and literary works by the late 18th century (2009).

Such offerings were by no means confined to scaleboard bindings, although locally sourced, lightweight wooden boards would have been cheaper than imported pasteboards. Colonial binders produced a range of work, from the fine, gold-tooled bindings of John Ratcliff and Edward Ranger in 17th century Boston to ubiquitous blue paper wrappers. French notes that Ratcliff and Ranger bound in imported morocco or “turkey leather” over pasteboard, whereas typical Boston bindings of the period “were blind-tooled native sheep or calf covers over wooden [scale] boards, with plain endpapers, or sometimes with no endpapers at all” (1967, 12). German immigrants continued to use heavy, shaped wooden boards for their Bibles and religious texts. Smaller, less valuable books also received a range of cover treatments. Amory writes,

Pamphlets were issued ‘stabbed,’ in blue-gray cartridge-paper wrappers, sewn through three holes in the sides, for immediate hawking through the streets. From around 1743, about the same period as in England, the wrappers might also bear a printed title or advertisement, and owners at all times bound books for themselves in limp parchment or wallpaper. (Amory and Hall 2000, 54)

Scaleboard bindings apparently offered a middle ground for those who wanted cheap yet durable permanent bindings. Scaleboard is frequently found on Boston imprints from the late 17th century through the Revolutionary War,

and occasionally on books from other publishing centers throughout New England and the Mid-Atlantic colonies. They were so usual in the Northeast that Holmes remarks upon their absence in Ratcliff's 1685 binding of Increase Mather's *A Call from Heaven*. He describes the book as solid and strong but crude and utilitarian, sewn on three sawn-in rawhide thongs, two of which are laced through pasteboards, “not the beech or oak boards then used on the commoner sheepskin bindings of the time and used in Boston for fully forty years later” (1928, 37).

Several other authors note the use of scaleboard bindings on particular texts, or in the inventories of American binders and booksellers. Amory writes that sermons for special occasions were often issued stitched into paper wrappers or, if sold in a bookstore, in the less common “sheep over scabboard” (1993, 49). Michael Perry, an unsuccessful Boston bookseller who died intestate in 1700, was found to have 10 times more locally printed books than imported books in his shop, as well as bookbinding materials such as calf and sheepskin leather, dyes for sprinkling, paste papers, Bible clasps, and “pasteboard and ‘scale’ or scabboard, a kind of oak veneer used for stiffening covers” (Amory 1993, 36). Willman and Carol Spawn write that Francis Skinner, an 18th-century Newport binder, “often used thin wooden boards for the sides of his smaller books in place of expensive pasteboard” (1965, 58-59).

Many scaleboard bindings were exceptionally plain and very crudely finished. French notes the simplicity of colonial bindings, including those on schoolbooks, which were typically bound in scaleboard:

Many books, and probably the greatest number, were bound in full sheep, or more rarely in calf, with no ornamentation whatever. Some examples of the New England Primer have been preserved, despite the hard use they underwent, in their original sheepskin covers, a mere scrap of leather drawn on and pasted down without benefit of the binder's knife either for paring or trimming. (French 1967, 21)

According to Lehmann-Haupt, such bindings suggest a reliance on colonial rather than imported materials:

Leather manufacturing, one of the earliest industries, was encouraged by local laws. Therefore, we find books bound in sheep or calf, rather than imported morocco or levant. These early books bore little decoration, resembling the typical law-book style of binding, a resemblance which increased when, in the eighteenth century, gilt-lettered red leather labels appeared on the backs. (Lehmann-Haupt 1951, 24-25)

Not all scaleboard bindings were plain. Like books bound in pasteboard, they were often decorated according to the Cambridge style used on theological works in England (French 1967). According to Willman Spawn, the boards of

a typical early 18th-century Boston or Philadelphia binding were usually covered with sheepskin and blind-tooled with double panels created by single-line fillets and a decorative roll. The panels were set off by hand stamps at the corners. Spines and endpapers were plain, and the board edges might be tooled with the same decorative roll. Imported calf and morocco were used occasionally on special bindings. Single panels with hand stamps at the corners were also occasionally used, particularly on smaller books. Sometimes the boards of inexpensive bindings were simply outlined with single or double fillets. In the 1730s and 1740s, gold tooling and a decorative roll run along the edge of the spine inside the spine fillet appeared on Boston bindings, which are more plentiful than Philadelphia bindings from the same period. New York bindings, however, utilize central stamps, wider decorative rolls, and vertical single fillets two or three inches from the spine: characteristics that reflect 17th-century London stationers' bindings more than the Cambridge style of Boston and Philadelphia binders (Spawn 1983).

In her essay "Early American bookbinding by hand, 1636-1820," French also describes a typical colonial binding. In this case, the binding was simply manufactured and decorated, although it was presented as a gift:

The great bulk of the bindings of the seventeenth and the first half of the eighteenth century were of sheepskin over wooden boards in Boston, over pasteboard in Philadelphia. They were decorated with simple but pleasing rolls and fleurons impressed in blind, even the many presentation copies given by their authors or by Judge Sewall or Thomas Prince, both of them book buyers and book givers. A typical example is the copy of Thomas Paine's *The Pastoral Charge* (in the Massachusetts Historical Society), printed for Daniel Henschman and sold at his shop in 1720. According to its Latin inscription, the work was given to Robert Treat Paine by his father. The binding was done with sheepskin, on horizontally grained wooden boards; there were no headbands nor tooling on the board edges. Two leather thongs were stabbed through the book and put down under the covers. Page edges were sprinkled red. A double panel adorned the covers, made by a double blind fillet with the familiar rather large Henschman fleurons at the outer corners of the inner panel. (1986, 128-129)

Most scaleboard bindings, however, were less elaborate. The early scaleboard examples Miller describes are generally untitled, flat-spined, tightback books bound in full sheep or calf, stained dark brown and blind-tooled with simple panel decorations. After 1750, these full bindings gave way to quarter bindings with sheepskin spines and paper-covered sides; in music books the sides might be left bare (Miller 2009).

The *New England Primer*, which was used to teach reading and godliness in Boston from at least 1690 to 1806, provides

examples of both types of scaleboard bindings. In *Old-Time Schools and School-Books*, the primer is described as having covers "of thin oak, that cracked and splintered badly with use, in spite of the coarse blue paper which was pasted over the wood. The back was of leather. Neither back nor sides had any printing on them" (Johnson 1963, 74). According to the author, these plain, fragile, aging quarter-leather bindings were often "protected by an outer cover of sheepskin neatly folded in at the edges and sewed in place with homespun tow. After 1825 this outer covering was apt to be calico, and sometimes there were tie strings attached at the sides" (Johnson 1963, 162).

Whether plain or elaborate, bound in full or quarter leather, scaleboard bindings often made use of simplified binding practices such as stitching or stabbing the text block rather than sewing through the fold. Such practices sped the binding process tremendously and likely lowered the price of the finished volume. French writes, "To Ratcliff belongs the dubious distinction of introducing to the colonies the vicious practice of stabbing through the inner margins of a book and sewing through the holes, thus making a rigid binding and a book which will not open easily. Sometimes the four rawhide thongs which were laced into the boards were likewise stabbed through the margins at intervals between the sewing stitches" (1967, 17). Miller notes that the earliest scaleboard bindings were stabbed with two wide thongs whose ends were adhered to the horizontally grained boards beneath the leather. Both scaleboard and pasteboard bindings were prepared in this way, however, implying that the two types of boards were interchangeable and that their use depended on regional factors.

Such bindings dominated the American book trade for almost a century. Historians agree that Boston was the center of printing and publishing until the beginning of the Revolution, when changing immigration patterns and the establishment of the federal government in Philadelphia led that city to take precedence. After the Revolutionary War, according to Spawn, regional differences in binding styles ceased to exist, with the exception of the unique Pennsylvania German styles (1983). Also by that time, according to French, "pasteboard covers had become the rule instead of the exception. Scabboard was still used, but only on school texts and other cheap books covered with paper or undecorated sheepskin; and pack thread was used to the complete exclusion of leather thongs" (1967, 50).

Although the existing literature has contributed greatly to the understanding of scaleboard bindings, many questions remain to be answered. For example, what were the boards made of? Although several authors have posited that the thin, planed boards were made from oak, maple, beech, or birch—woods traditionally used in heavier medieval bindings—no definitive analysis of the woods used in scaleboard bindings had been undertaken prior to this study. Identifying

the wood species may help answer a further question: Where did scaleboards originate? Were they a product of the furniture industry, the printing industry, or both? Were they imported to the colonies, like so many other necessities of the printing trade—presses, ink, pasteboard—or were they a cheaper, locally produced alternative? The tantalizing clues contained in the *Oxford English Dictionary* suggest that future research must examine the scanty primary evidence of the printing and binding trades as well as the fragile scaleboard bindings themselves.

RESEARCH METHODS: FINDING AND DOCUMENTING SCALEBOARD BINDINGS

This study built on the results of Miller's month-long fellowship at the Library Company of Philadelphia in fall 2010 and pursued several of her suggestions for further study. At the Library Company and the Historical Society of Pennsylvania, scaleboard bindings that post-dated the 1795 cut-off date for Miller's study were examined, as well as duplicate imprints from the Library Company's uncatalogued collections. At the Winterthur Library, imprints from Miller's study were compared with similar or duplicate imprints to see whether they had been bound in the same way. Scaleboard bindings were also compared with a wide range of other books from the colonial period, including similar bindings in pasteboard and exceptionally fine bindings. Harry Alden, a botanist who specializes in wood identification, was also consulted for preliminary characterization of the wood used in nine of the scaleboard bindings examined. Where possible, wood samples were collected for future identification.

At Winterthur, Miller's list of imprints was first compared with the authors, titles, and printers included in the Winterthur catalog. Exact matches and similar imprints—mainly sermons, psalm books, and primers—were used as a starting point for finding more scaleboard bindings. Because most scaleboard bindings are small, the initial search was confined to the shelves where the smallest rare books (octavos and duodecimos) are kept. When these had been thoroughly examined, the search was broadened to books of standard size whose authors, titles, or subjects had previously been found in scaleboard bindings: sermons and theological works, psalm books and music books, school books, histories, classics, and books on home economics, animal husbandry, or gardening. Few additional bindings were discovered in this way, suggesting that binders recognized the inherent weaknesses of scaleboard and reserved it for the smallest and lightest imprints.

The study soon confirmed that, in addition to being small, books bound in scaleboard are usually plainly decorated, with characteristic types of damage. In full leather bindings, the corners of the boards are often chipped and exposed, providing a glimpse of the wood grain (fig. 1a). By contrast,

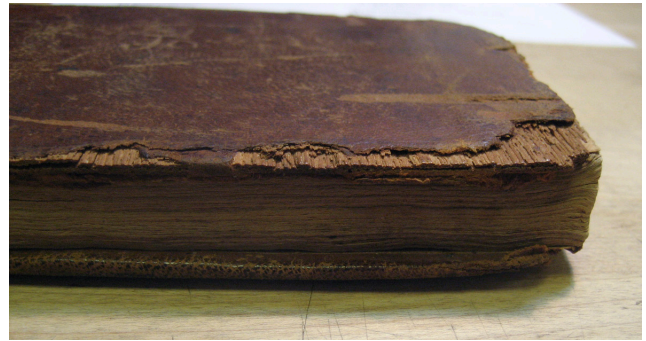


Fig. 1a. In scaleboard bindings, wood grain is often visible at the corners, along worn edges, or at the hinge when the book is open. (J[ohn] Hill, *The Young Secretary's Guide: or, a Speedy Help to Learning*, 24th ed. Boston: Printed and Sold by Thomas Fleet, 1750. Copy 1. 15.8 x 9.2 x 2.4 cm) Photo by the author, courtesy of The Library Company of Philadelphia



Fig. 1b. Loss to the top of this board gives the leather a surprisingly limp, empty appearance. (J[ohn] Hill, *The Young Secretary's Guide: or, a Speedy Help to Learning*, 24th ed. Boston: Printed and Sold by Thomas Fleet, 1750. Copy 2. 15.9 x 9.5 x 2.9 cm) Photo by the author, courtesy of The Library Company of Philadelphia

the corners of pasteboard books generally bend rather than break. On scaleboard bindings, the leather may also display what Miller has called “the empty sleeve syndrome”: even if it remains intact, it may be limp and floppy over areas of board loss (fig. 1b). If the boards cannot be seen through the binding, opening the book and examining the inner hinge will often reveal either wood grain or the more homogeneous pasteboard. In quarter leather bindings with paper sides, damage to the paper often reveals large sections of the boards, and the fore-edges of the boards often suffer from severe losses, particularly if the wood grain is vertical (fig. 2). Short, wide music books are often bound in scaleboard, although their leather or tawed-skin overcovers make confirming the board material a challenge.

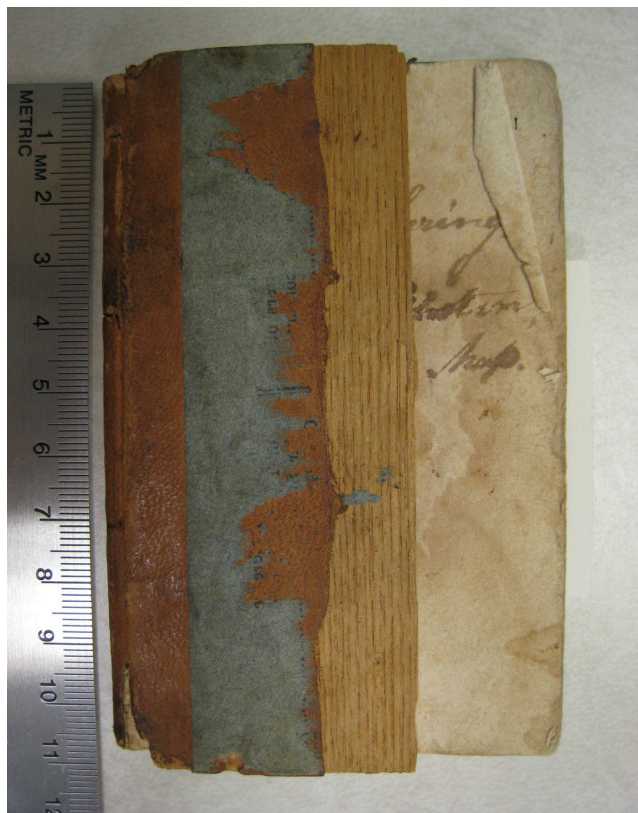


Fig. 2. Vertical wood grain was common in copies of the *New England Primer*, resulting in loss along the fore-edge. (*The New-England Primer*, Greenfield, [Mass.]: Printed by Denio and Phelps, 1816. 10.9 x 7.0 x 0.9 cm) Photo by the author, courtesy of The Winterthur Library: Printed Book and Periodical Collection

The 85 scaleboard bindings identified were documented with the aid of a data sheet adapted from Miller's checklist. The reference number, author, title, date, and publication information, as well as the size of the bound book, were recorded for each volume. The book's covering materials and decoration, scaleboard grain structure and orientation, text block and endsheet construction, inscriptions, and method of text block attachment were also examined and documented. Sketches of the front cover and spine, as well as digital images of selected features, helped record the pertinent details. For the purposes of this paper, the resulting data were analyzed using an Excel spreadsheet.

SCALEBOARD BINDING STRUCTURES: A SUMMARY OF THE FINDINGS

Many of the assumptions regarding scaleboard bindings were borne out by this study, which included imprints from 1686 to 1833. The majority of the books examined were small—duodecimo, octavo, or small quarto imprints—with horizontal-grain, ring-porous scaleboards and stabbed

bindings. In addition, the majority of books printed prior to 1760 originated in Boston, while the majority of those printed thereafter were from New York, Philadelphia, and towns scattered across New England. More than 50 percent of the works bound in scaleboard were theological texts or schoolbooks, but the variety in content increased dramatically over the study period. Simple full-leather bindings prevailed until the 1790s; quarter-leather bindings with paper sides dominated thereafter.

IMPRINTS IN SCALEBOARD

The first English printer and printing press arrived in Cambridge, Massachusetts, in 1638, as part of an effort to educate and convert the Native American population. By 1674, printing had expanded to Boston, which dominated the American publishing industry until Philadelphia took over in the mid-18th century (Lehmann-Haupt 1951). As might be expected, therefore, 257 of the 347 books in Miller's study were printed in Boston. Another 85 books were printed in 22 other cities, from Delaware to Maine, between 1715 and 1795. The earliest non-Boston imprint in scaleboard was from 1690 (Philadelphia), followed by imprints from 1709 (New London, Conn.) and 1715 (New York City). Miller also noted that scaleboard bindings outside Boston became far more common in the 1780s, when Boston binders appear to have moved to quarter bindings with pasteboards. The majority of imprints prior to 1786 were sermons; after 1786, they were educational texts.

In this smaller study, the books originated in 17 cities, from Philadelphia in the south to Montpelier, Vermont, in the north. One 1806 imprint of *The Works of Aristotle* was identified only as having been printed in New England. Boston, New York, and Philadelphia produced the majority of the texts (54, 9, and 8 percent, respectively), with the remainder printed in 14 smaller publishing centers across the northeastern colonies (see table 1). As in Miller's study, the most common imprints were theological texts from Boston, followed closely by schoolbooks printed elsewhere. It is interesting to note that the three copies of the *New England Primer* in the sample set all originated outside the major printing centers. Subject matter varied most widely in New York and Philadelphia. As expected, scaleboard use appeared to migrate away from Boston as its publishing dominance dwindled.

In the Winterthur Library, a number of titles found elsewhere in scaleboard were found to have been bound instead in paper boards or millboard (see table 2). Although the sample set is so small that it is impossible to draw definitive conclusions from it, these alternative bindings suggest that Pennsylvania binders were more likely to use paper boards, given their local supply of the raw material. The later dates of the imprints in paper boards also illustrate the wider availability of American-made pasteboard by the late 18th century. Book purchasers in New England may have been

Table 1. Imprints in Scaleboard by Content and City of Origin

Contents	Bellows Falls, VT	Boston	Brattleborough, VT	Exeter, NH	Germantown	Greenfield, MA	Hartford, CT	Middletown, CT	Montpelier, VT	New England	New London, CT	New York	Newburyport, MA	Philadelphia	Portsmouth, NH	Walpole, NH	Watertown, NY	Worcester, MA	Grand Total
children's theology		1												1					2
classics										1									1
dream interpretation												1							1
dyeing											1								1
etiquette															3				3
history					1							1							2
hymn book		1											1						2
law book		2																	2
literature												2							2
maxims		1																	1
military exercises									1										1
music book		1		1										1					3
poetry											1								1
politics		3												1					4
primer						1							1			1			3
ready reckoner													1						1
recipes	1																		1
satire												1							1
schoolbook		7	1			1	1		1					2			1	3	17
sermon		5						1											6
theology		25										3		1					29
women's advice														1					1
Grand Total	1	46	1	1	1	2	1	1	2	1	2	9	3	7	3	1		3	85

able to specify which type of boards they desired, possibly at different price points, or different materials might have been used interchangeably when binding popular, inexpensive titles for retail sale.

Regardless of where and when they were printed, the books bound in scaleboard were uniformly small. The books examined in this study ranged from 10.5 to 20.5 cm in height, 7.0 to 24.0 cm in width, and 0.9 to 4.5 cm in thickness. The majority were duodecimo impositions, trailed by octavo and quarto imprints (see table 3). The largest books included a ready reckoner—a book of accounting tables with a tall, narrow format—and books of sheet music with a short, wide format. The smallest books were the three copies of the *New England Primer*, all under 12 cm in height and sized to fit a child's hand.

The limited size of the imprints suggests that binders recognized the inherent fragility of the thin wooden boards, which often split and chipped even in the smallest bindings.

TEXT BLOCK CONSTRUCTION AND BOARD ATTACHMENT

As James N. Green, librarian at the Library Company, has noted, in the colonial period “paper was the largest component in the cost of printing,” and few printers would essay upon bound books that required more than 10 folded sheets, or 160 pages in octavo (2007, 266). The paper quality also presumably affected the printer's or publisher's outlay, and scaleboard bindings, with their reputation for cheapness, might be expected to contain the lowest-quality paper stocks.

Table 2. Titles Found in Both Scaleboard and Other Types of Boards

Study	Library	No. Copies	Author	Title	Imprint	Date	Boards	Binding
Miller	LCP	1	William Buchan	<i>Advice to Mothers ... on Their Own Health</i>	Boston: Joseph Bumstead	1809	scaleboard	quarter leather with marbled paper sides
Wolcott	WL	1	William Buchan	<i>Advice to Mothers ... on Their Own Health</i>	Philadelphia: John Bioren	1804	pasteboard	full leather quarto
Miller and Wolcott	LCP	3	Henry Care	<i>English Liberties, or the Free-born Subject's Inheritance</i>	Boston: J. Franklin for N. Buttolph, B. Eliot, and D. Henchman	1721 (3)	scaleboard	full leather
Wolcott	WL	1	Henry Care	<i>English Liberties, or the Free-born Subject's Inheritance</i>	Providence, R.I.: J. Carter	1774	pasteboard	full leather
Miller and Wolcott	LCP	5	Lord Chesterfield	<i>Principles of Politeness, and of Knowing the World</i>	New Haven, CT: A. Morse	1789	scaleboard	full leather
					Boston: Belknap and Hall	1794	scaleboard	quarter leather with blue paper sides
					Portsmouth, NH: Melcher and Osborne	1786 (3)	scaleboard	full leather
Wolcott	WL	1	Lord Chesterfield	<i>Principles of Politeness, and of Knowing the World</i>	Philadelphia: Mathew Carey	1800	pasteboard	quarter leather with marbled paper sides
Miller and Wolcott	LCP	2	Daniel Fenning	<i>The Ready Reckoner</i>	Boston: John W. Folsom	[1785]	scaleboard	full leather
					Newburyport, MA: Edmund M. Blunt	1794	scaleboard	full leather
Wolcott	WL	4	Daniel Fenning	<i>The Ready Reckoner</i>	Reading, PA: Benjamin Johnson	1789	pasteboard	full leather
					Philadelphia: Jacob Johnson	1794	pasteboard	full leather pocketbook
					Newburyport, MA: Edmund M. Blunt	1794	millboard	full leather
					Philadelphia: Henry Sweitzer	1801	pasteboard	quarter leather with blue paper sides
Wolcott	LCP	2	George Fisher	<i>The Instructor: or, American Young Man's Best Companion</i>	Worcester, MA: Isaiah Thomas	1785 (2)	scaleboard	full leather
Wolcott	WL	1	George Fisher	<i>The Instructor: or, American Young Man's Best Companion</i>	Burlington, VT: Isaac Collins	1775	pasteboard	full leather

Table 3. Imposition of Imprints in Scaleboard

Imposition		Total
Duodecimo	12mo	6
	12mo in 12s and 6s	2
	12mo in 6s	42
	12mo in 8s	1
Octavo	8mo	16
	8mo in 4s	10
Quarto	4mo	6
	4mo in 2s	1
	4mo in 8s	1
Grand Total		85

In reality, the handmade white papers in the books from this study displayed a surprising range in quality, from fine laid papers with evenly distributed fibers to coarse laid papers with lumpy surface texture and quantities of blue fibers. Most of the volumes were printed on medium-quality laid paper; several of the high- and medium-quality papers contained watermarks that might be used to trace their origins with further research. Ten volumes were printed on wove paper; the first of these appeared in 1798, just three years after American-made wove papers became available (Lehmann-Haupt 1951). The presence of high-quality and innovative papers suggests that scaleboard bindings were not limited to the most cheaply

printed texts, but were used even for highly respected and expensive imprints, or those that were meant to impress prospective readers. The 13 books printed on high-quality laid paper included the two most elaborately decorated bindings in the group, and more than half of them were sewn rather than stabbed, producing more durable and expensive books.

As a general rule, more scaleboard bindings were stabbed than sewn. As Miller also noted, the majority of the text blocks—whether sewn or stabbed—were notched along the spine as if for recessed sewing (see fig. 3). Both V- and U-shaped notches were observed, sometimes in combination with horizontal slits at the kettle stations, suggesting that the notches might be cut by knife or by saw. The number of notches varied: two, three, and four notches were most common. One 1785 Worcester schoolbook was unique in that some of its fold-out diagrams were evidently notched for recessed sewing, although the rest of the text block was not; the book was bound on five raised cords. Similarly, the handwritten music bound into the back of a 1798 Philadelphia songbook was notched along the spine, while the original printed text was not; the entire book appears to have been oversewn. This evidence suggests that printers or binders notched the spines of text blocks or insertions as a matter of course, perhaps long before the books were bound.

In stabbed bindings, two vertical slits were pierced or slit in the spine margin of the text block, generally 6 to 7.5 cm apart. Tawed-skin thongs, leather thongs, or woven tapes were threaded through the slits, and their ends were attached to the spine edge of the scaleboards, either on the inside beneath the pastedowns or, far more frequently, on the outside beneath the covering material. (Miller's study also identified several bindings from 1690–1704 with tawed supports that had been laced through scaleboards lined on the inside with paper, a binding structure that has not been described elsewhere.) As Miller noted, the materials used in stabbed bindings, and their method of board attachment, could usually be determined by examining the bindings' inner hinges and the spine edges of the boards. Fifty-five percent of the full-leather bindings and 57 percent of the quarter bindings appeared to have been stabbed rather than sewn. Particularly in the latter case, the thong or tape slips were often clearly visible beneath the paper sides or pastedowns (see fig. 4). The imprints bound in this way included all of the primers and all but four of the religious texts printed in Boston. The stabbed structure—by far the fastest method of bookbinding—was used on the earliest and latest imprints in the study group and throughout the 18th century.

Two variations on the usual stabbed-binding format were identified. One 1763 Boston imprint displayed four vertical, pierced slits in the spine margin; although only the outermost slits contained thongs, the narrower inner slits also showed signs of use. This suggests that the book may have been sold stitched through the central slits and then rebound. Similarly,



Fig. 3. The split front hinge of this stabbed binding reveals a text block spine notched as if for recessed sewing, although the book was bound using two tawed-skin thongs stabbed through slits in the spine margin and adhered beneath the cover leather. (Benjamin Wadsworth, *A Dialogue Between a Minister and his Neighbour, About the Lord's Supper*. Boston: Printed by S. Kneeland, for Benj. Eliot, 1724. 14.0 x 8.3 x 1.9 cm) Photo by the author, courtesy of The Historical Society of Pennsylvania

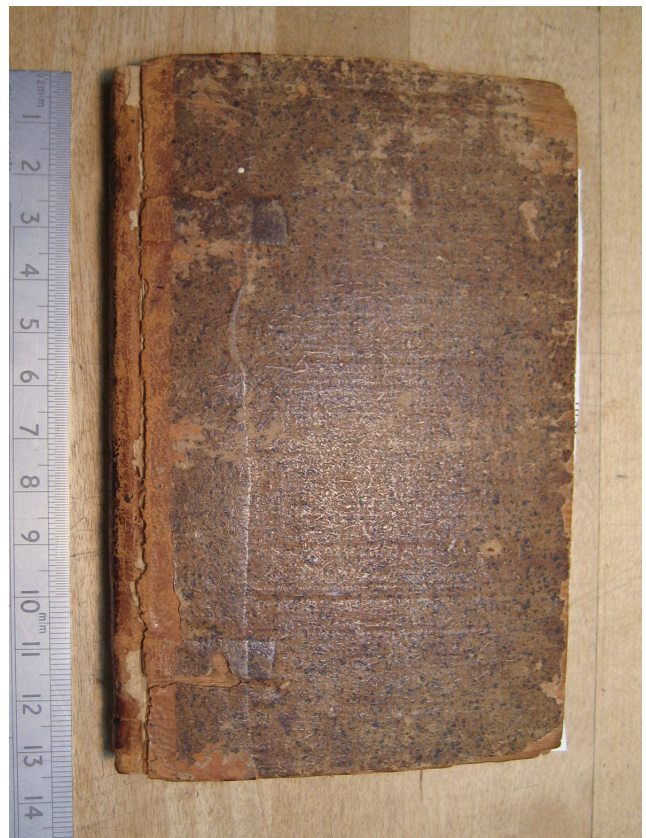


Fig. 4. The thong slips are clearly visible beneath the leather spine and sprinkled paper sides of this stabbed binding. (Jedidiah Morse, *Elements of Geography*, 2nd ed. Boston: Printed by I. Thomas and E.T. Andrews, 1796. 13.5 x 8.5 x 1.7 cm) Photo by the author, courtesy of The Library Company of Philadelphia



Fig. 5. For fast processing, this *Ready Reckoner*—a tall, narrow book containing sets of accounting tables—was sewn on four recessed cords using an abbreviated sewing structure, and only the outermost cord slips were used to attach the boards. (Daniel Fenning, *The Ready Reckoner*, 11th ed. Newburyport, [Mass.]: Printed by Edmund M. Blunt and sold by Messrs. Thomas and Andrews . . ., 1794. 20.0 x 9.2 x 2.7 cm) Photo by the author, courtesy of The Library Company of Philadelphia

a 1772 Boston imprint featured three additional pierced holes in the spine margin, suggesting that the book was issued stitched—possibly as a pamphlet—and later rebound.

Imprints in sewn bindings dated from 1713 to 1832, and may have been used more often for less ephemeral titles, since sewing—particularly on raised cords—would have been more labor intensive and thus more expensive. Sewn imprints included all three copies of a book on etiquette, as well as several of the more varied texts from the turn of the 19th century: a book of advice for women, a book of satire about women, *Arabian Nights Entertainments*, Alexander Pope’s *Essay on Man*, *The Works of Aristotle*, a book on dyeing, and a book of infantry exercises.

About one-third of the books were sewn on recessed supports—cords, tawed-skin thongs, or leather thongs (listed in order from most to least common)—and 15 percent were sewn on raised cords. Regardless of the book’s final structure, the binders generally used abbreviated sewing for the sake

of speed (see fig. 5). Binders also took time-saving measures when attaching the boards. When books were sewn on more than two cords, some of the cord slips were often trimmed flush with the edges of the spine, and only two or three were used to secure the text block to the binding. Tawed-skin or leather thongs always finished on the outsides of the boards, while cord slips usually finished inside.

Only one book—a badly deteriorated binding of William Little’s 1798 *The Easy Instructor*, a music book—may have been oversewn, without the use of sewing supports. No vertical slits could be found along the spine edges of its tattered leaves, and no cord or thong slips could be located beneath the pastedowns or the thick leather overcover. The damaged centerfolds of the folios, which possessed holes in the center, might mean that the book was once sewn through the fold. Since it was bound, however, the book has undergone multiple repair campaigns, and it is difficult to assess its original structure.

Regardless of their structure, the completed text blocks were generally left unshaped. As in Miller’s study, most of the books had flat spines; very few were rounded, and only one was backed.

ENDSHEET AND ENDBAND MATERIALS AND CONSTRUCTION

In scaleboard bindings, endsheets served to attach and reinforce the thin boards and to indicate the binding’s value: the more paper used in the endsheets, and the higher its quality, the more expensive the binding was likely to be. All but five of the books examined had separate endsheets of some kind, from pastedowns of printed waste to double folios of fine watermarked paper. Almost half had single-folio endsheets; one-third had double-folio endsheets; and one-fifth had pastedowns only.

Single-folio endsheets appeared on 38 bindings, of which roughly two-thirds were stabbed rather than sewn: a correlation between speedy text-block assembly and simple endsheet construction. The endleaves were usually made of laid paper rather than printed waste and notched for sewing. They were generally stabbed or sewn with the remainder of the text block, but occasionally they were tipped in afterward. Even in stabbed bindings, sewing thread could sometimes be seen in the hinges of the book, indicating that the folios might have been sewn on over the thongs as an added precaution. In sewn bindings, despite the abbreviated sewing within the text block, the endleaves were usually sewn all-along for added strength.

Double-folio endsheets were found on 25 bindings, and occurred far more frequently in sewn bindings than in stabbed bindings (see fig. 6), another indication of the sewn volumes’ superior quality. Their materials ranged from fine white laid papers with watermarks to coarse white wove papers with blue fibers. Double-folio endsheets also appeared with five variations, all of which supplied at least one flyleaf and one



Fig. 6. Sewn scaleboard bindings were more likely to have complex endleaves (here, a double folio with two stubs, a pastedown, and a flyleaf), and the thong slips were often visible beneath the pastedowns. ([James Buchanan,] *The British Grammar*. Boston: Printed by Nathaniel Coverly, 1784. 19.5 x 13.1 x 4.2 cm) Photo by the author, courtesy of The Library Company of Philadelphia

pastedown; the number of stubs, board linings, and flyleaves varied. The most common variation included a cut or torn stub, a pastedown, and two flyleaves; the stub was put down on top of the turn-ins, suggesting that the thong or cord slips alone were used to attach the board before covering. The least common variations were also the simplest, involving either a pastedown and three flyleaves or two stubs, a pastedown, and a single flyleaf.

The two remaining variations were more complex and appeared only on sewn bindings; in both cases, the boards were apparently attached using the cord slips as well as the outermost endleaves, which were used to line the boards. This practice may have resulted in more dimensional stability during covering.² A full-leather binding was applied over the lined boards, and the turn-ins were folded over on top of the board linings. The pastedown, or a stub and pastedown, was then adhered on top of the turn-ins, leaving one or two flyleaves free. Bindings with these endsheet structures appeared on imprints dating from 1781 to 1796, one of which—a book on etiquette—was printed on high-quality laid paper. The relatively high endsheet paper quality, and the additional time required to bind books with more complex endsheets, suggests that these bindings were more costly.

In the 16 bindings that had pastedowns alone—a brief nod to aesthetics on the binder's part, indicating fast and inexpensive work—most were of white laid or wove paper. Occasionally the grain direction of the paper was opposite to that used in the text block, making it clear that the pastedowns were from another source. One quarter binding containing a 1792 New York imprint had hooked pastedowns of printed waste, apparently from an almanac. Although the book was

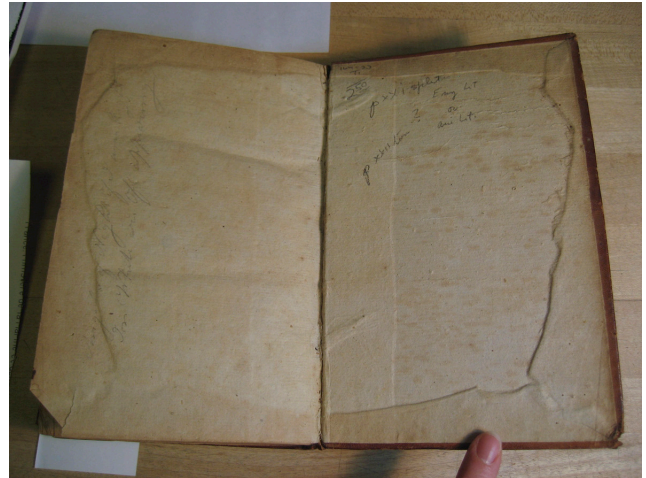


Fig. 7. Stabbed bindings often lacked endleaves or had simple, inexpensive endleaves, such as this partial lining or stub of printed waste. (John Flavel, *A Token for Mourners*. Boston: Printed for N. Boone, 1725. 13.8 x 8.4 x 1.6 cm) Photo by the author, courtesy of The Historical Society of Pennsylvania



Fig. 8. Detail of the plain worked endband found on one binding (George Fisher, *The Instructor: or, American Young Man's Best Companion*, 30th ed. Worcester, Mass.: Isaiah Thomas, 1785. Copy 3. 17.6 x 11.1 x 4.5 cm) Photo by the author, courtesy of The Library Company of Philadelphia

sewn on recessed cords, no cord slips could be detected beneath the pastedowns or paste-paper sides, suggesting that they were cut flush with the shoulders of the text block and that the pastedowns alone were used to attach the boards.

Five stabbed bindings—including two Boston theology books and three schoolbooks or primers—had no added endleaves, and were presumably the fastest and cheapest to bind. In three of them, the boards were left bare. In the fourth, a partial lining or stub of printed waste was applied to each board beneath the turn-ins, leaving the remainder of the board bare (see fig. 7). These partial linings may have served to stabilize the boards against dimensional change during the adhesion of the thong slips and full leather cover. In the fifth binding without added endsheets, the first and last printed leaves of the text block were used as pastedowns.

Endbands—which also served as indicators of quality due to the time required to make them—were found in only three scaleboard bindings, two of which had obviously been rebound. The other, a 1785 Worcester printing of George Fisher’s *The Instructor: or, American Young Man’s Best Companion*, featured primary endbands worked in plain white thread, tacked down only at the beginning, middle, and end of the text block (fig. 8). This binding, one of seven in which the boards were lined with the outermost endsheets as part of the binding process, shows no evidence of later rebounding. The carefully executed endsheets and endbands suggest that this was a more expensive binding, perhaps presented as a gift.

BOARD SHAPING AND GRAIN DIRECTION

The scaleboards examined in this study had smooth surfaces with no visible tool marks and ranged in thickness from 1 to 2 mm. In several cases—perhaps from uneven pressure applied during planing—the boards tapered toward the fore-edge, where they were particularly vulnerable to breakage. The squares were often uneven, and the boards were often flush with the text block at one or more edges. One exception was a 1771 Germantown binding, which had perfectly even 2-mm squares at head and tail and a 1.5-mm square at the fore-edge. As in Miller’s study, only a few boards were back-cornered to accommodate the turn-ins over the spine (see fig. 9).

Most of the boards had horizontal grain. Vertical-grain boards were used on only five books: 1686 and 1713 imprints from Boston and New York, respectively; the 1771 Germantown imprint mentioned above, bound in the traditional German style with raised cords and clasps (see fig. 19); and two copies of the *New England Primer* from 1814 and 1816. This suggests that vertical-grain boards, which were traditional on medieval and European scaleboard bindings, were used early in the American scaleboard-binding period, perhaps by immigrant binders or before the bindings’ weaknesses had been assessed. They may also have been used in bindings where a traditional approach was paramount, as in the German binding, and in later, cheap bindings where durability had ceased to be an issue, as in the primers. In all other cases, binders recognized the virtue of horizontal-grain boards, which continue to protect the text block even when split or chipped.

One of the books examined, a 1744 Boston imprint of Experience Mayhew’s *Grace Defended* (see fig. 18), was bound with a pasteboard front cover and a scaleboard back cover. The pasteboard was much heavier than the scaleboard, and it was also longer than the scaleboard by approximately 5 mm. The mismatch—on a fairly ornate binding with a stenciled, sprinkled double-panel design—might suggest that wooden and paper boards could be used interchangeably, even on more expensive bindings. Alternatively, the binder might have run out of the pasteboard specified for the book—a rare



Fig. 9. Detail, back-cornered board. The board also has a blind-tooled double-fillet border, an exceedingly common design feature. (John Wise, *The Churches Quarrel Espoused*, 2nd ed. Boston: Sold by Nicholas Boone, at the Sign of the Bible in Cornhill, 1715. 14.0 x 8.8 x 2.7 cm) Photo by the author, courtesy of The Library Company of Philadelphia

commodity in Boston?—and substituted scaleboard without the buyer’s knowledge.

In each of the bindings, the end grain of the boards was examined to determine the character of the wood and its species, if possible. The majority of the scaleboards were made from radial slices of ring-porous hardwood for maximum dimensional stability. Their vessels, which often formed tightly spaced rings indicating slow growth, were generally visible to the naked eye at the corners, fore-edge, or spine edge of the board (see fig. 10). The scaleboards often had no discernible rays on the tangential surface; in a few cases, visible rays created a checkered or iridescent appearance like that seen in maple. Two scaleboard bindings featured diffuse-porous woods with no visible pores and a fine, even texture. Loose wood fragments were taken from six bindings at the Library Company of Philadelphia and the Historical Society of Pennsylvania for future species identification.

During this study, wood expert Harry Alden inspected several scaleboard bindings with exposed end grain and identified nine bindings as having ash boards. These bindings contained



Fig. 10. Detail of radially cut, ring-porous hardwood visible through a tear in the leather binding of Joseph Morgan's *The Portsmouth Disputation Examined*, a 1713 New York imprint featuring vertical-grain scaleboards. (Printed and sold by William Bradford; 16.1 x 10.5 x 1.7 cm) Photo by the author, courtesy of The Historical Society of Pennsylvania

imprints ranging in date from 1790 to 1832, and they were printed in Philadelphia, New York, Massachusetts, and Vermont, suggesting either widespread use of ash to produce scaleboard or far-reaching trade in the finished product. Ash is a ring-porous wood with barely discernible rays on the tangential surface, similar to chestnut in appearance but far harder and more rigid; today it is used to make baseball bats (Alden 2011). Although ash is found in Europe as well as in North America, it has never before been linked to book boards.

According to furniture conservator Mark Anderson, colonial shingle-makers—who have been posited as one source of scaleboard—used cedar or white oak rather than ash, which does not possess the same rot resistance. In addition, while most of the scaleboards were radial in character (and might thus have resulted from splitting or riving wood), others were tangential to the point where they split through their thickness along the growth rings. This suggests that scaleboards—which also lacked the rough surface of split shakes—were not a byproduct of the shingle industry. Planes, however, can cut wood in any direction, and oversized planes seem likely to have been the tool used to produce scaleboards. To Anderson's knowledge, only furniture makers might have used thin, smoothly finished ash boards like those seen in scaleboard bindings (2011). However, it is easy to imagine that printers would also have appreciated ash's hardness and rigidity if they were using scaleboard to register their type.

COVER MATERIALS

As in Miller's study, almost 75 percent of the scaleboard bindings examined were tight-backed books in full brown leather (see fig. 11). Forty-three were from Boston; the remaining 19 originated in cities from Philadelphia to Montpelier, Vermont. The imprints they contained dated from 1686 to 1820, and—with one exception—all the books printed prior

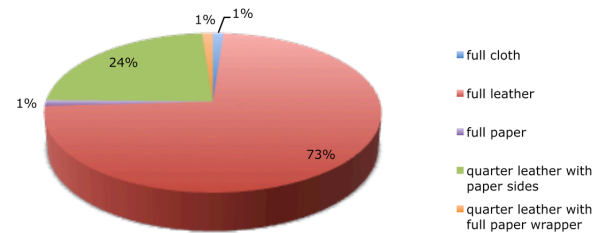


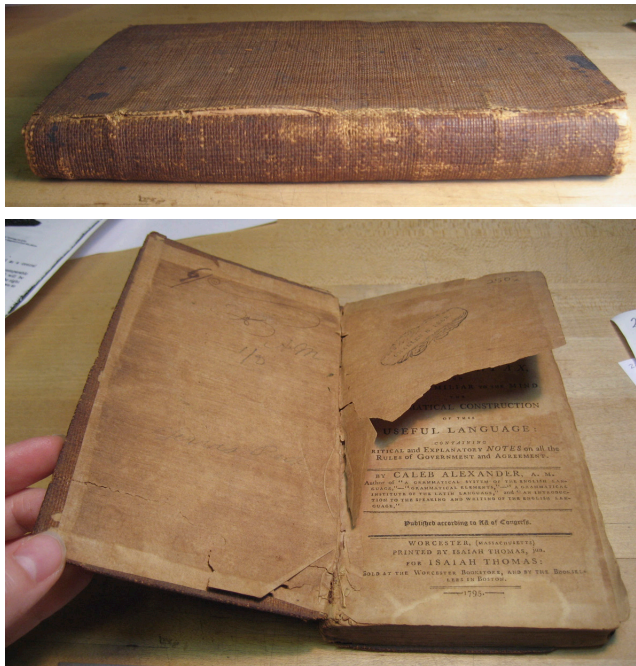
Fig. 11. Covering materials of scaleboard bindings

to 1790 were bound in full leather. Thereafter, the leather coverings began to be replaced by quarter-leather bindings with paper sides. A 1766 Philadelphia religious imprint was the first, with a sheepskin spine and marbled paper sides; the rest were printed between 1790 and 1833. The remaining books from the study group—a 1795 Worcester schoolbook, an 1803 Middletown book of sermons, and an 1820 Bellows Falls recipe book—were bound in unique ways: in full plain-weave canvas, full paste paper, and full printed blue paper over a sheepskin spine, respectively.

The books examined supported the notion that colonial binders made use of locally produced materials. In both full and quarter bindings, the leather usually displayed a wavy, linear follicle pattern and a tendency to delaminate, suggesting that it was sheepskin. Calfskin—another leather that could be produced in the colonies—also appeared to be present, but only in four of the bindings examined. Further study of the binding leathers would be required for definitive species identification.

The leather also underwent varying degrees of preparation prior to binding and during the process of fitting it to the boards. Sometimes it was quite thick and poorly pared, producing heavy endcaps; in the case of a 1742 Boston imprint, these caps were lower than the board edges and did little to protect the head and tail of the text block. The corners of full-leather bindings were also trimmed very little as a rule, with the turn-ins merely folded over one another like wrapping paper on a package. Such corners, which appeared in 58 percent of the leather bindings, were recorded as “lapped” corners. In corners that were mitered, the amount of leather left at the corner varied dramatically, and the turn-ins might meet each other or reveal the bare board between them. The turn-ins themselves were almost always irregularly trimmed, and varied from 2 mm to 3 cm in depth. The turn-ins at the head and tail were generally worked first, with the fore-edge turn-ins lapped over them. Many of these binding trends continued in the full bindings in cloth or paper, as well as the later quarter bindings.

Canvas was a relatively rare material for bookbinding prior to the introduction of impermeable, manufactured bookcloth in the 19th century, and its survival is always remarkable. Although the plain-weave canvas covering on a



Figs. 12a, 12b. Top: full canvas binding over raised cords on a 1795 schoolbook. Bottom: The canvas cover and outermost leaves are discolored and brittle, suggesting that the wood used in the scaleboards was unusually acidic. (Caleb Alexander, *A New Introduction to the Latin Language*. Worcester, [Mass.]: Printed by Isaiah Thomas, jun. for Isaiah Thomas, 1795. 17.4 x 10.6 x 1.9 cm) Photo by the author, courtesy of The Library Company of Philadelphia

1795 Latin textbook is now seriously discolored, apparently due to the acidity of the wood used in the scaleboards, the cloth in this case has proved to be almost as durable as leather (figs. 12a, 12b). The cover is plain, the corners are lapped in the usual way, and the canvas was not tied down over the raised cords on the spine. The rounded, backed spine, however, is unique. The unusual canvas cover suggests that the book might have been bound for the bookseller rather than the purchaser, or that parents buying schoolbooks commonly selected the cheapest permanent binding available (Leighton 1949).

In another experimental binding, paste paper alone was used to cover an 1803 book of sermons; losses along the spine and over the thongs indicate the weakness of paper as a covering material, at least without additional reinforcement at the spine (fig. 13). As in quarter bindings, the corners were lapped, perhaps to provide additional reinforcement for the fragile boards. Such a binding would have been less expensive and less durable than a full- or quarter-leather binding, although it was probably considered equally permanent.

Tight-backed, quarter-bound books with leather spines and paper sides were far more usual, particularly as the 18th century progressed. In this study as well as in Miller's, quarter bindings were found to utilize a variety of paper covering

materials, from the ubiquitous plain blue paper (see fig. 2) to various decorated papers. Printed waste on blue and white papers was used face-down to cover two children's books: a form of recycling for the binder, indicating the cheapest work. In general, the more expensive paste, marbled, and Dutch gilt papers were reserved for religious books and other literature, while cheap blue and brown papers were commonly used on schoolbooks, primers, and music books.

The latter—the three music books from the study group were all bound in quarter leather with blue paper sides—represent a special type of quarter binding. Because of the extreme width of their boards, books containing sheet music were particularly susceptible to damage and were provided with overcovers of thick leather or tawed skin. These covers often appeared homemade, with imperfect processing of the skin or amateurish blind tooling (fig. 14). In two cases, the overcover was folded over the boards and stitched in place with thread or string, with paper pastedowns adhered on top. In the third case, the stitching was absent, and the turn-ins of



Fig. 13. Full paste-paper binding: The decorative paper spine has largely worn away from the stabbed text block, and the tawed thongs are clearly visible beneath the paper. (Robert Russel, *Seven Sermons on Different Important Subjects*. Middletown, [Conn.]: Printed by T. & J. B. Dunning, 1803. 14.3 x 9.1 x 1.6 cm) Photo by the author, courtesy of The Library Company of Philadelphia



Fig. 14. The thick leather overcover on this music book, originally bound in quarter leather with blue paper sides, features amateurish blind tooling. (William Little, *The Easy Instructor*. Philadelphia: 1798. 14.0 x 23.5 x 3.7 cm) Photo by the author, courtesy of The Winterthur Library: Printed Book and Periodical Collection

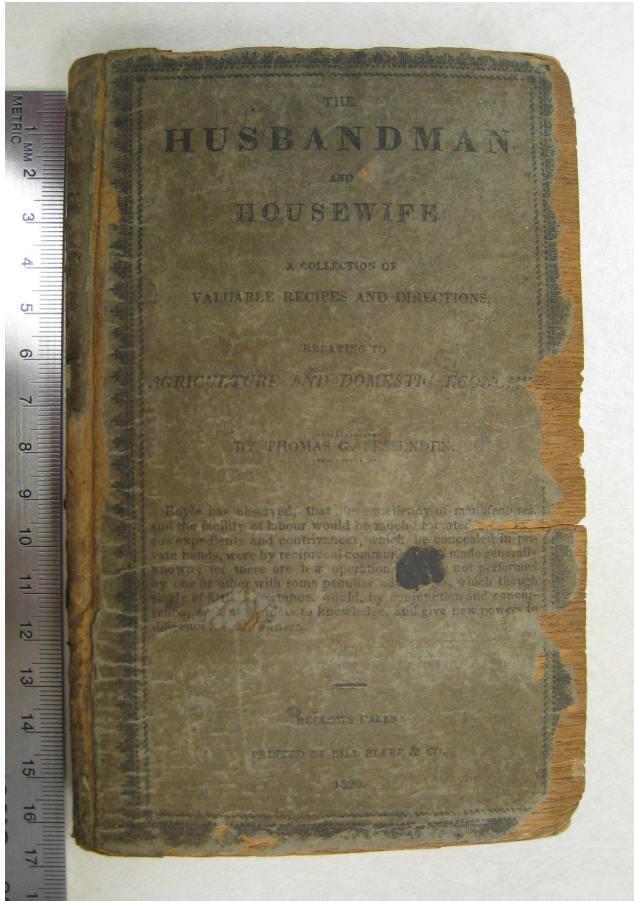


Fig. 15. For this trade binding, a printed blue paper cover was adhered over a leather spine, which provided extra protection to the stabbed text block. (Thomas Fessenden, *Husbandman and Housewife*. Bellows Falls [Vermont]: Printed by Bill Blake and Co., 1820. 16.3 x 10.5 x 1.9 cm) Photo by the author, courtesy of The Winterthur Library: Printed Book and Periodical Collection

the overcover were secured with woven textile pastedowns. The scaleboards could often be detected on these books only through tears in the pastedowns or cuts in the overcovers, which indicate the owners' care for the much-used books.

Finally, a unique binding on an 1820 recipe book features a leather spine as for a quarter binding, but is fully covered in printed blue paper. The front cover is printed with the title page from the book, with an added border that resembles the tooling on a fine leather binding (fig. 15). The spine is printed with two labels displaying the book's title and price (50¢), suggesting that this book was bound prior to retail, with details that imitated the look of fine binding without the associated cost.³

COVER DECORATION

Full leather scaleboard bindings were decorated in a variety of styles, all fairly simple and modest. In general, the leather

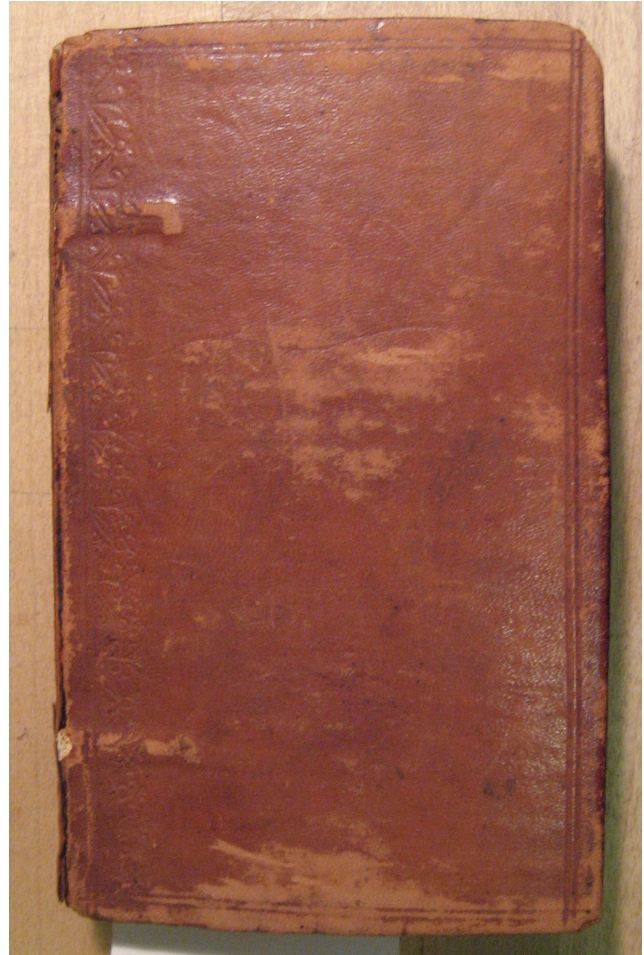


Fig. 16. Bordered panel with decorative roll along the spine edge (Henry Care, *English Liberties*, 5th ed. Boston: Printed by J. Franklin, for N. Buttolph, B. Eliot, and D. Henchman, 1721. 16.0 x 9.9 x 3.1 cm) Photo by the author, courtesy of The Library Company of Philadelphia

itself was plain (42 percent), sprinkled with stain (44 percent), or polished (16 percent). One binding was marbled with stain rather than sprinkled, and two bindings were both sprinkled and polished. The edges of the text block were sometimes left plain, but they were more often colored or sprinkled with dye or stain. These would have been relatively simple, quick methods for embellishing bindings, appropriate for books at the lower end of the market. The edge coloration suggests that the text edges were generally trimmed with a plough to create a smooth surface.

More than 30 percent of the full leather bindings had plain, untitled, and untooled covers, indicating their inexpensive, utilitarian manufacture. The remaining bindings were simply and often crudely blind-tooled. One Boston imprint with an otherwise plain cover had a decorative roll run along the spine edge of each board. Most frequently, the boards were bordered with double or triple fillet lines. Variations on

this theme included the use of a decorative roll rather than a fillet to produce the border (on a 1718 Philadelphia school-book), or the addition of extra fillet lines or rolls close to the spine edge in Massachusetts imprints, producing asymmetrical panels (see fig. 16). In six bindings, the board edges were also blind-tooled with a decorative roll.

In most cases, the books had flat or slightly rounded spines that were more often tooled than left plain. Usually, the binder tooled the spine with the same fillet used on the boards, either marking the endcaps only or dividing the spine into panels. Although each panel division was generally marked by a single tool strike, two tooled lines were occasionally used, and sometimes multiple fillets were grouped according to a pattern. In a spine with four panels, for example, the binder might employ single fillets at the endcaps, two fillets at the next station, and three fillets at the center of the spine. On some books, as Miller also found in her study, the fillet lines were markedly crooked.

When books in full leather were sewn on raised cords, the raised bands on the spine were treated in a variety of ways. In three of these books, the leather was not tied down over the cords, and the spine was perfectly plain. In a like number of cases, the leather was tied down over the cords but the spines were left untooled. Finally, the raised bands might be emphasized by tooled lines in blind or gold; the latter appeared on only three of the bindings.

While two-thirds of the full leather bindings examined were untitled or newly titled, 25 imprints—dating from 1713 to 1806—bore contemporary spine labels of gold-tooled leather or hand-written paper or vellum. One 1785 Boston imprint had an inscription (now illegible) inked directly onto the spine. Many of the books from the collection of the Historical Society of Pennsylvania possessed hand-written paper or vellum spine labels, apparently dating to the original bindings. In several cases, the labels overlapped the spine edges of the boards, and the rolls or fillets used to border the covers were impressed in the labels as well as the leather. The earliest labeled imprint from the study group is the 1713 New York printing of Joseph Morgan's *The Portsmouth Disputation Examined*; this imprint predates the earliest spine label mentioned in the literature by 13 years (French 1986).

None of the quarter bindings were titled on the spine, although one theological text had an illegible inscription in iron-gall ink on the front cover. Seventeen of the bindings featured plain spines. One 1766 Philadelphia imprint had blind-tooled oak leaves stamped in each panel between the raised cords, which had been tied down but not offset with tooling. Two 19th-century flat-spined bindings—one book of stories and one spelling book—had single gold-tooled fillet lines dividing the spine into panels: an unusual touch of elegance on otherwise unremarkable books for children.

Two full-leather bindings stood out because of their relatively sophisticated decorative schemes. The cover of

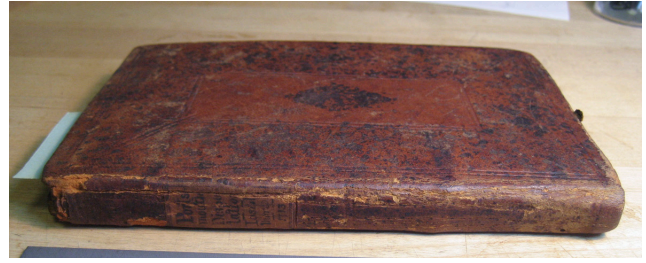


Fig. 17. Stenciled, sprinkled mitered panel with central lozenge from a 1713 New York imprint of Joseph Morgan's *The Portsmouth Disputation Examined*, printed and sold by William Bradford (16.1 x 10.5 x 1.7 cm) The grain of the scaleboard is vertical rather than horizontal. Photo by the author, courtesy of The Historical Society of Pennsylvania

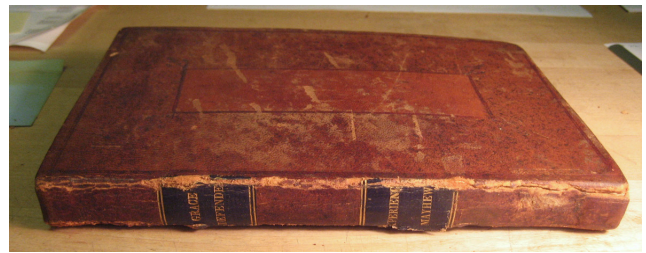


Fig. 18. Stenciled, sprinkled double-panel binding from a 1744 Boston imprint of Experience Mayhew's *Grace Defended, in a Modest Plea* (printed by B. Green and Company for D. Henchman in Cornhill; 20.5 x 13.6 x 2.9 cm) The front board is pasteboard rather than scaleboard and 5 mm longer than the back board. Photo by the author, courtesy of The Historical Society of Pennsylvania

the 1713 New York imprint mentioned above was tooled with a mitered double panel; a stencil was used to create a sprinkled outer panel and central lozenge (fig. 17). As Willman Spawn has noted, New York binders were the only colonists who placed central stamps on their bindings (1983). The cover of a 1744 Boston imprint of Experience Mayhew's *Grace Defended, in a Modest Plea* featured a blind-tooled double panel with fleurons stamped at the corners (fig. 18). The outer panel was sprinkled, but the inner panel was masked off and left plain. While these are not fine bindings, lavished with gold tooling, they represent an unusual investment in time on the part of the binder and of money on the part of the buyer.

One more full-leather binding deserves special attention because of its unusual construction (fig. 19). Although this 1771 Germantown imprint is bound in 2-mm-thick, vertical-grain scaleboard rather than shaped wooden boards, in all other ways it is a traditional German binding. The thick, solid text block of fine laid paper was sewn on five raised cords, and the spine was given a slight round and supplied with a textile spine lining, now visible at the torn head and tail caps. When the book was bound in scaleboard, the black, polished sheepskin cover was tied down over the cords. Thick



Fig. 19. Christopher Saur's 1771 Germantown imprint of Johann Philip Schabale's *Die Wandlende Seel, das ist: Sesprach* is a traditional German binding on vertical-grain scaleboard rather than shaped wooden boards, complete with raised cords, even squares, fore-edge clasps, and a thick text block with a slightly rounded spine (17.0 x 10.0 x 4.4 cm). Photo by the author, courtesy of The Library Company of Philadelphia

leather straps with metal hooks on the ends were nailed to the fore-edge of the lower board, and copper-alloy clasps were nailed to the upper. Notwithstanding its thin boards and plain cover, this sober and well-made book would have been relatively time-consuming and costly to produce. Like the two decorative bindings mentioned above, it illustrates the higher quality of some bindings in scaleboard.

DAMAGE AND REPAIRS

In scaleboard bindings, the usual weaknesses of paper and leather are compounded by the fragility of thin wood and the mechanical stresses produced by abbreviated binding structures. In addition to the damage normally associated with heavy use, such as torn endcaps and split hinges, scaleboard bindings often exhibit chipped corners, split boards, and insect damage. Ring-porous boards with more tangential character are particularly prone to splitting, often displaying limp leather over areas of board loss. Text loss is also common, particularly in stabbed bindings, which demand both flexible paper and flexible thongs in order to open well. With increasing age, rigidity, and use, the supports break at the hinges and sever the text-to-binding attachment. In an effort to combat these weaknesses, libraries and private owners have employed a variety of repair strategies, illustrating the enduring importance of these small, unpretentious books.

Failure of the binding leather is a common problem in scaleboard bindings, particularly at points of flexion (over the joints and spine), abrasion (at board corners and edges), and misuse (as at the headcap, which readers often use to pull books from the shelf). The leather joints in about one-third of the scaleboard bindings had failed partially or completely due to wear or to red rot, a condition in which sulfuric acid produced by environmental pollutants and tanning agents renders the leather weak, friable, and rust-red in color. The endcaps were missing or torn in approximately one-quarter of the books. Five books had been professionally rebacked,

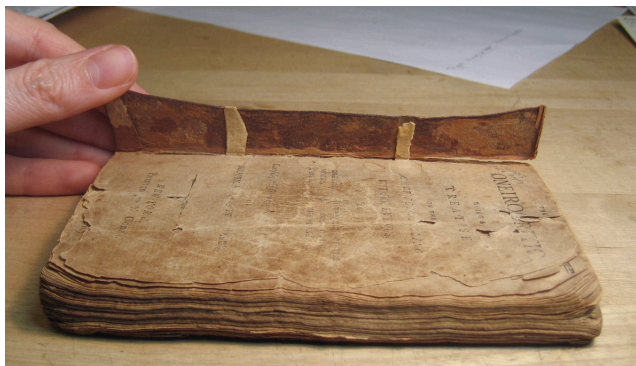
and the spines of others had been reinforced with cloth, paper, new leather, or synthetic materials. The split leather overcover of a music book had been repaired (or perhaps first assembled) by stabbing holes along the edges of the slit with an awl and sewing through them. Although the thread has since vanished, the repair provides evidence of the desire to protect and preserve the volume.

When paper was used to cover scaleboard bindings, it often abraded and tore; the colored papers were also prone to fading when exposed to light. The single full-paper binding in the survey suffered almost complete loss of the material over the spine, and the color of its paste paper is now difficult to discern (see fig. 13). The paper sides of several quarter-leather bindings displayed similar damage, with remnants of blue paper adhered only in scraps and tatters over the boards. The turn-ins and lapped paper corners, protected from abrasion and light damage on the insides of the boards, were more likely to remain intact. It is interesting to note that the single full-canvas binding—a precursor to the durable bookcloth case binding developed in the 19th century—fared comparatively well (see fig. 12a).

In stabbed bindings, the leather joints, inner hinges, and text-block supports were particularly susceptible to failure, resulting in partial or complete board detachment. In one book, the front board was entirely lost, leaving behind only the thong slips and leather spine that once secured it (fig. 20a). In music books, whose wide boards and text blocks increased the leverage along the joint and the likelihood of thong breakage, the heavy leather overcovers were probably designed to reinforce the board attachment. Even in smaller scaleboard bindings, board detachment had occurred in eight cases, not including the professionally rebacked books. Previous owners reattached boards in various ways, either tipping them to the flyleaves or, more surprisingly, punching holes in the thin wood with an awl and using thread to secure the boards to the text block.

Stabbed bindings were also particularly vulnerable to textual loss. If the thongs broke at the hinges or within the text block, the leaves could become detached; some books had experienced serious losses. In a case where the supports had broken at the hinge and the leather had pulled away from the spine of the text block, the book was in danger of falling out of its binding entirely (fig. 21). Past readers have reinforced the text-to-binding attachment in a number of ways, from reinforcing the hinges to running new supports through the leaves and securing them to the binding. Loose leaves or covers were often held in place with sewing thread or pins, sometimes with multiple repair campaigns and extensive stitching. These laborious homemade repairs show how deeply the books were valued by their owners, despite their plain bindings.

Of course, the thin, brittle scaleboards possessed their own vulnerabilities and vices. Chipped corners, split boards,



Figs. 20a, 20b. The front board of this quarter binding has become detached from the spine leather and thongs; loss of the paper over the sides may have contributed to board breakage and loss. ([Havez,] Ibrahim [Ali Mahomed]. *The Oneirocritic*. New York: Printed for N. Ogden, [1790.] 14.0 x 8.6 x 2.0 cm) Photo by the author, courtesy of The Library Company of Philadelphia



Fig. 21. This stabbed text block has pulled away from its tight-backed leather binding. (James Janeway, *Invisibles, Realities*. Boston: Reprinted by Tho. Fleet, for J. Blanchard, 1742. 14.0 x 8.8 x 2.4 cm) Photo by the author, courtesy of The Historical Society of Pennsylvania



Fig. 22. Two horizontal splits in the front board of this spelling book have been stitched back together with thread and then reinforced with straw paper; the tail has been oversewn to the spine leather. (Noah Webster, *Elementary Spelling Book*. Watertown, New York: Published by Knowlton and Rice, 1833. 17.6 x 10.8 x 2.0 cm) Photo by the author, courtesy of The Library Company of Philadelphia

and minor breakage were common in both full and quarter bindings, although paper loss over the boards of the latter dramatically increased the risk of substantial wood loss (fig. 20b). Books with vertical-grain boards sometimes lost half their covers, and insect damage was common. Acidic woods used in scaleboard may also result in damage to covering materials and the paper of the text block, as witnessed by the brittle, discolored canvas and endleaves in the full-cloth binding (fig. 12b). Book owners often repaired or reinforced broken boards by adhering twine or heavy paper over splits or stitching across the breaks. As in the stitched board reattachments, these efforts were often surprisingly successful (fig. 22).

IMPLICATIONS FOR THE CONSERVATION OF SCALEBOARD BINDINGS

In many ways, scaleboard bindings present familiar conservation problems: delaminating sheepskin, abrasion and wear at the corners, split hinges and joints, and the threat of textual loss. The two exceptions are the scaleboard itself, with its tendency to chip, fracture, and split, and the stabbed binding structure, which limits the opening of the book and places the text block in jeopardy. Despite the aggressively minimal way in which these books were bound, however, the majority—at least in this study group—were in surprisingly good shape. Even in dilapidated bindings, structural intervention is rarely called for. These rare and historic bindings, which represent the reading materials of the common people during the colonial period and the infancy of the United States, contain not only important texts but evidence of the tools and materials with which their binders worked. Their value as artifacts calls for a minimal, conservative approach to conservation, focused on preventive care, safe handling, and appropriate housing.

Proper care for scaleboard bindings begins with identification. As time allows, libraries with collections of early Americana should survey their holdings for small, plain books with the characteristic damage associated with scaleboard bindings: chipped corners, limp leather over split or broken boards, and visible wood grain in abraded areas, at the inner hinges, or under the pastedowns. Finding and identifying these hidden bindings—particularly if they are catalogued as such after discovery—will open new avenues for scholarly research as well as ensuring optimal treatment for the books.

By far the most effective way to protect scaleboard bindings is through proper storage and housing. Many of the bindings examined were sturdy and physically stable, and could be shelved upright without injury. However, the books' small size makes them vulnerable: they are easy to lose sight of, particularly in mixed ranges of books, and they may be shoved to the back of a shelf without notice. Whenever possible, scaleboard bindings should be shelved with other rare books of a similar size. Particularly small or damaged bindings should be provided with custom-made, hard-sided archival enclosures. In this study, many such books were shelved either tied with twill tape or housed in open paper envelopes. While this served the purpose of keeping the pieces of the book together, a rigid enclosure would provide more support. Very small scaleboard bindings may be housed in boxes larger than themselves, with custom-made inserts to hold the books securely and permit their safe removal (figs. 23a, 23b). Such boxes are also easier to locate and retrieve for library patrons.

Scaleboard bindings may be particularly vulnerable to fluctuations in temperature and humidity, which could promote expansion, contraction, and cracking of the thin, reactive wood. Ideally, they should also be stored in constant conditions of 18–20°C (64–68°F) and 45–55% relative humidity

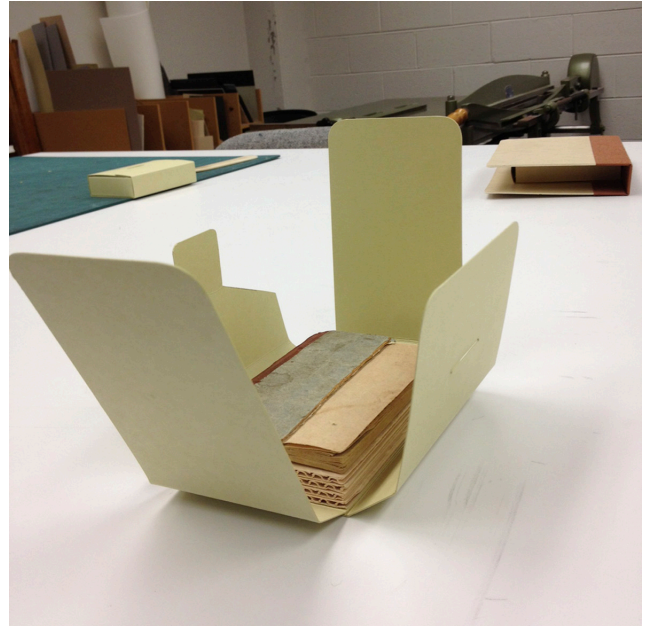


Fig. 23a. For very small books, a tuxedo box of alkaline cardstock built up with alkaline corrugated board provides rigid support.

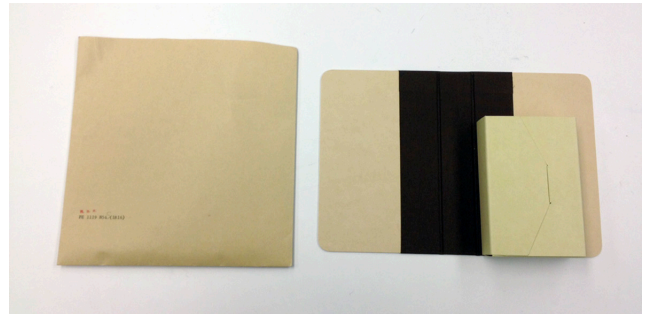


Fig. 23b. Adhering the tuxedo box within a pamphlet binder allows the book to be shelved upright: a sturdy, safe replacement for paper folders used as housings.

(Canadian Conservation Institute 1995). In private collections or small institutions where such tight environmental controls are impossible to maintain, the books should be stored in an interior space rather than against an outside wall; attics and basements should also be avoided because of their fluctuations in temperature and their increased risk of leaks. In such situations, protective enclosures would be doubly helpful, providing not only structural support but protection against environmental changes, light, atmospheric pollutants, insects, and dust.

Appropriate handling is also important for the long-term protection of these bindings. Stabbed books may open poorly, particularly if the paper of the text block is stiff and inflexible, if the book was stabbed too far into the spine margin, or if it was repaired with rigid materials at the hinge. Readers should be trained to open the books with care, never forcing the boards

or pages farther apart than they will easily go. They should also provide the book with appropriate support while reading. Many of the scaleboard bindings, such as the primers, are so small that reading them cradled within one hand may be safer than trying to use a standard book cradle and book weights. However, most may be safely used with small book cradles or cushions. Music books, with their longer boards and text blocks, are in particular need of support while reading.

If a scaleboard binding is selected for exhibition, it should be secured in a custom-made cradle that does not strain the fragile binding structure. If necessary, the leaves may be strapped with polyethylene strips to keep the book open, but the angle of display should not put stress on the spine. The page opening should be changed regularly, and the book should not be kept on prolonged display. Light levels should be low—50 lux or less—and ultraviolet illumination should be eliminated to protect the paper and media from photo-oxidation and fading.

Digitization projects, which are becoming more and more common as libraries attempt to increase Internet access to their collections, may present particular challenges where scaleboard bindings are concerned. Because the books often open poorly, flatbed scanners are not appropriate for digitizing them. Whenever possible, overhead scanners that can accommodate for the angle of the book opening should be used instead. Because of their historical importance, the books should not be disbound for imaging. If necessary, the processing of scaleboard bindings should be delayed until more flexible imaging equipment is available.

In some cases, minor aesthetic or structural conservation treatments may be desirable. Red-rotted leather—particularly common in 19th-century bindings—makes books dusty and difficult to handle. Torn endcaps and split joints can also increase the risks of handling or display. When necessary, the leather on scaleboard bindings may be consolidated or repaired with appropriate adhesives and mending tissues. Red-rot cocktail—a blend of equal parts dilute Klucel G in isopropanol, isopropanol, and SC6000, an acrylic-wax emulsion—is often chosen as a leather consolidant because of its apparent penetration and long-term flexibility, although it can darken the leather. Mending tissues employing Lascaux 498 HV, an acrylic dispersion that remains soluble in ethanol and isopropanol, provide a modicum of reversibility and protection against discoloration of the leather. In cases where less intervention is called for, the affected books should be provided with custom-made boxes or wrappers, both to contain any detached pieces and to protect other library materials from the fine red dust produced by the disintegrating leather.

Split or broken scaleboards may be similarly contained, or they may be mended using an appropriate conservation adhesive. Hot hide glue or gelatin is traditionally used for repairing wooden furniture, and it may also be used to mend

split boards. The repair campaigns of the books' prior owners also indicate that reinforcing the boards with paper may be sufficient to stop a crack from propagating or to keep a split board intact. A remoistenable tissue employing a thin, strong, translucent Japanese paper and an equal blend of methyl cellulose and wheat starch paste can be used for local, visually discreet board reinforcement, with or without an internal hide-glue or gelatin mend. This adhesive mixture, which can be reactivated with a blend of alcohol and water, limits the amount of moisture to which the boards are exposed, since absorption and drying could cause the wood to deform.

The thongs and cords used as binding supports, which are so often broken over the hinge or within the text block, should generally be left untouched, as replacing or repairing them makes the history of the binding difficult to decipher. Although damaged supports place the text block at risk, housing the affected books in archival boxes will prevent outright loss of information. In cases where books are heavily used, and their intellectual content is thought to outweigh their historical context, broken supports may be replaced by new alum-tawed thongs, cords, or linen or ramie tapes. Sewing over recessed cords, even where historically inaccurate, may be preferable to re-establishing a stabbed binding, as it places less strain on the text block; the existing spine notches may be utilized for this purpose. In any major treatment, of course, the historical structure of the book should be thoroughly documented before it is dismantled, and the original materials should be retained with the book.

In part because the books are so small and utilize high-quality handmade papers, the text blocks are usually in good condition, with few tears and losses. Like many books of this period, however, they are subject to iron-gall ink corrosion from the owners' inscriptions and annotations. If necessary, ink-damaged areas in scaleboard bindings may be reinforced with a thin solvent-activated mending paper, such as Berlin tissue coated with 2% Klucel G hydroxypropyl cellulose in ethanol (Pataki 2009). The adhesive on this fine, transparent repair material can be reactivated with small amounts of ethanol, limiting swelling of the cellulose during mending and reducing the stress on paper oxidized by the iron-gall ink. Although more invasive aqueous treatments for iron-gall ink exist, such as bathing the affected paper in a calcium phytate solution, this approach is not recommended for these rare, historically important books.

SCALEBOARD BINDINGS: CONCLUSIONS AND NEXT STEPS

This study of 85 scaleboard bindings from three library collections lends credence to existing scholarly research on these early American books while raising intriguing new questions. While most of the examined books were small and plain, with stabbed text blocks—reinforcing the notion that scaleboard

bindings were a cheap, utilitarian format—others made use of sturdy sewing structures, substantial endsheets, and elaborate decorative schemes. The care with which a few of the books were finished shows that scaleboard bindings could be elegant as well as crude. The overall progression in binding styles—from full leather and quarter bindings to innovative canvas, paste paper, and printed paper bindings—also illustrates the final evolutions in a chain of simplification and economy that began with the printing press and ended with the complete mechanization of the binding trade by the late 19th century.

The increased variety in content over the study period, which spanned from 1686 to 1833, clearly reveals both readers' changing tastes and the freedom offered by the expansion of printing from Boston and New England to the mid-Atlantic colonies. In addition to the expected schoolbooks and sermons, books in later decades also contained poetry, advice, etiquette, literature, and trade information. Sewn binding structures and double-folio endsheets were more common on these less ephemeral texts, suggesting that readers were willing to pay more for them.

Most surprisingly, the boards in nine bindings were identified as ash—a wood that has never before been identified with bookbinding and that may suggest linkages among bookbinders, printers, and the colonial furniture industry. However, multiple wood types were clearly represented in the scaleboard bindings examined, from diffuse-porous woods with very fine, even texture to ring-porous woods with distinct ray patterns. Further wood identification—coupled with study of historical records that document the early American printing, binding, and furniture industries—may help to establish the manufacturing origins of these thin, finished boards and to explain observed patterns of use.

Despite their fragile materials and rapid assembly, many of these books were designed to impress their buyers or recipients. Laborious homemade repairs also show how deeply the books were valued by their owners, despite their plain covers. These rare and historic bindings, which represent the reading materials of the common people during the colonial period and the infancy of the United States, contain not only important texts for average readers but evidence of the tools and materials with which their binders worked: a glimpse of the complex, changing intellectual and material contexts of the book in the transatlantic economy of the late 17th to early 19th centuries. Further identification, documentation, and preservation of such bindings will spur scholarly research and appropriate care for these unassuming but important books.

ACKNOWLEDGMENTS

Many generous souls helped with this research. Julia Miller provided enthusiastic support and guidance, as well as sharing her remarkable fund of existing data on scaleboard bindings. Emily Guthrie, Helena Richardson, and Chela

Metzger—Winterthur librarians and library conservator—spent hours with the author in the rare book stacks, searching for books in thin wooden boards. Book conservator Jennifer Rosner and other staff from the Library Company of Philadelphia combed the stacks of two institutions for scaleboard bindings Miller had not had time to examine, and allowed the author to work alongside the conservators in the Library Company bindery. Alice Austin shared her experiences with recreating scaleboard bindings, and showed the author the results of her labors. Mark Anderson and Stephanie Aufret performed initial assessments of the wood used in scaleboards, and Harry Alden donated his valuable time to make definitive identifications. Rebecca Smyrl valiantly and ably edited this manuscript. Finally, a George Stout Grant from the Foundation of the American Institute for Conservation made the presentation of this research possible.

NOTES

1. Julia Miller has since published a summary of her later research, which mirrors the results of this study: "Not Just Another Beautiful Book: A Typology of American Scaleboard Bindings," *Suave Mechanicals: Essays in the History of Bookbinding*, vol. 1, ed. Julia Miller (Ann Arbor, Mich.: The Legacy Press, 2013), 246–318.
2. Those who have attempted to recreate scaleboard bindings using thin plywood laminates—which should be more dimensionally stable than the veneer-like boards used in original bindings—still complained of the wood's reactivity to moisture when the leather was applied. Thanks to Alice Austin of The Library Company of Philadelphia for this piece of information.
3. According to the Federal Reserve Bank of Minneapolis, 50 cents in 1820 is the equivalent of \$8.35 in today's currency: a relatively inexpensive price for a book (www.minneapolisfed.org/community_education/teacher/calc/hist1800.cfm, accessed 10/05/2013).

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Book and Paper Group Tips Session 2013: Contemporary Treatment—Tips and Techniques

KAREN DABNEY

TIP: A “HOT AIR” TRICK FOR LOWERING PH IN AQUEOUS TREATMENT

PROBLEM

The author used this “hot air” trick in 1993 to remove salts from a water-damaged 1840s lithograph, *The Presidents of the United States*, published by E. B. and E. C. Kellogg (fig. 1). During testing, the lithograph’s external salts were revealed to be soluble in water. The lithograph was washed with deionized water on a suction table to allow monitoring of the salt removal. The surface salts dissolved readily. Contrary to expectations, the hardened ridges of salt deposited within the paper remained insoluble.

ASSESSMENT

The salt deposits appeared to be associated with water damage and may have leached from a plaster wall into the framed print. The salts could have been components of lime plaster: hydrated lime (calcium hydroxide) and a common additive to lime plaster, gypsum (calcium sulfate dihydrate).

Calcium hydroxide has low solubility in water and is alkaline. Gypsum is more soluble in water and is not alkaline. If the print’s surface salt was gypsum and the insoluble interior salt was calcium hydroxide, the latter could be dissolved by acidifying the water.

SOLUTION AND CONCLUSION

This strategy required a method of lowering the pH that would not leave a residue in the paper. Carbonic acid seemed

This informal tips session took place on June 1, 2013, during the 41st AIC Annual Meeting in Indianapolis, Indiana. The moderator, Book and Paper Group Program Chair Sarah Reidell, selected and organized the tip contributors after placing an open call for volunteers from among the BPG and AIC membership. Readers are reminded that the Book and Paper Group does not necessarily endorse the methods or materials shared by tip contributors. Further evaluation or research is advised before putting treatment observations into practice.



Fig. 1. A detail of the lithograph’s verso before treatment, showing the small white salt deposits scattered over the surface and a hardened ridge caused by internal salt deposits. The dark accretions appeared to be residue from insect egg cases.

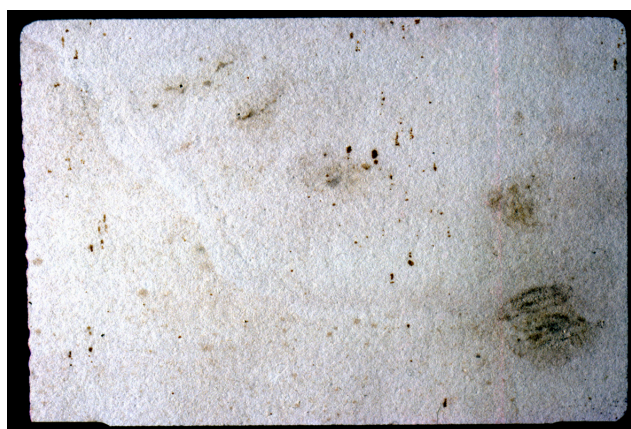


Fig. 2. The same detail of the lithograph’s verso after treatment, with the salts and accretions removed

like a promising option. Although the conservation lab at the Pennsylvania Historical and Museum Commission did not have a carbon-dioxide tank readily available, the author realized she had everything she needed to test this option immediately. She exhaled repeatedly into a beaker of deionized water while stirring it vigorously, and was able to decrease the pH of the water from 5.5 to 4, as measured by ColorpHast pH strips. Local applications of the pH 4 water to the lithograph on the suction table quickly dissolved the internal salts, leaving bulging voids that were burnished flat with a bone folder through Hollytex, then dried under restraint. A “hot air” trick solved the problem (fig. 2).

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BETH DOYLE

TIP: A PAPYRUS REHOUSING PROJECT AT DUKE UNIVERSITY LIBRARIES

There are just over 1,500 papyri in the Duke University Libraries David M. Rubenstein Rare Book and Manuscript Library. They date from the 12th century B.C.E. to the 10th century C.E. Each fragment is housed between two pieces of glass sealed with adhesive tape. These glass packets used to be stacked three layers deep in boxes, with only a piece of blotter or folder stock between the layers.

A papyrus rehousing project was undertaken for several reasons. The existing housings did not provide adequate protection against physical damage and loss (fig. 3). The retrieval process was also difficult and potentially dangerous. To get to a papyrus fragment, staff had to search through the layers to find it, pull it from the box, then walk downstairs to the reading room. What ultimately made Conservation prioritize this project was discovering that the library renovation schedule had changed: in one year, the entire Rubenstein Library collection had to be moved to swing space.

Due to time and budget constraints, the new housing strategy had to be affordable and fast to assemble, and standard metal-edge boxes had to be used since there was no time to make custom boxes. The solution was a folder made from two pieces of four-ply mat board hinged together with Tyvek tape (fig. 4). Inside the folder is a piece of ¼-inch Volara foam with a custom-cut window that fits the glass packet. The foam is attached to the back board with double-sided adhesive tape. Seven of these folders fit into a 3-inch-deep metal-edge box (fig. 5).

On the front of each folder is a “picture label” that shows the contents and its accession number (fig. 6). This label is a quick way to confirm that the item inside is what it should be, and if it is missing it shows the staff what to look for. Each



Fig. 3. Retrieving papyrus from old housing



Fig. 4. Mat board and Volara folder



Fig. 5. Folders in new box

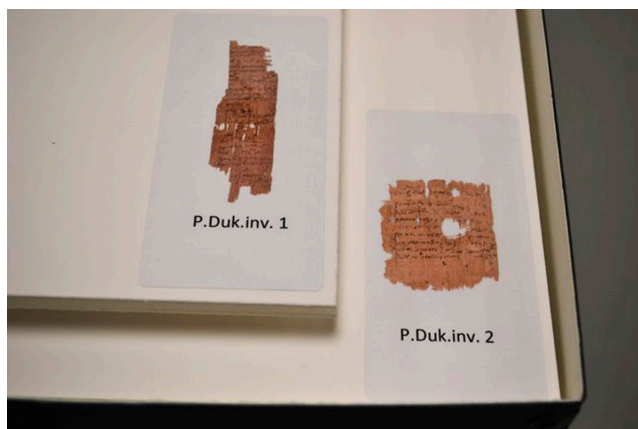


Fig. 6. Picture label on outside of folder

papyrus fragment is photographed with minimal image processing, so its shape can be seen. Microsoft Word and an Avery label template are used to print the labels, and the ink is fixed with a thin layer of Klucel G. These labels have been so successful that they are now used on enclosures for any non-book object.

Each month, the lab held two “Papyri Days” in which everyone worked to produce the folders in an assembly-line fashion. Before Papyri Day, the mat board and Volara were cut to size and stacked in a central location in the lab. On Papyri Day, one lab member took pictures; another made the labels as the images were saved to the server. The rest of the staff worked on hinging the mat board covers and cutting the Volara to fit the glass packets. At the end of the day, the folders were put in order and placed in new metal-edge boxes. Box labels were created once all the papyri were accounted for and in order.

The rehousing project was successfully finished on time and on budget, and the papyrus fragments take up less space

than before. The feedback from the reading room staff has been very positive. “It’s been wonderful to circulate these documents in such clean, safe, and elegant housings! Many thanks to Conservation for this work, which makes our work so much easier,” said David Pavelich, Head of Research Services in the Rubenstein Library.

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JAMYE JAMISON

TIP: LASCAUX LININGS IN THE TREATMENT OF PARK PLANS FROM THE CLEVELAND PUBLIC LIBRARY

In addition to checking out the latest bestseller, patrons of Cleveland Public Library (CPL) can also view many wonderful pieces of Cleveland’s rich history. ICA Art Conservation often partners with CPL to conserve some of the more unique works in the collection, including a selection of seven park plans from a large collection of 1890s maps used in the design and creation of some of Cleveland’s most beloved parks. These large-scale topographic renderings were hand-drawn in ink, graphite, and watercolor on thick paper backed with fabric and rolled for transport to and from the field. Over many years of use and storage, the plans were in a severely deteriorated state. The paper was brittle, fractured, and beginning to detach from the fabric backing, with numerous losses already present and many more pieces tenuously attached (fig. 7). Because of the maps’ size—they ranged from 8 to 13 feet long and about 4 to 5 feet high—the plans needed to be stored rolled.

Rather than trying to mend the split fabric and reattach the loose pieces to the unstable and deteriorating backing, a different approach was developed using Lascaux adhesives



Fig. 7. Before treatment: The map is unstable and unable to be photographed vertically. Courtesy of John T. Seyfried

to make heat-activated lining paper on a large scale. Taking a page from textile conservation, and with a lot of trial and error, a technique was devised to apply a 2:1 mixture of Lascaux 498HV and Lascaux 360HV to Japanese paper, creating a thicker layer of adhesive on one side only. First, the lining paper was placed on a piece of silicone-release polyester film. The Lascaux mixture was then thinned 1:2 with water, and two coats of the dilute adhesive were brushed onto the lining paper, allowing each coat to dry fully before applying the next. The lining paper was then peeled off the polyester film and flipped over, so a coat of full-strength adhesive could be applied to the now-sealed paper. If multiple lengths of paper needed to be joined along a horizontal seam to make a wider, longer sheet, the edges were overlapped about $\frac{1}{4}$ inch and tacked down lightly with heat.

Once each map had been humidified and flattened, it was placed face down on silicone-release polyester film.



Fig. 8. During treatment: The original fabric backing is present on the left, one vertical section is partially exposed in the center, and the map is partially lined with Lascaux lining paper on the right. The paper is suspended on a roll over the map. Courtesy of John T. Seyfried



Fig. 9. After treatment: Now with a handling edge of folded lining paper, the map is held vertically on a magnet board for photography. Courtesy of John T. Seyfried

The old fabric backing was peeled from the back of the paper, and the pieces were lightly tacked together with a thin film of the same Lascaux mixture to hold them in place. Vertical sections 6 to 8 inches wide were released from the fabric one at a time, and then the new lining paper was laid down and attached with heat using a Willard iron (approximately 45 seconds at 80°C). In this way, all the small fractured pieces were kept together and aligned properly while the backing removal for that section continued (fig. 8). If necessary, the verso could also be dry cleaned before the lining paper was laid down. Once the entire map was lined, the edges of the lining paper were folded in to create a sturdy border for handling (fig. 9). With the more flexible and stable Japanese paper backing, the objects can be rolled media-side out for long-term storage with minimal stress to the thick, brittle paper.

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LAURA MCCANN

TIPS: SUPERSTORMS AND CONTEMPORARY DISASTER PREPAREDNESS AND RESPONSE

Major storm events can cause widespread devastation to property and infrastructure systems, creating additional challenges for the response and recovery efforts of flooded libraries and archives. Staff from New York University (NYU) Libraries' Barbara Goldsmith Preservation and Conservation Department experienced these challenges when responding to the flooding of two collections in New York City after Superstorm Sandy: NYU Ehrman Medical Library and a private collection of Irish-Americana. Widespread and prolonged electrical outages, as well as damage from the force of the storm surge, required adjusting existing emergency plans and rethinking preparedness activities.

PREPAREDNESS TIPS

- Predefine collection priorities. Predefined and recorded collection priorities enable efficient allocation of recovery resources, insuring that resources are not wasted recovering easily replaceable materials.
- Consider superstorms in risk management. Assessments should include the risk of major storm events and 100-year floods. High-priority collection items must not be stored in flood zones or basements.
- Keep paper copies of plans. Updated paper copies of emergency plans must be periodically distributed to staff for safekeeping in both homes and offices.

SUPPLY TIPS

- Head lamps and lanterns: Recovery activities during prolonged electrical outages require light sources that facilitate work, such as headlamps and battery-powered lanterns, as well as extra batteries.
- TEK-wipes: A nonwoven polyester/cellulose blend, TEK-wipes are a sustainable alternative to blotters and paper towels. Available in rolls or small sheets, TEK-wipes are inert, washable, reusable, highly absorbent, and have excellent wet strength.
- Personal protective equipment (PPE): Stock lots of personal protective equipment (especially gloves) for staff working on response and recovery, as well as for administrative and curatorial staff who may visit the site.
- Power supply: An independent power supply, such as a generator, will greatly support response and recovery efforts. Understanding local electrical power systems and possible alternative power sources can aid in identifying sites for triage and freezing.

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RENATE MESMER

TIPS: MATERIALS AND TECHNIQUES FOR MOUNTS, ENCAPSULATIONS, AND BOOK SUPPORTS

MOUNTING A TWO-PIECE VELLUM MANUSCRIPT ON A SLIDING MECHANISM

Storage space in museums is often very tight. This 17th-century iron-gall-ink vellum manuscript had been cut in half for unknown reasons. The manuscript was folded, wrinkled, and distorted, and the iron-gall ink was flaking (figs. 10, 11). The vellum was humidified and carefully flattened, and the flaking ink was consolidated. In order for the reader to view and study the item as one piece while minimizing the amount of storage space needed, the manuscript was housed in a folder made from corrugated board (fig. 12) with the halves mounted on opposite sides (fig. 13). One half was mounted on a sliding mechanism made from a wide silicon-coated Mylar belt wrapped around heavy cardstock or museum board. The two halves of the manuscript were mounted with narrow strips of polyester film, which were laced through the mounting support to the back. A tab allows readers to easily slide one half of the vellum manuscript until it is lined up with its opposite part (fig. 14).

MOUNTING A WAX SEAL

Wax seals at the Folger Shakespeare Library are often mounted using strips of folding box board (fig. 15). The folding box board is scored to the thickness of the seal (fig. 16) and cut

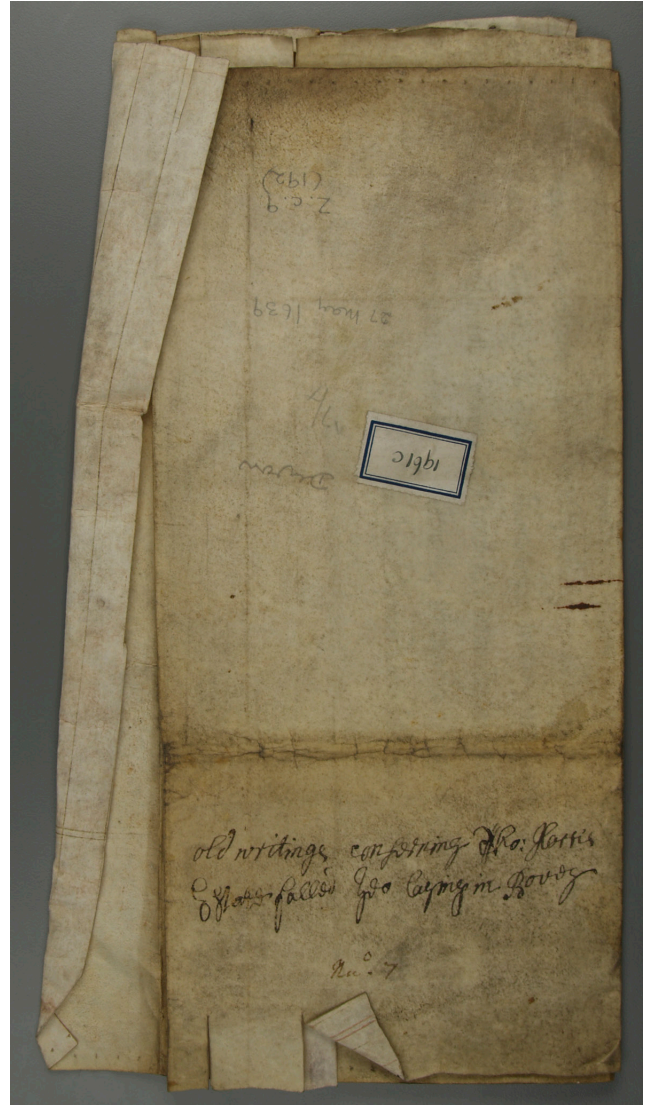


Fig. 10. Folded vellum manuscript before treatment



Fig. 11. Opened vellum manuscript before treatment



Fig. 12. Closed corrugated-board folder from Conservation by Design

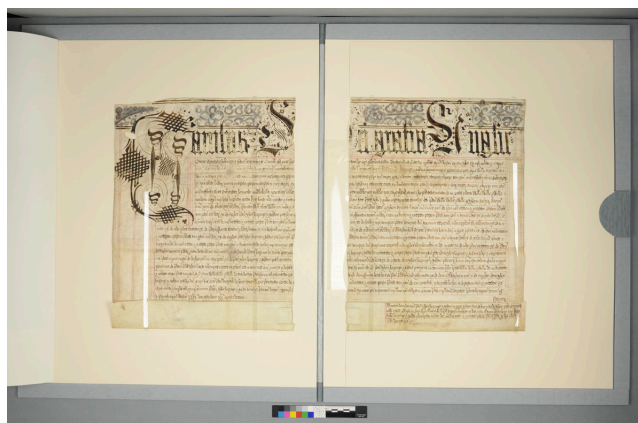


Fig. 13. The two halves of the manuscript mounted opposite to each other



Fig. 14. Right half of the manuscript lined up with the left half using the sliding mechanism



Fig. 15. Wax seal mounted to a backing board using folding box board from Conservation by Design

into a strip, leaving excess material beyond the scored line. Incisions are cut up to the scored line (fig. 17) so that the board can be folded and molded around the seal. Half rounds or short strips can accommodate the unevenness of the seal (fig. 18). The folding box board is flexible when pulled away from the seal and allows for safe and easy removal of the seal from the mount if needed.

ULTRASONIC WELDING WITH POLYESTER FILM AND HANJI PAPER

Flower petals found loose in a 17th-century cookery and medicinal recipe book (fig. 19) needed to be safely attached in the book in their original positions. The petals were sandwiched between pieces of Berlin Tissue and encapsulated in 3-mil polyester film with a medium-weight Hanji paper hinge (fig. 20). The encapsulated petals were reinserted in their exact original position by tipping the paper hinge into the gutter of the page with paste (fig. 21).



Fig. 16. Step 1: The folding box board is scored to the thickness of the seal (here, the distance between the bottom edge of the board and the fold line).

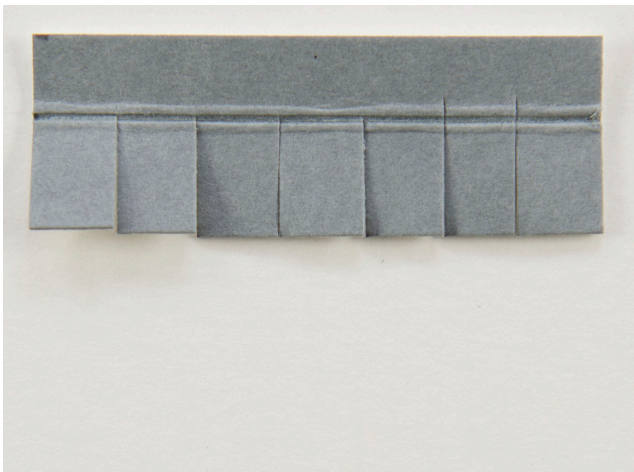


Fig. 17. Step 2: A strip is cut wider than the seal thickness, with the scored line running along it, and incisions are cut in the excess to allow the strip to bend.

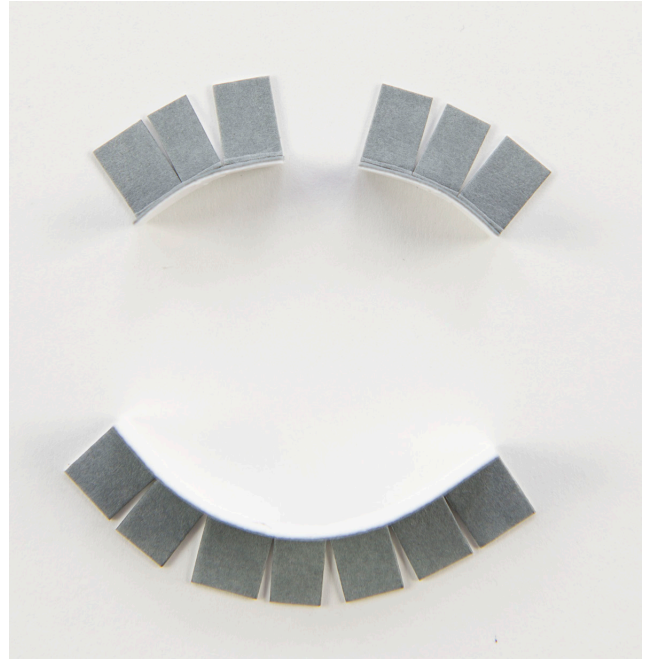


Fig. 18. Step 3: Tabbed strips are cut to length and bent to accommodate the shape of the seal.

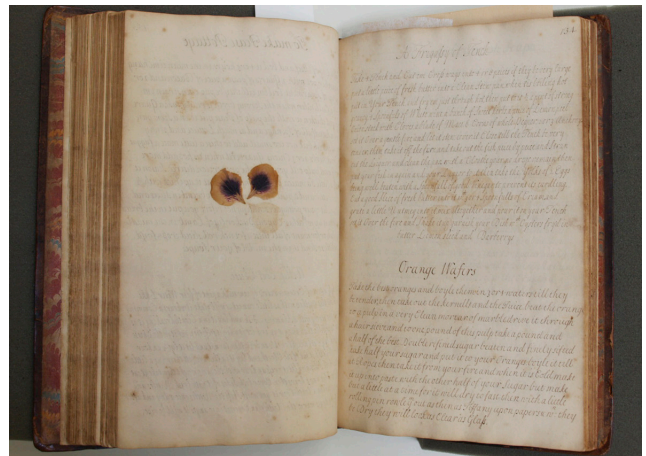


Fig. 19. Flower petals in the book before treatment



Fig. 20. Diagram of encapsulation assembly. The Berlin tissue is from Gangolf Ulbricht in Germany.

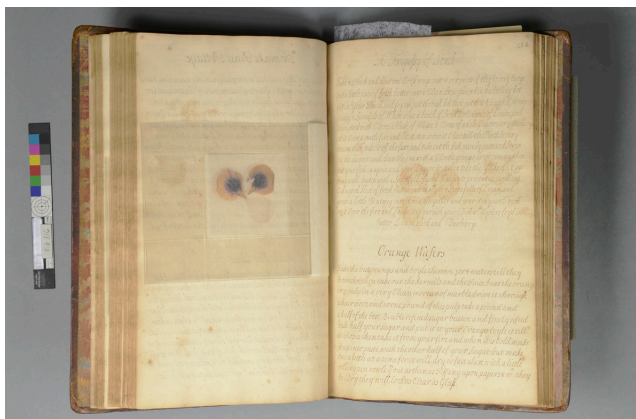


Fig. 21. Flower petals encapsulated after treatment



Fig. 22. Fragile book supported by an adjustable book cradle made from corrugated board

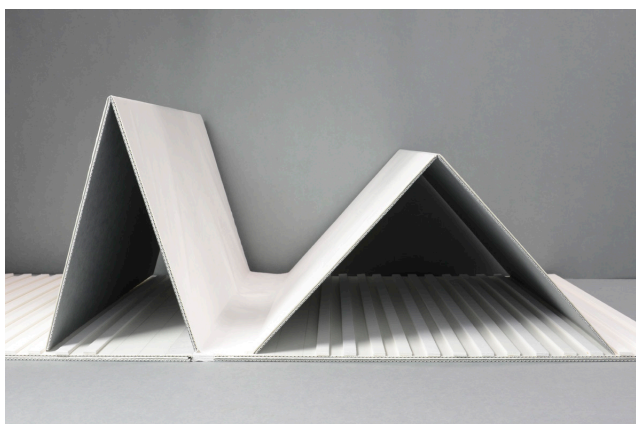


Fig. 23. Folding legs make the cradle fully adjustable

ADJUSTABLE BOOK SUPPORT FOR EXTREMELY FRAGILE BOOKS

In order to reduce handling of a fragile item, an adjustable book cradle made from corrugated board can be built to fit and house the item while work is ongoing (fig. 22). Two folded pieces of corrugated board support the book boards. They are mounted spine-width apart to the base of the cradle and draped with Tyvek to protect the book cover. Strips of a thick and sturdy material spaced evenly across the corrugated-board base allow the positions of the folding legs to be adjusted (fig. 23).

CLEARING AN INCORRECT FOLD IN VIVAK

An inexpensive embossing heat tool (Marvy Uchida) can be used to heat up an incorrectly placed fold in Vivak (PETG, polyethylene terephthalate). The fold will start clearing around 220°F. See video clip at <http://youtu.be/oCnawlrSi3g>.

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KAREN L. PAVELKA

TIP: OIL-ABSORBENT PADS AS USEFUL TOOLS FOR DISASTER RESPONSE

During a Spring 2013 class on disaster-response techniques, the students designed a water event and a fire event (fig. 24). Hurricane Sandy was very much in the news when the class began, which inspired the students to add motor oil to the exercise. For the mock water disaster, objects were soaked in tap water, lake water retrieved from Ladybird Lake in Austin, Texas, and seawater fabricated with Instant Ocean, a commercially available blend of salts. Duplicate batches were created with motor oil added to each batch.

Cleaning the motor oil proved to be difficult. Oily objects were rinsed in soapy water, then clean water, but this was only somewhat effective. Then Rebecca Elder, a colleague, found “scavenger pads” in the Grainger catalog. After these had been ordered and tested, they were found to be somewhat useful for containing and controlling the oil. More importantly, they allowed the oil to be disposed of more safely and allowed less of it to go down the drain.



Fig. 24: Class members with respirators

The pads, made of polypropylene fibers, attract the oil and repel water. They are designed to be floated on the oil-contaminated water; when they become saturated, they can be removed and replaced. In tests with water and oil in beakers, they seemed to be effective and removed virtually all the oil. The pads were also tested on oily paper, books, and ceramics, and while they did not poultice oil from cellulosic materials as hoped, they were less messy than paper towels, largely because they contained the oil without the water.

Searching "oil absorbent pads" on any search engine will produce multiple suppliers. The pads come in a range of qualities, from rough to smooth, and some suppliers will give samples. No brand comparisons have yet been made. The pads are also relatively cheap; ordered through the University of Texas system, the 16 x 20-inch pads cost about \$0.70 each.

The small experiments the class did are described on the web at www.ischool.utexas.edu/~pavelka/Oil_scavenger.html. The work is more anecdotal than scientific, but it may be useful. No more tests are planned with the pads because it's tiresome to clean up oil in the lab.

ACKNOWLEDGMENTS

Thanks to Emily Rainwater for presenting this tip.

Karen L. Pavelka, Lecturer, School of Information, University of Texas at Austin, pavelka@ischool.utexas.edu

SHELLY SMITH

TIP: ACTION BIAS

As a conservator in a public research library, the author is routinely asked to talk to non-conservators (other library professionals, members of the general public) about conservation. For many years, these presentations have ended with a quotation: "Don't just do something, stand there." These words from the White Rabbit in Walt Disney's *Alice in Wonderland* (1951) are meant to convey that the urge to do something with damaged materials—repair a torn page with pressure-sensitive tape, glue a loose bit of cover with white glue—can sometimes cause more harm than good. It's important to take the totality of the information into account before deciding on a course of action.

In the business world, this urge to just do something is called "action bias," and it's generally thought of as a positive trait: a way to engage, to encourage performance, and to inspire new thinking. However, action bias can also be detrimental. For example, a person might feel an obligation to act due to the influence or expectations of others (whether perceived or actual), even if evidence exists that it is better not to act.

This can be illustrated with the example of a soccer goalkeeper. In a penalty-kick situation, a goalkeeper must choose an action (to stand or to dive to one side of the goal) before gathering enough data (which way the ball is headed) to support that action. Statistics show that standing in the center of the goal (doing nothing) would lead to the most success (Bar-Eli et al. 2007). However, the expectations of both the goalkeeper and of the spectators make it nearly impossible to just stand there and not attempt to block the kick.

Imagine an analogous situation in which a conservator is presented with a damaged object. The urge is to solve the problem; the conservator knows s/he can do the work, and the curator wants it done. But is doing something the best course of action? Perhaps the "damage" is a feature of the artifact, and conservation would irreversibly alter it (e.g., evidence of artist's intent in an unfinished artist's book, or historic value in the case of dark marks and ingrained grime on Dickens's personal reading copy of *A Christmas Carol*). The best choice for the object at that particular moment might be to do nothing. Sometimes doing nothing gives us time to wait for new and emerging research that could inform future treatment decisions. In addition, sometimes doing nothing is the best choice for everything else in the conservator's care: time spent on one object translates into time not spent on something else. In a world of limited resources (both time and money), conservators should consider action bias when deciding on a course of action. It is in their nature, education, and ethics to want to do something because they can or should, but they ought also to be able to give themselves permission to wait and see.

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Shelly Smith, *Head of Conservation Treatment, The New York Public Library, Barbara Goldsmith Preservation Division, shellysmith@nypl.org*

JUDITH WALSH

TIP: A SIMPLE SUCTION-DISK EXTENSION FOR TREATING BOUND ITEMS

A cheaply made, flexible extension for a table-mounted suction device was found to be useful in treating stains in bound materials.¹ A long strip of flexible plastic, such as polyester or polyethylene film, is folded over itself to become a channel to pull a vacuum from the tabletop suction device to the area below the stain.

To make one, cut a strip of plastic about 4 or 4 ½ inches wide, and two times as long as needed to extend into the volume to be treated. Fold the strip in half to locate the center, and cut two rectangular openings as illustrated in figure 25.

Next, assemble two layers of screening (thicker Pecap or window screening) and one layer of thick polyester web (Hollytex). These should be about ½ inch smaller than half the plastic strip in both dimensions (fig. 26).

Fold the plastic strip around the two layers of screening and polyester web, and seal the three open sides with tape (fig. 27).

Position one opening in the channel above the suction disk, and feed the length of the strip under the page to be treated, as seen in figure 28. The other opening will fall below the stain to be treated. The double layer of screening prevents the channel from collapsing as the air is pulled through it. A sheet of filter paper works well as the absorber in the system; a blotter is often too dense.

NOTES

1. This device was invented by the paper-conservation majors in the Buffalo Class of 2012: Lauren Calcote, Gwenanne Edwards, Saori Kawasumi, and Kesha Talbert.

Judith Walsh, *Professor, Art Conservation Department, SUNY Buffalo State College, walshjc@buffalostate.edu*

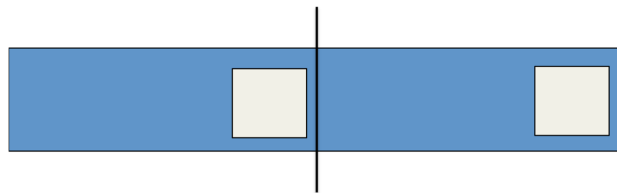


Fig. 25. The plastic channel showing the placement of the two openings to be cut: the openings should be smaller than the dimensions of the suction device.



Fig. 26. The three layers of material to be placed inside the plastic channel: the layers allow the passage of air through the plastic to the suction device.

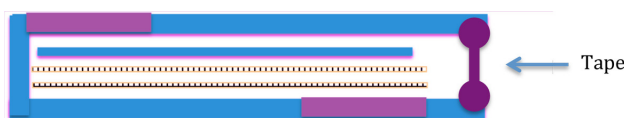


Fig. 27. The assembled package in cross section: note the tape at the edges.

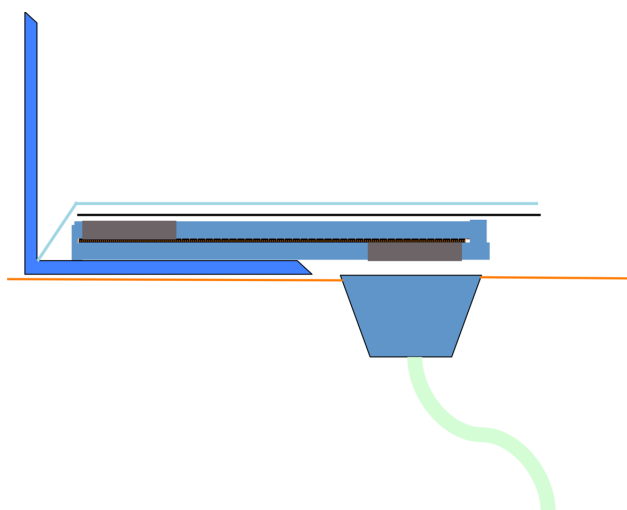


Fig. 28. The extension device in place under a leaf in a bound volume, extending down the text block to the table-mounted suction device. A piece of absorbent filter paper is placed under the stained leaf.

JUDITH WALSH

TIP: A WICKING SYSTEM FOR REMOVAL OF SOLVENT-SOLUBLE STAINS

In this system for stain removal, a paper object sits in contact with solvent that can only evaporate along a paper wick. The combination of a long exposure time and the strong wicking action of the evaporating solvent draws the stain out of the paper into the wick at the drying interface.

Make a small tray of polyester film slightly larger than the item to be treated. Secure the corners. In a fume hood, line the tray with cotton blotter, and wet the blotter with the appropriate solvent. Create a wick by creasing a piece of Whatman filter paper that will sit below the stain, and extend it above the edge of the tray at the side closest to the stain (fig. 29).

Place the stained item on the solvent-saturated blotter, with the stain positioned over the filter-paper wick. Cover the item with another sheet of polyester film the same size as the tray, so no solvent will move out of the tray except through the wick (fig. 30). Wait patiently. As the solvent evaporates, it will carry the soluble products up the wick to a tide line at the drying interface.

Judith Walsh, Professor, Art Conservation Department, SUNY Buffalo State College, walshjc@buffalostate.edu



Fig. 29. Tray of polyester film containing blotter and sufficient solvent to saturate the blotter. The creased filter-paper wick is seen at the right.



Fig. 30. The object is positioned on the blotter with the stain over the wick. A sheet of polyester film rests over the item, and the solvent eventually evaporates up the wick.

Archives Conservation Discussion Group 2013: Is it Real? The Value and Ethics of Using Surrogates

ABSTRACT

The Archives Conservation Discussion Group moderated a discussion delving into the issues, uses, and needs of surrogacy in collections. The demands on physical collections are growing as interest in unique collections increases. These demands are a concern to the conservation and preservation community. Surrogates are often suggested in order to mitigate damage and exposure of the physical objects. This solution is a controversial topic. Some have embraced this practice while others refuse to make the switch. A summary of the presentations and the subsequent discussion session is provided below.

SUMMARY OF PRESENTATIONS

JEANNE DREWES

REPLACE, REPAIR, REMOVE, OR REMAKE: DECISION-
MAKING FOR SEVERELY DAMAGED ITEMS IN GENERAL
COLLECTIONS

Libraries view the Library of Congress as the library of last resort or the library of record. When an item is requested for use, it should be mechanically sound. However, there are times when materials are so badly damaged that they cannot be used. Those materials come to the Binding and Collections Care Division. A flowchart was developed to aid staff in making decisions on these damaged materials (fig. 1). After many other decisions, there is an option for producing a facsimile. When a damaged title is within copyright, it may not be digitized and published online; therefore, a

This open discussion took place on May 31, 2013, during the AIC 41st Annual Meeting, May 29–June 1, 2013, Indianapolis, IN. The moderators organized and led the discussion and recorded notes. Readers are reminded that the moderators do not necessarily endorse all the comments recorded, and that although every effort was made to record proceedings accurately, further evaluation or research is advised before putting treatment observations into practice.

physical facsimile of it may be necessary. When a digital copy is created, the Library of Congress also keeps a physical copy. Digital copies are rigorously checked for quality. If a physical facsimile is created, any original pieces to the item are kept with it as well. For example, the design on the cover may be retained and put in a pocket of the newly created, bound facsimile. Accompanying materials may include items such as maps and color plates, all from the original, which are inserted into the facsimile. A note is added to the catalog record listing the original elements retained. A whole process is now in place to ensure that the collections are usable by researchers. Facsimiles work because they ensure that a mechanically sound object can be used by researchers.

Jeanne Drewes, Chief of Binding and Collections Care and Program Manager of Mass Deacidification, Library of Congress

GARY FROST

DIORAMA: INTERPLAY OF ORIGINALS AND COPIES IN
EXHIBITS

We are confronted with a lot of binaries such as originals and copies, screen and print. The large space between the two binary views, originals and copies, is referred to as a diorama. Exhibits are moving away from the original object to re-representation of the original as a physical or digital surrogate. The “cabinet of curiosities” or Wunderkammer was popular in the 17th century. The 19th–20th centuries saw a transition from artifact-rich, systematic exhibits to dioramic or habitat installations. Much like those early cabinets of curiosities, libraries exhibit groups of things and interpret their presentation. The displacement of physical artifacts has become more apparent. We are moving away from the real things to their representations or facsimiles. In addition, captions that interpret the collection are added to the re-representation of the items. We go to an exhibit to be, if not enthralled, then at least transported into a new perspective on the given topic. The exhibit represents a

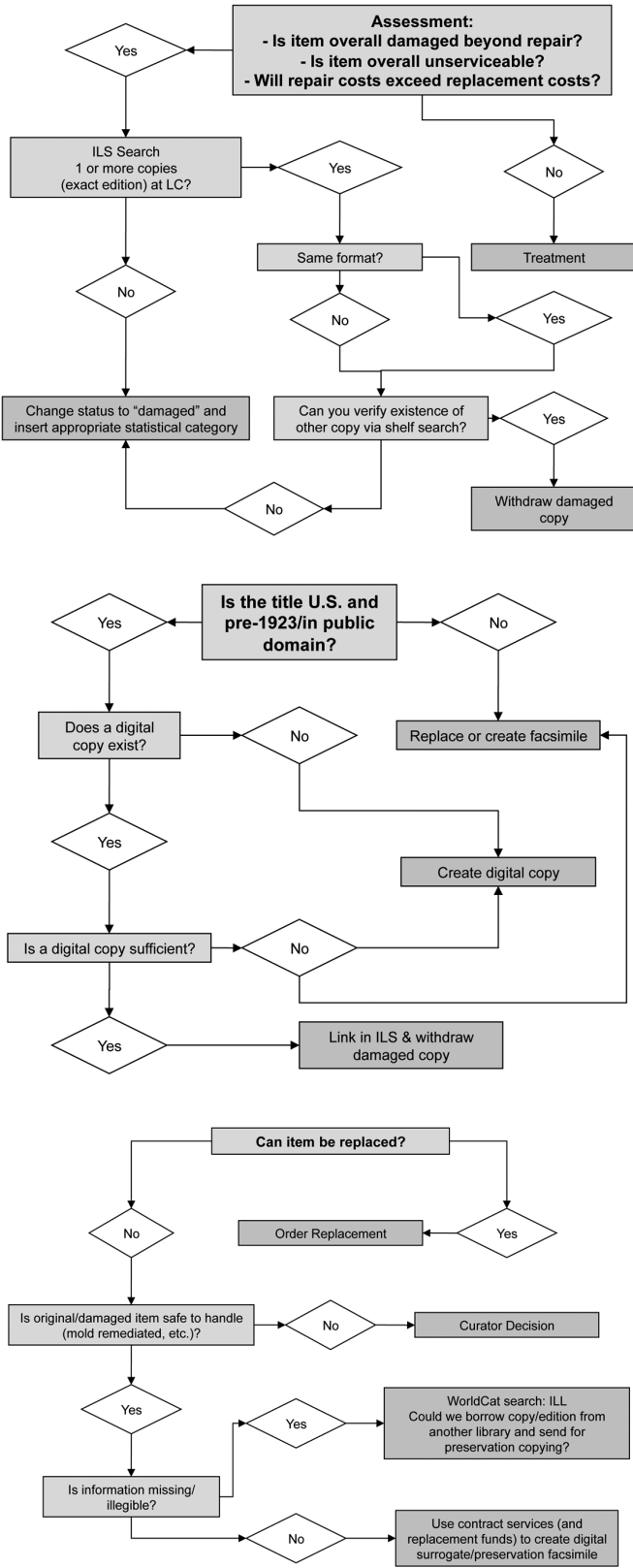


Fig. 1. Library of Congress flowcharts for decision-making regarding damaged books and the production of facsimiles

moment of learning or a moment of discovery. Those behind the curtain—the preparators, conservators, and curators—take the same journey as the viewer.

According to the 1968 Webster’s Dictionary, “The diorama is an imaged succession of brilliant scenes or episodes imperceptibly merging one into another like a pageant in miniature.” All are key words in the circumstance of interplay.

The displacement continues as more information is placed into databases and is extracted from databases. The digital re-representation in effect proliferates the copies before the emergence of the exemplar in a strange reversal of authentication. Conservators can offer insight into the authentication of the artifact as well as the modification of the artifact. Therefore we can extend the preservation agenda forward by authenticating the process of authentication that is inherent in exhibits and by acknowledging the provenance of the original. This can be the conservator’s special contribution.

Gary Frost, Conservator Emeritus, University of Iowa Libraries

JANE E. KLINGER

THE RELATION OF THE SURROGATE AND THE REAL

The use of surrogates at the U.S. Holocaust Memorial Museum (USHMM) can be viewed through the lens of the development of digital reproduction. The USHMM has always had a strong commitment to authenticity in presenting the history of the Holocaust. Thus, in developing the permanent exhibition, the museum determined that the most effective way to remember the victims, honor the survivors, and respond to Holocaust deniers was to display only original artifacts. The overarching framework of the main exhibition is a carefully constructed, strictly chronological format, making it difficult to alter an area or exhibit case. There was, however, a nod to preserving light-sensitive material early on. Items could be removed from permanent display when like could replace like: one copy could replace another, or—in some cases—an item could be replaced with another item that was similar in size, format, and content.

At the opening in 1993, the museum ran into some snags. Lenders imposed restrictions on exhibition parameters of unique items. The fledgling museum’s response in 1992 was to hire an artist experienced in producing facsimiles using materials consistent with those of the period. The first time this approach was used was in reproducing the McCloy letter that belongs to the National Archives. The letter is an important item in the exhibition. In it, Assistant Secretary of War John McCloy writes to the World Jewish Congress about why the administration will not honor their request to bomb Auschwitz. The artist used a period typewriter and paper and recreated the stamps. The facsimile is embossed with the name of her company. The copy of the letter has

been on display for 19.5 years, longer than is preferable by the conservation staff.

The children's drawings from the orphanage in Theresienstadt could also be on exhibition for only six months. The Jewish Museum in Prague agreed to allow the USHMM to have an artist create facsimiles of the drawings and requested a second set of facsimiles be produced for them. The Rassenschande poster is not an artist's reproduction because it does not duplicate the original printing method or materials. Instead, a member of the design and production staff made a silkscreen reproduction.

About seven years after the opening of the USHMM, discussions were held regarding the condition of the affidavit of Rudolf Hoess regarding the number of Jews and other victims gassed at Auschwitz. It had been on permanent display since the opening and the ink had faded considerably. The value of preserving the original was discussed at length with the curator. In this instance, the museum did not want to appear to be manufacturing evidence and so decided to make an obvious photographic reproduction of the letter. In addition to the label stating that it is a reproduction, visitors have visual cues that help them identify it as such. The museum has also used traditional photographs as reproductions in other instances, for example as a surrogate for the forged passport of Vladka Meed, who was living under an assumed identity.

As time progressed, different reproduction techniques were employed. The plan and advertising poster for the ship *St. Louis* were also replaced with reproductions after unsuccessful attempts at trying to find additional copies. The curator agreed to use reproductions because they serve more as a background in the exhibit case than as primary objects. A photograph of the poster was taken and the traditional film negative was scanned and then printed. Within the following year, reproduction of the ship's plan was completely digitally produced. By visiting the U.S. Holocaust Memorial Museum, one can see the development of the production of surrogates from artist-made facsimiles to full digital reproductions.

Jane E. Klinger, Chief Conservator, United States Holocaust Memorial Museum

VALERIE HOTCHKISS

FROM PHYSICAL ARTIFACTS TO COPIES TO SUPER SURROGATES: THE USE (AND ABUSE) OF SURROGATES IN SPECIAL COLLECTIONS

At the University of Illinois, teaching and exhibition are the lifeblood of the library. At a teaching library, as stewards of one of the best rare-book collections in the country, staff don't want to tell scholars that they are not worthy of consulting the originals. The Rare Book Library shuns the use

of surrogates in exhibition for the same reason. The use of facsimiles cheapens the whole experience and makes the library seem more off-putting and arrogant than it is already perceived to be. People do not want to see copies; it is the real thing that takes the public's breath away. This is the so-called "Clooney Law" of exhibits: It is one thing to see George Clooney in a movie but quite another to have a glass of wine with him. The library wants visitors to experience the thrill of the real thing.

What if a given library doesn't have the proper conditions, such as lighting, temperature, or proper cases? What if the item needs to be placed on exhibit for an extended period of time? These limitations can be used to advocate for better exhibition space at the institution. Conservators should not endanger original materials, but neither should they dumb down exhibits if they can avoid it. Building limitations should not be a justification for fooling the public.

There are many innovative ways to use facsimiles in conjunction with the original. If the real thing is absent, the copy tends to fall flat for the visitor. In some cases, however, facsimiles can be used effectively to enhance the exhibit. They can show details, inform a text panel, or show more than one portion of a book. There need to be visual cues to denote a surrogate. Facsimiles should not be placed in book cradles or mounts, and they should be prominently labeled as copies. When used properly, surrogates can broaden the curatorial range and can supplement the visitor's experience. Even more impressive is the use of digital displays to flip through a book. The First Folio display at the Folger Shakespeare Library allows visitors to digitally flip through the entire book, just below an exhibit of the real thing. This can especially engage younger visitors—often more so than the book itself.

The most respectable and common use of digital facsimiles in exhibition work—the online exhibit—is a useful phenomenon that allows us to curate exhibitions of our collections that can reach a far broader audience than any event in our galleries. But the ground rules are clear to everyone involved. Looking at an image online—even a beautiful, amazingly detailed image that shows every chain line and ink splatter—one remains quite aware that it is not the real thing. Digital surrogates can be used to "use" or see items that are too fragile to be handled.

Some are moving away from the online exhibit to providing access to e-versions of rare books or "super surrogates," as in the "value added Ebook" series or ShE-Book project at the University of Illinois. In addition to providing digital access to the complete book, the tablet-friendly platform also offers searchable text and translations, a virtual visit to the vault that provides a 360° view of the book, and a commentary by a well-known teacher of each text.

In conclusion, there are distinct places for copies, facsimiles, and super surrogates in special collections work, but not in exhibition cases and not in the hands of researchers

unless requested. But for enhancing access, study, and understanding, our brave new world that has such pixels in it is a wonderful place to be.

Valerie Hotchkiss, Director of the Rare Book and Manuscript Library and Andrew S. G. Turnyn Endowed Professor, University of Illinois at Urbana-Champaign

MARIEKA KAYE

SURROGATE USE IN INTERACTIVE EXHIBITS

These days visitors expect more interactive elements in exhibits. Very often interaction is achieved through digital means, such as digitized books with pages that are turned through a computer screen. At the Huntington Library there is a permanent exhibit called *Beautiful Science: Ideas That Changed the World*, which is housed in the Dibner Hall of the History of Science. There are a number of interactive elements in this exhibit, such as replicas of scientific instruments, but unique challenges arose with anatomical books containing movable parts. The challenge was to provide viewers with the experience of using the books while still keeping the delicate originals safe. The items were digitally scanned, cut out, laminated, and then reassembled. The parts were sewn together with a thin elastic beading cord so that the viewers could flip through them with flexibility and ease. The downside is that the parts often become loose and damaged from so much use. It is helpful to have extra copies of the movable parts made and ready for replacements. Conservation staff members routinely walk through the exhibit checking on the physical integrity of the surrogates. There is a lot of manual labor and maintenance associated with these structures.

There are times when library items are too delicate to be handled as desired, but book conservators strive to prepare



Fig. 2. A visitor interacts with a surrogate of an anatomical model from George Spratt's 1841 *Obstetric Tables*, Huntington Library. Courtesy of Marieka Kaye

and care for items so they may be physically handled, not just placed in a vitrine and kept locked away. Fortunately there are creative solutions such as the construction of surrogates, which allow people to still have an intimate encounter with the structures firsthand, as was originally intended. At the Huntington Library the anatomical models are displayed next to the originals, enhancing the visitor's experience (fig. 2).

Marieka Kaye, Exhibits Conservator, The Huntington Library

MEG BROWN

WEARING TWO HATS: EXHIBIT COORDINATOR AND CONSERVATOR

Most conservators assume that curators will object to the use of a facsimile. It precludes us from even asking the question, "Is it okay to exhibit a facsimile?" Conservators need to gauge how much interest is in the original. If facsimiles are made, then they can increase the legibility of an illegible original. Facsimiles can also be used to digitally resize an item if the original does not fit in the exhibit case. A facsimile can be made better than the original. As an example, illustrated figures from a Dickens novel were scanned, and puppets were produced from them, making 3D objects from 2D objects (fig. 3). This enhanced the exhibit by allowing the curator to add detail to a story (fig. 4). Sometimes facsimile-making is about the interpretation and the story the exhibit is trying to tell rather than about the objects themselves.

Facsimiles of the original photographs were used in the *Caribbean Sea Migration and Boat People* exhibit. The exhibit focused on the stories of the people and their incredible journeys, not on the photographer. In this case, the curator was amenable to allowing facsimiles in the exhibit with the original artifacts as supplements. At Duke University Library, conservators have good relationships with curators, so there are open conversations about why originals should not be displayed.

At Duke, facsimiles are often used for permanent displays or when the conditions in a case are not up to conservation standards. Facsimiles and labels were placed at the ends of a case where the lux levels were too high: 2900 lux. Originals were placed only in the middle of the case where the light levels could be adjusted through the use of filters. Conservators should open dialogs with administrators and explain the damage that can occur to original objects so the question of surrogates can be resolved. Showing administrators and curators visible damage caused by exhibiting items can enable conservators to change the conditions for their exhibit areas.

Meg Brown, Exhibits Librarian, Duke University Library



Fig. 3. The original, uncut version of Pollock's illustrations for Charles Dickens's *Oliver Twist*, meant to be cut out and used for puppet theatre. Courtesy of Meg Brown



Fig. 4. Although the original illustrations were visually appealing, they were made with light-sensitive watercolors. This cut-out 3D puppet version offered something extra that helped convince the curator to use the facsimile instead of the original. Courtesy of Meg Brown

ANN CARROLL KEARNEY CONSERVATION CONVERSATIONS: SURROGATE CREATION AND THE PRIVATE CONSERVATOR

As conservators we “know our stuff,” and we focus on preserving original artifacts. Collectors and private clients are also professionals who have carefully assembled items that have subjective and objective value. Our goals include protecting clients' artifacts; creating surrogates for display, research, and security; and communicating the importance of these goals to clients. Collectors' concerns can differ. Their

pride and personal respect for the artifacts' value often compels them to handle and display the real things. At the same time, collectors do want to provide ideal care for their collections. Additionally, they have concerns about the expense of creating surrogates.

This talk steps away from the conservator's point of view of facsimiles, and, borrowing elements from the user-centered design and business models, adopts a different perspective. Look at the issue from the collectors' point of view. Their goals and concerns can offer focus to our technical knowledge and theoretical understanding. Considering their viewpoint allows us to clarify the benefits and challenges of surrogate creation for all concerned. Stepping back and seeing the situation from the client's point of view can help conservators reconfigure a wider view of their responsibilities and objectives, thereby strengthening the relationship with the client. And a strong working relationship is the foundation for success in any business venture.

Ann Carroll Kearney, Collections Conservator, University of Albany–State University of New York Libraries

IS IT REAL? THE VALUE AND ETHICS OF USING SURROGATES: DISCUSSION SESSION

Audience Member: If and how do you label facsimiles in exhibits?

Kaye: In the Huntington's *History of Science* exhibit, all the original flat manuscripts were displayed for 3 months and then replaced with facsimiles. The exhibit has been on display for 5 years. The items are explicitly labeled as facsimiles. Occasionally, items are lent to other institutions. It can be difficult to control how your objects are labeled when borrowed. In one case an institution wanted to display both sides of a two-sided letter. The original was framed next to a facsimile of the verso, displayed side-by-side. There was one instance where an alarmed viewer believed an original Washington letter was cut apart to show two sides because it was not labeled properly. The facsimiles can be so good that they can even fool an educated viewer, so labeling is crucial for exhibits.

Hotchkiss: Labeling is a problem. I recently visited major university libraries that often do not label their surrogates. I encourage AIC members to advocate for better labeling in exhibits to denote when a facsimile is displayed. At least give some visual clues that the item is a facsimile. Do not try to fool the visitor.

Brown: For Jane Klinger, how does one define different kinds of facsimiles? What do you mean by a facsimile and how do you explain the type of process that was used in the limited

amount of space a label affords? For instance, if the original is a photographic negative and the exhibit includes only the photographs that were produced, how do you succinctly convey to the viewer that the negative is the original and the print on display is a surrogate? There seems to be a limit to the amount of text that the viewer will read. Standards do not seem to exist in the literature.

Klinger: Even in our own discussion, in this talk, there is a loose use of the term facsimile, and its definition is varied. What is original and what is the copy, when we are looking at large runs of prints? As a group we need to work on the terminology. The older labels at the U.S. Holocaust Memorial Museum have the phrase “artist-made facsimile.” In order to increase the amount of space available on the label for expository text it was reduced to “facsimile” by curators.

When digital copies came to the forefront then “Giclée” was added to the label. Buzz words are popular. They try now to be more general by using the term “digital reproduction” or “photo reproduction.” “Facsimile” implies that the same materials and techniques were used to create the copy that were used to make the original. In this manner the U.S. Holocaust Memorial Museum is very particular in the use of the terminology.

Brown: Why is that your definition of “facsimile”?

Klinger: It comes from my European training background. Back in the 80s and 90s it was either photography or photocopy. Otherwise, you had experts and craftsmen come in to reproduce with original materials. I don’t feel that visitors have the same experience with the use of all reproductions in exhibits.

Brown: I am only worried about what the average user understands in terms of the labeling. With the terms “facsimile” and “digital reproduction,” it is clear that it is not the original. A “photo-reproduction” of a photograph may be more difficult for the viewer to grasp. Perhaps the education literature in museums can provide some guidance.

Audience Member: In my institution we also grapple with the issue of facsimiles. Labels clearly identify all facsimiles and specifically use that term. We also have a sign at the entrance of the exhibit area, and we explain to visitors why facsimiles are used. Often it is because of damage from light levels or due to the fragility of the object. We even label why we have low light levels. In our estimation it is important to explain to the viewer why they see facsimiles when they go to an exhibit.

Audience Member: I suggest that private clients drape a curtain over their item when it is not being viewed. The item is thus protected from unnecessary light exposure. Plus the light can

be movement activated. Perhaps this technique can also be used in museums or libraries.

Hotchkiss: At the Gridwall Library at Southern Methodist University, the lights turn off after 5–10 minutes of no movement. It takes a minimum of renovation to achieve this, and all galleries should strive to install it.

Moderator: The Art Institute also toyed with the idea of replacing the gallery lights with motion detectors, so that all galleries not being used would be in the dark, as a green initiative.

Audience Member: Do some institutions label the actual facsimile instead of the label?

Klinger: The U.S. Holocaust Memorial Museum labeled both the item and the label. For the McCloy letter, which is an artist-made facsimile, the name of the artist’s company, *Faksimile*, is embossed on the item. For the children’s artwork, where embossing was found to be disruptive, there is an archival stamp on the back. If you decide not to display the real thing then you need to be honest about it. For the Hoess confession, researchers have requested and have been allowed to see the original.

ACKNOWLEDGMENTS

The co-chairs of ACDG would like to thank Sarah Reidell, BPG Program Chair, and Emily Rainwater, BPG Assistant Program Chair, for help in organizing and advising this panel. They also wish to express the utmost gratitude to all the panelists—Margaret Brown, Jeanne Drewes, Gary Frost, Valerie Hotchkiss, Marielka Kaye, Ann Kearne, and Jane Klinger—for their willingness to participate and share their professional expertise with the AIC conservation community. Without all their efforts the ACDG would not have been a success.

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Art on Paper Discussion Group 2013: Making Terminology Meaningful

ABSTRACT

The inaugural session of the Art on Paper Discussion Group (APDG) held at the 2013 AIC annual meeting brought together an enthusiastic and diverse group of conservators to discuss terminology used to describe media in works of art on paper. The session began with presentations by each of the APDG Co-Chairs, followed by guided break-out exercises and a moderated group discussion.

INTRODUCTION

The purpose of this session was to engage conservators who work with art on paper (or other art and artifacts with similar issues) in a discussion about approaches to describing materials and techniques. The primary focus was the draft “Guidelines for Descriptive Terminology for Works of Art on Paper” (Guidelines) developed by project conservators at the Philadelphia Museum of Art (PMA) along with a working group of conservators from throughout the country (see Appendix 1). The project is supported by an IMLS 21st Century Museum Professionals Grant. Before the annual meeting, the PMA conservators shared an overview of the draft guidelines with the BPG membership through a posting on the AIC-BPG website. The session opened with presentations on the impetus and goals for the project and also outlined the scope and organization of the Guidelines. They addressed how the specialized knowledge and media identification skills of conservators, which rely on visual examination of the actual object, are essential to arriving at meaningful descriptions. The presenters also examined

This open discussion took place on May 31, 2013, during the AIC 41st Annual Meeting, May 29–June 1, 2013, Indianapolis, IN. The moderators organized and led the discussion and recorded notes. Readers are reminded that the moderators do not necessarily endorse all the comments recorded, and that although every effort was made to record proceedings accurately, further evaluation or research is advised before putting treatment observations into practice.

institutional practices for gathering and sharing this information with wider professional and public audiences. This introduction prepared the session participants for the exercises that followed.

PRESENTATION SUMMARIES

STEPHANIE LUSSIER

IMPETUS FOR THE PROJECT

Stephanie provided background on how the co-chairs became interested in this topic, from her own involvement with a comprehensive collection survey at the Whitney Museum of American Art (WMAA) to Nancy and Scott’s in-depth study of the drawing and construction materials of self-taught artist James Castle. Through these projects, she introduced the participants to some of the challenges of using “consistent and accessible terms that accurately and precisely describe drawing and print media,” which are especially apparent when considering works by self-taught artists, and more generally, works created in the 20th century and beyond. These challenges ranged from recognizing the limitations of existing resources and precedents for describing works on paper—many of which grew out of traditional approaches to describing Old Master drawings—to internal institutional practices for entering and using information in collections information systems. The lack of clear protocols in this area sometimes leads to inadvertent discrepancies (e.g., on exhibition labels, when descriptions are pulled directly from databases without consideration of when or if the pieces ever were assessed formally).

Multiple audiences or content users, both inside and outside museums, use the media descriptions conservators develop (either directly or indirectly), and need to be considered. Those outside the museum include artists, researchers, and museum visitors; those inside include staff from many departments throughout the museum, from art handlers to curators. The awareness of these multiple audiences led the WMAA survey project conservators to begin examining

museum practices for generating and recording information about artists' materials and techniques, and much of this work has informed the approach suggested in the Guidelines.

In closing, Stephanie emphasized that conservators should advocate for and provide meaningful and technically correct media descriptions: "As conservators, we see ourselves as uniquely suited to identifying and describing artists' materials and techniques, yet we often work behind the scenes and may be bypassed in this process. With the increased visibility of collections due to web presence, the consequent greater ease of accessing information, and the potential for an increasingly diverse audience, we are presented with an opportunity to not only improve internal dialogue, but to contribute to the enhanced technical understanding of the general public by creating a collective language and way of using language that is meaningful to conservators and allied professionals alike."

NANCY ASH

PURPOSE AND GOALS

Nancy described the overarching goals of the Guidelines and their intended use, and emphasized that precise terminology is important because it contributes to understanding a work of art and its historic context and gives insight into an artist's intentions and working methods. The Guidelines are intended to help not only conservators and curators, but other art-world professionals in the use of precise and consistent language to describe works of art. They are intended to clarify and provide consistent approaches to how we *identify*, *describe*, and *record* information about artists' materials and techniques, and will provide a system for adapting a description so that it conforms with curatorial preferences or institutional protocols, or can be used for a range of purposes. Nancy then outlined the three principal activities involved:

- *Identification* – In paper conservation, in particular, we rely primarily on our knowledge of the visual characteristics of materials, and less frequently on scientific analysis. In either case, examination of the physical object (the artwork)—and our knowledge about how the composition of each material dictates its appearance and handling properties—is paramount. Magnification is probably our most important tool for visual identification.
- *Description* – The description is how we translate what we have identified visually into written form using consistent language and grammar. This is the focus of the Guidelines: applying the rules of syntax—which govern the way words are combined, the order of elements, punctuation, etc.—to appropriately chosen terms for drawing and print media, techniques, and processes identified in a work of art.
- *Recording* – How and where we record the descriptions we have developed is critical. We have two major concerns

about how and where we record what we observe, and these highlight the need for a more systematic approach:

- The detailed descriptions that conservators, catalogers, and curators develop are routinely adapted by others and appear in online catalogs, wall labels, etc. In other words, they have a rich and varied life after they leave our hands. The information becomes public, is reused and repeated, and we have a responsibility to try to get it right.
- Also, the development of Collections Information Systems has in many ways bypassed an essential internal dialogue that includes a critical review of materials descriptions. When information is entered into collections databases, the entries take on the appearance of authority yet may not be the result of any sort of formal assessment of the actual object.

What we propose is the use of three levels of description in three distinct fields in collections databases to capture a range of information for different purposes (fig. 1). (Similar approaches already have been implemented in several museums.)


- Level 1, the "Medium," generally provides the simplest accurate description. While it may be the same as the Extended Medium description (i.e., contain it in its entirety), often it may be an adaptation of it that reflects curatorial preferences or institutional protocols. (Note that the Guidelines will provide resources to aid the process of simplifying descriptions.)
- Level 2, the "Extended Medium," is the primary focus of the Guidelines and reflects the principal goal of describing the works of art as concisely and consistently as possible,

Application: contemporary print


Level 1 - Medium:
Color woodcut and soft ground etching
(number of colors and reference to paper omitted by institutional preference)

Level 2 - Extended Medium:
Color woodcut and soft ground etching,
printed in three colors, on paper

Level 3 - Technical Note:
This print is made using two print processes,
relief and intaglio; the woodcut is printed in
two colors, green and yellow-green, from
2(?) blocks, and the soft ground etching is
printed from one intaglio plate in black ink



Detail from Robert Mangold,
Green Column/Figure, 2003,
Philadelphia Museum of Art



Full-size image

Philadelphia Museum of Art
IMLS 21st Century Museum Professionals Grant

Fig. 1. Presentation slide illustrating the application of the Guidelines and the use of separate fields in a collections database

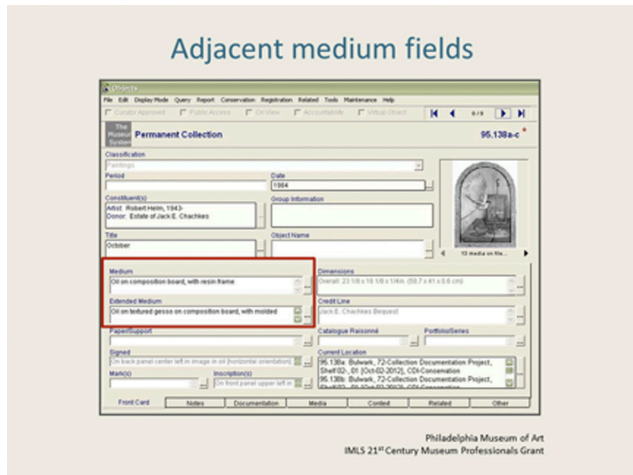


Fig. 2. Presentation slide showing adjacency of “Medium” and “Extended Medium” fields in a collections database. Image courtesy of the Whitney Museum of American Art

while conveying maximum information. The descriptions follow the Guidelines for language and syntax and, ideally, come from direct visual examination.

- Level 3, “Technical Notes,” is intended to accommodate detailed observations and is not structured or limited by the rules of syntax given in the Guidelines.

Note that, in a collections database, it is critical that the “Medium” and “Extended Medium” fields are located adjacent to each other on the same screen or tab to facilitate using content from one to adapt the other (as shown in figure 2); lack of this adjacency would make movement between the fields too cumbersome, and in all likelihood the system would not be used.

SCOTT HOMOLKA

OVERVIEW OF DEVELOPMENT, ORGANIZATION, AND SCOPE OF THE GUIDELINES

Scott’s presentation introduced the participants to how the terminology project has progressed, as well as the organization and scope of the draft Guidelines. At the project outset, we had little more than a central idea motivated by many of the complex issues and challenges encountered in our work. From this central idea we developed an outline of phases for the project. We began by compiling and reviewing existing resources useful for a consideration of terminology, and identifying categories of artists’ media. From this we generated lists of terms and materials glossaries and began drafting what we called “justification” or discussion documents that provided a rationale for specific rules. Finally, we reached out to colleagues who had done in-depth research or who

had special expertise in artists’ materials and formed a Media Terminology Working Group to provide input and help us shape the Guidelines. Moving forward, we will be faced with the challenging tasks of gaining evaluation and feedback, refining individual guidelines, and re-organizing the structure as necessary for continuity and clarity.

After sketching out documents that laid out the broad set of issues to be addressed in the Guidelines, in April 2012 we convened a one-day meeting of the working group to discuss issues of descriptive terminology. During this meeting—using artworks from the PMA collection selected to illustrate and emphasize specific challenges—we engaged in some simple “looking and describing” exercises to spur discussion and debate. After a period of evaluating feedback from the working group and developing the Guidelines documents more fully, we reconvened the group in March 2013 to discuss and further refine individual topics.

ORGANIZATION OF THE GUIDELINES

The Guidelines are organized into two main sections. Part I deals with identification and characterization of materials and techniques, and Part 2 presents rules of syntax.

The overview of Part I of the Guidelines consisted of excerpts from the Table of Contents. Part I is divided into sections on drawings and prints, and includes categories of traditional drawing materials, non-traditional drawing materials and collage, manipulations, and print processes and techniques. Lists of terms, glossaries, and materials hierarchies (charts) were developed as supporting resources for both the “Drawings” and “Prints” sections. “Print Process Hierarchies,” for example, are tables that organize and group specific printmaking terms within a broad print process.

The overview of Part 2 of the Guidelines focused on syntax. Syntax can be defined as the rules guiding word order,

Fig. 3. Presentation slide illustrating the concept of “associated techniques” in the description of a print

grammar, and other specifics of language usage (for example, using prepositions or choosing between singular and plural forms of nouns). An example was shown from the section “Print-Specific Syntax,” which guides the user through a range of topics for describing prints. One example described specific “associated printmaking techniques” (variations that are associated with and only exist within a more general printmaking process; see fig. 3). Another example described additional manipulations of the print matrix.

Scott’s presentation concluded with several slides that presented excerpts from the actual draft Guidelines; for instance, he illustrated a guideline covering the inclusion and use of color, including language for color descriptors and how to consistently describe compound colors.

BREAK-OUT SESSION: EXERCISES

ELIZA SPAULDING

INSTRUCTIONS FOR PARTICIPANTS

The approximately 90 participants who attended the session were divided into 10 discussion groups, and one of five exercises was distributed to each group. Each group had a moderator and a note-taker. Many of the moderators were members of the Media Terminology Working Group and very familiar with the project; the note-takers were emerging conservators and took notes on group comments/discussions as well as participant demographics. The moderators clarified and facilitated the use of the draft Guidelines and prompted discussion on specific points.

The exercises were intended to capture how participants describe artists’ media and to gain feedback on how the Guidelines could be improved. Each exercise featured a drawing, print, or collage, and included a list of the media present along with their relative abundance and corresponding manipulations, and type of paper support. Relevant sections of the draft Guidelines accompanied the exercises. With the moderator’s guidance, members of each group first recorded how they would describe the artwork in their own words (no right or wrong answers!), then how they would describe the artwork using the Guidelines excerpts provided. They then were asked to engage in a discussion about their responses and other media-terminology issues. Finally, the groups shared their responses and other feedback from the breakout sessions with the entire audience, leading to a lively discussion. The feedback from the APDG session has been enormously helpful in shaping the Guidelines and we are grateful for everyone’s participation.

Included in this submission are examples of two of the exercises. The participants were first prompted to consider how *they* might describe the work of art depicted in this exercise, and next, to modify that description using the draft

Guidelines provided. Lastly, as time permitted, each group tackled specific discussion points for the exercise.

EXERCISE # 1: JOSEPH YOAKUM, *THE HILLS OF OLD WYOMING IN THE VALLEY OF THE MOON NEAR CASPAR WYOMING*, c. 1969

This Joseph Yoakum drawing presented the challenges of interpretation one may face even with a guiding system in place (see Appendix 2). Pastel and colored pencil are the most abundant materials in this work. In following the “listing order” guidelines, some participants listed those materials first, citing visual dominance as the reason. Others felt that the ballpoint pen was “most dominant” as the foundation of the drawing (the artist began with a pen “outline” that defined the composition) and therefore listed ballpoint pen first. The importance of order of application on Old Master drawings (“what came first”) was mentioned, and the use of the word “over” to indicate layered media applications was suggested. This suggestion was in keeping with the “general syntax” rules presented in the draft Guidelines.

The moderators also reiterated that the Guidelines are intended to accommodate different types of collections. This exercise presented an opportunity to reflect on how the rules of syntax may work effectively for both Old Master and more contemporary drawings.

Additionally, this exercise tested the proposed guidelines for color inclusion: when to list individual colors vs. when to default to the general term “color.” This area will continue to be refined as “colored materials” are categorized and compared, focusing on specific rules for “limited palette” (chalk, ballpoint pen) vs. “full-palette” (pastel, colored pencil) materials.

EXERCISE # 3: WILLIAM BLAKE, *GOD JUDGING ADAM*, c. 1795

A unique and complex work by William Blake consisting of a printed image with significant embellishment in inks and watercolor paints provided the opportunity to discuss many aspects of the draft guidelines (see Appendix 3). The discussion group participants raised points that led to a constructive evaluation of the draft rules of syntax (word order and use of prepositions) as related to material abundance and order of application, pointing out in particular the awkwardness caused by placing “pen and ink” between “watercolor” and “opaque watercolor” when ordered according to the relative abundance of materials. This led to a discussion of creating a rule that suggests grouping like materials, while continuing the use of qualifying terms such as “with” or “traces/touches of” to indicate relative abundance.

The group also commented that they appreciated the idea of a “Technical Notes” field where one could record speculations about techniques, especially where there was some uncertainty. (Can one visually identify Blake’s relief etching, or is

the identification based on scholarly research about Blake and his pioneering technique?) This also speaks to the proposed “levels” for recording information in collections information systems as recommended in the current draft Guidelines.

CONCLUSION

The inaugural Art on Paper Discussion Group session was well attended and the participants expressed clear enthusiasm for the creation of the APDG and for the topic presented at our first gathering. The session was interactive and engaging and the thoughtfully expressed opinions of the session participants will serve to guide further development and refinement of the *Terminology Guidelines for Works of Art on Paper*. Next steps include exploring a range of possibilities for gaining critical evaluation and feedback, and importantly, for the future publication and dissemination of a finished product.

ACKNOWLEDGMENTS

Special thanks to the session moderators and note-takers, who contributed to the session’s content by guiding the group exercises and discussions and recording them: Shannon Brogdon-Grantham, Heather Brown, Margaret Holben Ellis, Anisha Gupta, Theresa Fairbanks-Harris, Amy Hughes, Hannah Mancill, Catherine Maynor, Clara Rojas-Sebesta, Kimberly Schenck, Harriet Stratis, Michelle Sullivan, Becca Pollak, Elisabetta Polidori, Christina Taylor, and Aisha Wahab. With gratitude to Eliza Spaulding, Andrew W. Mellon Fellow in Paper Conservation, Philadelphia Museum of Art, for her superb organizational skills and for essentially serving as a fourth co-chair.

Working Group members: Karl Buchberg, Anne Driesse, Margaret Holben Ellis, Theresa Fairbanks-Harris, Amanda Hunter Johnson, Penley Knipe, Catherine Maynor, Rachel Mustalish, Annette Manick, Katrina Newbury, Antoinette Owen, Suzanne Penn, Thomas Primeau, Kimberly Schenck, Marjorie Shelley, Matthew Skopek, Reba Fishman Snyder, Harriet Stratis, and Judith Walsh

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APPENDIX 1

GUIDELINES FOR DESCRIPTIVE TERMINOLOGY FOR WORKS OF ART ON PAPER

Philadelphia Museum of Art

Supported by IMLS 21st Century Museum Professionals Grant

OVERVIEW**Goals**

This project is intended to address the need for more accurate and consistent documentation of the materials and techniques used to create works of art on paper. No detailed guide for this currently exists. The guidelines presented here are designed to provide conservators, curators, registrars, cataloguers and others charged with describing art on paper with a step-by-step approach for describing all aspects of the manufacture of these works.

The project was prompted by several recurring issues: 1) how to effectively and consistently describe and communicate the materials used in works of art to other museum professionals and to the public, 2) how to facilitate the recording and subsequent use of materials information in museum collections information systems, and 3) how to refine descriptive language to contribute most effectively to the education and visual experience of the museum visitor. While these guidelines are primarily “addressed” to the conservator, they are intended to assist all professionals working in this subject area. One intended result is more accurate, and hence more meaningful, material descriptions through the use of consistent terminology, regardless of who generates and records the information. Conservators, curators and other users will bring different levels and types of knowledge and connoisseurship to the task. Therefore, an additional goal is to educate those with less experience, or perhaps less direct access to the physical works of art, in how to record information that is accurate regardless of level of detail. Media-specific “Hierarchies,” or charts that provide terminology and preferred usage that progress from the general to the specific, will serve as tools to assist in this process.

It is hoped that the impact of the project will be three-fold: 1) enhanced ability of conservators to communicate their knowledge about the materials of works of art on paper in a more accurate and consistent manner, 2) greater understanding through improved resources for allied museum professionals (cataloguers, curators, etc.), and 3) increased visual and information literacy of the museum-going public.

Identification and Characterization of Materials and Techniques

Conservators’ work bridges the art historical, the technical, and the scientific. They use visual examination and technical analysis to identify artists’ materials and methods of manufacture. They routinely examine and develop detailed descriptions for traditional, contemporary, and idiosyncratic artists’ materials for exhibition labels and catalogues. This information often appears in checklists and captions in print publications and online catalogues, and in exhibition wall labels and didactic panels.

To describe works of art on paper, the conservator first determines and characterizes the materials and techniques present, and then uses appropriate and consistent syntax to convey his/her observations. The result of the information-gathering stage is the **Identification and Characterization of Materials and Techniques**, in which the conservator defines what he or she is seeing. This entails identifying and describing materials according to their unique and distinctive features as determined through direct observation using magnification, different angles and types of light, and occasionally chemical or

instrumental analysis. It combines knowledge of the physical characteristics of materials and techniques and the time periods in which they were used. It may involve research such as consulting comparative images (photomicrographs), timelines, and other reference materials. Connoisseurship, the instinct and the critical judgment developed through a deep knowledge of these materials, is a vital component. Identification and Characterization of Materials and Techniques is addressed in Part 1 of the Guidelines.

Rules of Syntax

Once conservators have gathered the information, they need a consistent approach for assembling that information in order to achieve a degree of logical coherence and accuracy. This brings into play the **rules of syntax**, which govern the way words are combined, the structure or order of elements, punctuation, and other grammatical issues. The rules of syntax may be the most important aspect of the guidelines – guiding the writer in how to record and order what he/she has deciphered in a detailed, yet economical form, typically from most to least dominant material. Syntax is addressed in Part 2 of the Guidelines.

During this project, certain resources were relied upon repeatedly and thus are not specifically referenced throughout the Guidelines. These include:

- Getty Art and Architecture Thesaurus (AAT)
- CAMEO: Conservation and Art Material Encyclopedia Online <http://cameo.mfa.org>
- Whitney Museum of American Art in-house Collections Documentation Initiative (CDI) terminology and terminology hierarchy
- Art Institute of Chicago Italian Drawings Survey Guidelines
- Exhibition and collection catalogues from various museums (included in the bibliography)
- Other print and drawing materials encyclopedias/publications, and collections information presented on museum websites (included in the bibliography)

Information Storage and Use—Museum Collection Information Systems

Since most large institutions use a collections database that is routinely accessed by staff from many departments who may work in several locations, this project includes identifying user groups as well as recording “levels of information.” In fact, after the conservation survey of works of art on paper undertaken at the Whitney Museum of American Art in 2008–2010, the complexity of these issues precipitated the formation of an internal committee at that institution to retroactively evaluate terminology and protocols devised and implemented during the survey—with consideration for interdepartmental retrieval and use of information.

The development of museum collections information systems has in many ways bypassed the once routine internal dialogue that led to a critical review of the materials and techniques used in individual works of art. That is to say, when information is now being entered into such databases, often by cataloguers not trained in materials identification, the entry takes on the appearance of authority yet may not even be the result of a formal assessment of the actual object. Technical descriptions entered into such systems are often used either out of context or without full appreciation or understanding of their nuances. For example, descriptions are often extracted from a collections database for a specific use (e.g., as an image caption in a publication) without first being vetted by curators for accuracy or consulting a conservator for close visual assessment of the object. Scrutiny of wall labels in museum exhibitions reveals the ongoing struggle of how to bring clear and accessible (and consistent), yet technically accurate and interesting information to the viewer. A quick internet search of online museum collections catalogues exposes inconsistent descriptions and misidentified processes, sometimes for the same object (e.g., print multiples). Even in the same print publication, descriptions often vary both in technical degree and language use. These examples highlight the pressing need for

guidelines to direct how information about materials and manufacture is documented, used and understood in the broader museum context.

The “Medium” field/descriptions in collections information systems typically define(s) the physical or material aspects of a work of art, including design media (watercolor, acrylic, gold leaf), techniques and processes (collage, etching), and sometimes support (paper, board, other). To better inform an understanding of methods of manufacture, implements and manipulations of media are also traditionally included (*pen and ink, watercolor with scraping*). Often extracted directly from collections information systems for wall labels, websites, and exhibition catalogs, such descriptions greatly inform the viewer’s experience/understanding of the material work of art relative to the artist’s working methods, and yet vast inconsistencies are found in the presentation of this information, not only in comparisons across collections, but often within single institutions.

These guidelines are intended to guide conservators and other museum professionals in selecting terms and standardizing descriptions for drawings and prints in dedicated fields in collections databases. Guidelines for improved practices for recording changes made in information databases are also included. Additionally, these guidelines make a call for direct visual examination when describing works of art. Though it is hoped that this document will benefit all museum staff charged with describing and caring for collections of works of art, the authors cannot overemphasize the importance of involving conservators in the process of identifying and describing media and techniques for all works of art.

Levels of Description – Using Dedicated Fields in Collections Information Systems

This section addresses the recording of three levels of information describing materials and techniques. It is proposed that three levels of detail (using three different dedicated fields in collections information systems) be used to record and store descriptive information about print and drawing mediums. In addition, it is recommended that detailed information about print and drawing supports be recorded in the “support” field included in most collections database, and that changes/updates to any of this information be tracked in a concise and consistent way. The use of three distinct levels of media description allows an individual/institution to capture a range of information in designated fields in collections information systems for different purposes.

The “extended” description (Level 2) is the primary focus of these guidelines, and reflects the principal goal of describing the works of art as concisely and consistently as possible, while conveying maximum information. Ideally, such descriptions (and all descriptions) will derive from direct visual examination of a work of art and will follow the rules set forth in this document for language, syntax, and order. When there is doubt (or a material cannot be discerned visually with some degree of certainty), a less detailed approach using more general terms drawn from the print and drawing hierarchies is preferred.

- **Level 1: Medium.** This is the simplest or most concise description of materials and techniques for a given work of art and may be the description displayed on the front tab of a collections information system or that appears on exhibition wall labels or a museum website. It may reflect institutional or curatorial preferences and protocols applied to the Extended Medium description (level 2 below). It may be the same as that description (contain it in its entirety) or be derived from it by the conservator, curator, or cataloguer in abbreviated or slightly altered form.
- **Level 2: Extended Medium.** This description is the focus of these guidelines. It is a detailed yet concise description of the work of art, the result of a conservator’s close scrutiny of an object, or of close assessment by a curator or cataloguer. As described in these guidelines (and aided by

referencing the hierarchies, glossaries, and lists of terms), the word choices should follow the rules of syntax and accurately characterize aspects of manufacture.

- **Level 3: Notes on Materials/Technique/Manufacture.** This description can be most comprehensive or highly detailed, and is intended to accommodate detailed observations and notes (possibly for conservation documentation or scholarly purposes). It may take the form of a more comprehensive materials and techniques characterization, or a range of observations not necessarily structured or limited by the rules of syntax given in these guidelines.
- **Paper/Support:** In TMS and other collections information systems, there are separate fields for Media and for Support.

Protocols for Entering, Updating, Changing Information. This section provides guidelines for evaluating existing descriptions from various sources such as catalogues, artist/gallery-designated materials, and descriptions already in a museum database. It also provides protocols for entering the descriptions into the collections information system, retaining original source information and documenting any changes made.

Guidelines project staff/authorship

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 Museum of Fine Arts, Boston
 Museum of Modern Art
 National Gallery of Art
 San Francisco Museum of Modern Art
 Smithsonian American Art Museum
 Yale Center for British Art
 Whitney Museum of American Art

APPENDIX 2

BPG Art on Paper Discussion Group (APDG)
 Organizers: N. Ash, S. Homolka, S. Lussier, E. Spaulding
 AIC 41st Annual Meeting, Indianapolis, Friday, May 31, 2013

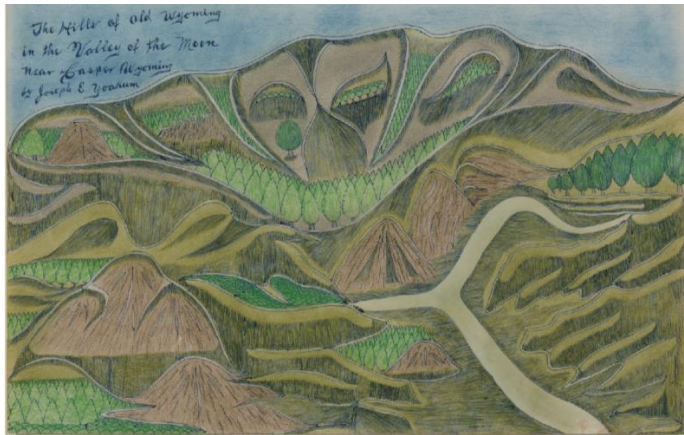
Exercise #1

Joseph Yoakum (American, 1890–1972)

The Hills of Old Wyoming in the Valley of the Moon near Casper Wyoming, c. 1969

Philadelphia Museum of Art, 2002-53-17

Sheet: 12 x 19 1/16 inches (30.5 x 48.4 cm)



Overall



Detail

Media (relative abundance)

Blue ballpoint pen (much)
 Colored pencil: green, yellow-green, and brown (much)
 Pastel: blue and gray (much)

Manipulations

Pastel: smudging

Support

Wove paper

1. How would you describe the artwork above in a Medium description?

2. Using the excerpts from the *Terminology Guidelines* provided, please modify your description accordingly.

Colored pencil, blue and gray pastels with smudging, and blue ballpoint pen on paper

3. What immediate suggestions/changes come to mind? Discuss.

Discussion topics:

Considerations: abundance vs. visual dominance – do you start with pen (since it outlines & defines the drawing) or colored pencil (most abundant /dominant medium)? Discuss creating a Technical Note (Level 3) to further elaborate on technique. What information would you include?

We would love your feedback! Were the draft *Guidelines* excerpts comprehensible? Are there specific changes/suggestions that you would recommend? The full draft guidelines will soon be available for further input. Please contact us at mediaterminology@philamuseum.org.

APPENDIX 3

BPG Art on Paper Discussion Group (APDG)
 Organizers: N. Ash, S. Homolka, S. Lussier, E. Spaulding
 AIC 41st Annual Meeting, Indianapolis, Friday, May 31, 2013

Exercise #3

William Blake (English, 1757-1827)

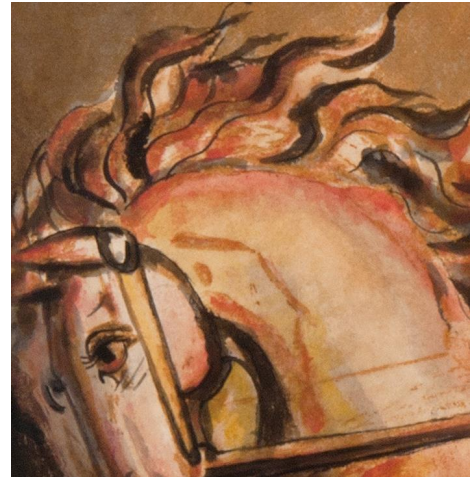
God Judging Adam, c. 1795, possibly printed and manipulated in 1804-5

Philadelphia Museum of Art 1964-110-5

Sheet: 16 9/16 x 20 1/2 inches (42.1 x 52.1 cm)



Overall



Detail

Media

Pen- and brush-applied ink: black
 Watercolor: red, orange, yellow, black
 White opaque watercolor (small amount)
 Color relief etching (two different brown inks)

Material Dominance - Abundance and Order

Substantial amounts of most media
 Drawing media are over print media

Paper support

Wove paper

Note: heavy paint and ink applications substantially transform each impression of the underlying print.

1. How would you describe the artwork above in a Medium description?

2. Using the excerpts from the *Terminology Guidelines* provided, please modify your description accordingly.

Watercolor and pen and brush and black ink with white opaque watercolor over color relief etching on paper

3. What immediate suggestions/changes come to mind? Discuss.

Discussion topics: Begin with the drawing media since it is visually much more predominant (printed components almost obscured)? vs. *Color relief etching with additions in pen and ink and watercolor on paper* [from PMA TMS database]? Discuss creating a Technical Note (Level 3). What information would you include?

We would love your feedback! Were the draft *Guidelines* excerpts comprehensible? Are there specific changes/suggestions that you would recommend? The full draft guidelines will soon be available for further input. Please contact us at mediaterminology@philamuseum.org.

Deceptive Covers: Armenian Bindings of 18th-Century Imprints from Constantinople

INTRODUCTION

While surveying early Armenian printed books at the Library of Congress (LC), the authors came across an endband on a book printed in Constantinople that appeared to be a hybrid of the traditional Armenian endband (fig. 1a) and the European front-bead endband. Like the former, it had a raised profile because the boards were cut flush with the text block and the endband sat on top of both, but, like the latter, the endband was worked in two colors on one support with a front bead, and not over three or more supports in a chevron pattern (fig. 1b). The goat-skin cover was blind tooled with European rolls and gouges and did not have the traditional Armenian fore-edge flap. Similar endbands were found on four other books printed in Constantinople in the 18th century, but not all were identical.

At first glance, these books appeared to be 16th-century European bindings (fig. 2), but closer inspection revealed that the binders had retained many of the aspects of traditional Armenian book structure (fig. 3). The LC survey underscored the findings of Armenian book historians (Kouymijian 2008): Armenian printed books retained manuscript structures well into the 19th century, when there was an apparent abrupt shift to contemporary European binding styles. Unfortunately, the peripatetic nature of the Armenian diaspora and the destruction of Armenian communities in Ottoman Turkey make it difficult to localize the books by binding style or print information alone, and provenance of individual volumes is difficult to establish.

The authors decided to see if there was a discernible style unique to bindings that were printed in Constantinople. They expanded the sample set and went to the Mashtots Institute of Ancient Manuscripts in Armenia, also known as the Matenadaran, to survey one of the largest cataloged collections of early printed books from Constantinople. A brief discussion of the findings follows an abbreviated history of Armenian printing as it pertains to this paper.

Presented at the Book and Paper Group Session, AIC's 40th Annual Meeting, May 8–11, 2012, Albuquerque, New Mexico.



Fig. 1a. Traditional Armenian raised endband. *Dzayn Ar Baghdzalin* "Grigor Tat'ewats'i" *Kiwregh Aghek'sandrats'i* (Constantinople: 1717), Library of Congress Collection. Courtesy of Tamara Ohanyan



Fig. 1b. Raised Armeno-European front-bead endband or "Western Armenian endband" *Girk Grkuks Ays Patmē* (Constantinople: 1710), Matenadaran Collection. Courtesy of Tamara Ohanyan



Fig. 2. Front cover of a printed book with a manuscript binding and European-style tooling. *Meknutiwn Srboy Awetaranin Orē Hohannu* (Constantinople: 1717), Matenadaran Collection. Courtesy of Tamara Ohanyan

ARMENIAN PRINTING IN CONSTANTINOPLE

The potential for print was recognized early on in the Armenian community. By the 16th century, extended wars between the Ottoman Turks and Persian Safavids resulted in the destruction of Armenian communities and the Armenians' dispersal from their homelands. Printing presented the possibility of creating an accessible and normative body of knowledge for far-flung communities, and was acknowledged as such by both the Armenian Apostolic church and Armenian merchants dispersed through Europe and Asia (Bairboutian 2004). The formerly rich Armenian manuscript traditions had been centered on monastery scriptoria, where manuscripts were produced for a sedentary population of the wealthy, comprised mainly of the church and nobility. With the definitive dispersal of the communities in the 14th through 16th centuries (depending on their location), systems for the transfer of knowledge were far removed from traditional centers of learning, such as the Patriarchates of Echmiasin, Sis, and Jerusalem (Hovanissian 2004). Against this backdrop, the first Armenian book, *Urbatagirik* (Book of Fridays), a compendium of religious and Armenian secular texts, was printed in 1512 in Venice.

Subsequently, printing in Armenian—financed mostly by Armenian mercantile communities and undertaken by lay priests—began in Constantinople in 1578, Isfahan in 1636, and Amsterdam in 1658. In the 18th century it reached the seat of the patriarchate, Echmiazin (Avdoyan 2012). The list continues, as wherever there was a significant Armenian population, print houses were established.

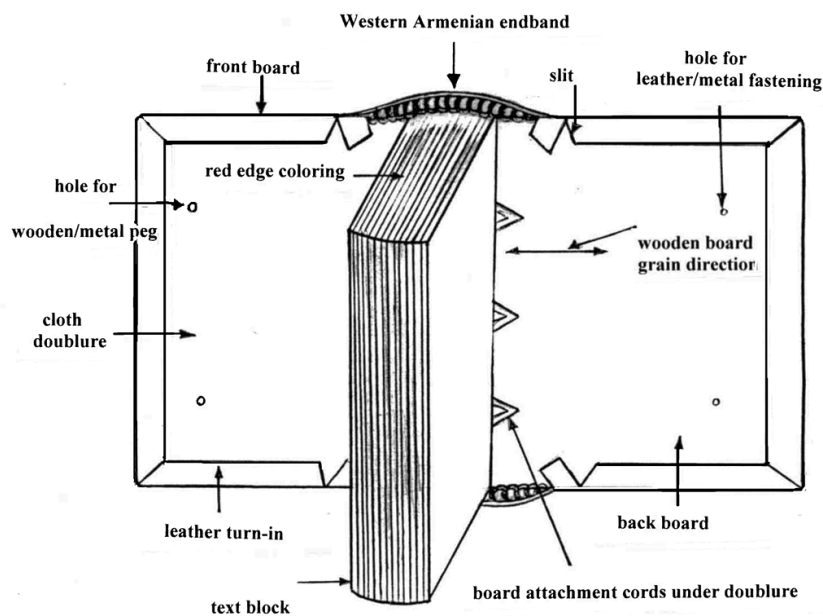


Fig. 3. Elements of traditional manuscript binding retained in the binding of a printed book. *Meknutiwn Srboy Awetaranin Orē Hohannu* (Constantinople: 1717), Matenadaran Collection. Courtesy of Tamara Ohanyan

Printed works included church liturgies, the gospels, and key works of Armenian history and literature, as well as instructional books on trading and mathematics. Between 1512 and 1800, 950 titles were published by diaspora communities. The largest number, 325, were printed in Constantinople (Korkotyan 1964, Avdoyan 2012).

Printing in Armenian in the Ottoman Empire began after Sultan Selim II passed an edict legalizing printing in scripts other than those based on Arabic letters. By the 1700s at least six Armenian printing houses were producing books, mainly in octavo and quarto sizes, for local and diaspora communities. Constantinople was well placed for the production and distribution of these works. Armenian traders imported paper for printing from France and Italy. The same trade routes carried printed books to coreligionists around the Mediterranean and Northern Europe, while overland silk caravans took them east to communities in Iran and beyond (Bairboutian 2004).

THE SURVEY

The main question that the survey wanted to answer was whether documenting changes in binding techniques—especially endband construction—would be useful in providing dates and locations for the bindings of books printed in Constantinople, and in illustrating the evolution of Armenian bindings and tastes from the manuscript period to the 19th century. With these issues in mind, only books that were in fairly poor condition—with their inner construction visible—were surveyed, making it possible to record changes in workshop practice. Of the sample of 52 books at the Matenadaran, two of the earliest were in contemporary Dutch limp vellum bindings and will not be discussed here. Of the remaining bindings, one was dated 1691, 44 had 18th-century dates, two were dated 1812, and three were undated. Books rebound in 19th-century publishers' bindings were not surveyed.

All the findings will be discussed in apposition to the medieval exemplar, addressing details such as the sewing holes, style of sewing, board attachment, board shape, edge decoration, doublures or pastedowns, and endbands. Paper stock will not be discussed, although watermarks (mostly French and Northern Italian) were photographed. Further research is also required on the tooled decoration, as there appears to be a repetition of design among some volumes. The discussion illustrates a range of changes in binding details, and documents a simplification of structure over time.

SEWING

The first step in the binding of a text after it was written or printed on leaves was preparing it for sewing by folding the sections and making the holes. In the manuscript tradition, W- and V-shaped notches (figs. 4a, 4b) were cut into the folded edge of the section to accommodate the two-cord sewing supports. In the surveyed books, V-shaped notches



Fig. 4a. W-shaped notch in manuscript spine. Verin Noravank Gospel manuscript (1487 ACE), Library of Congress Collection. Courtesy of Tamara Ohanyan



Fig. 4b. V-shaped notch in printed book spine. *Girk Srboyn Mashtois'ats' Vardapeti* (Constantinople: 1704), Matenadaran Collection. Courtesy of Tamara Ohanyan

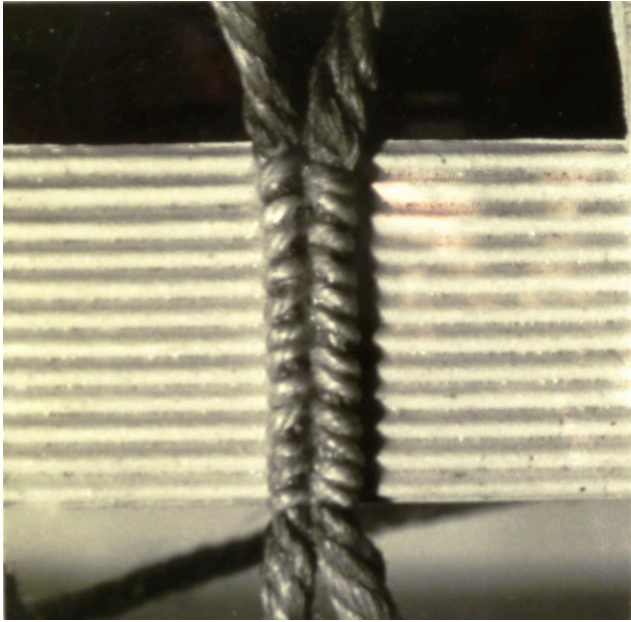


Fig. 5a. Example of herringbone sewing used in Armenian manuscript bindings. Courtesy of Tamara Ohanyan

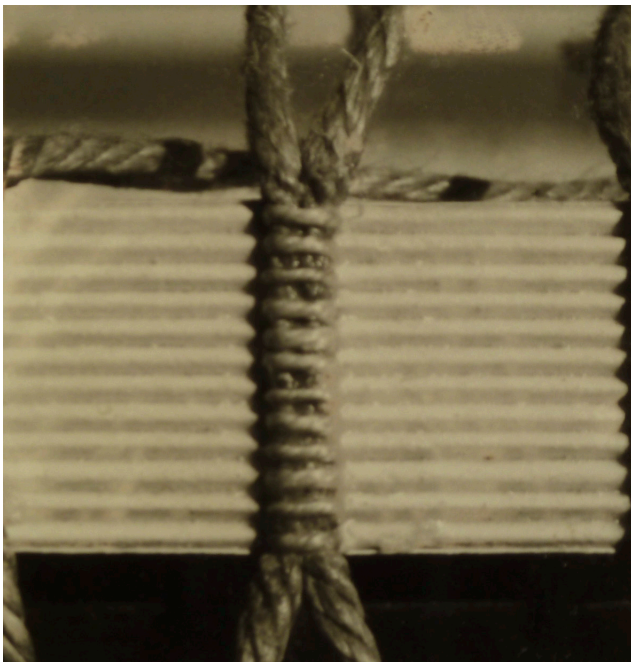


Fig. 5b. Example of two cords sewn as one, found in most printed books surveyed. Courtesy of Tamara Ohanyan

were present in six of the ten earliest printed books, which also had more traditional bindings (i.e., ties and Armenian endbands). Regular punched sewing holes were the most common in later books, and one book (printed in 1729) had sawn-in holes from later rebinding.

In manuscript bindings, herringbone sewing was used to connect the sections together to create the text block. The thread came out of the section between the two cords of the support, wrapped around one cord, hooked around the sewing of the section below, wrapped the second cord, and then returned to the inside of the section through the initial hole (fig. 5a). Anchoring the sewing to the section below created the herringbone pattern, and nestling the cords into notches cut for sewing made for a flat spine. In Armenian manuscripts, all sewing holes—including the kettle or end stitches—were supported in this manner.

The majority of the printed books surveyed were sewn with two cord supports used as a single cord: the thread came out on one side of the sewing supports, was wrapped around both cords on the same level, and returned back to the center of the gathering from the opposite side (fig. 5b). These supports were raised above the level of the spine. Despite a move toward simplified construction, all sewing holes, including kettle stitches, continued to be supported with cords. Only books with later European bindings had unsupported kettle stitches.

BOARDS AND BOARD ATTACHMENT

The boards followed the Armenian manuscript tradition and were made of wood (mainly oak and walnut) with the grain perpendicular to the spine; the edges were cut flush with the text block (fig. 6). In general, the wooden boards were 0.3–0.5 mm thick for the largest quarto-sized books. Holes for fastening the cords were drilled in a straight line parallel to the spine, with additional small holes at the top and bottom edges to anchor the endbands to the boards. As the holes were aligned with the grain direction of the wood, the boards were thinner than those on European wooden-board bindings of the same size. In the few volumes where the wood grain was parallel with the spine, the boards were broken along the holes; most appeared to be later rebindings. Wooden boards continued to be used for printed books well into the 18th century; pasteboards started appearing towards the end of the century. With one exception, the latter did not have the Armenian method of board attachment (described below).

Subtle changes were also found in the shaping of the board edges (fig. 7). Boards whose edges are beveled on the inner surface are one of the defining characteristics of Armenian manuscripts, and this type of board shaping was the most prevalent in the survey. Square-cut edges were also previously found in manuscript bindings. A third type of shaping, in which the wood was worked from both the inner and outer surfaces without a clear line for the start of the bevel—accentuating the thinness of the board—had not been previously documented in manuscript bindings. Finally, rounded board edges were found on the seven books with pasteboards; the shape was the result of the thickness of leather covering soft boards.



Fig. 6. Inner front board of a printed book shows the grain direction, holes for attaching the text block, primary endbands, and pins. Note the raised profile of the endband. *Meknutiwn Srboy Awetaranin Orē Hohannu* (Constantinople: 1717), Matenadaran Collection. Courtesy of Tamara Ohanyan

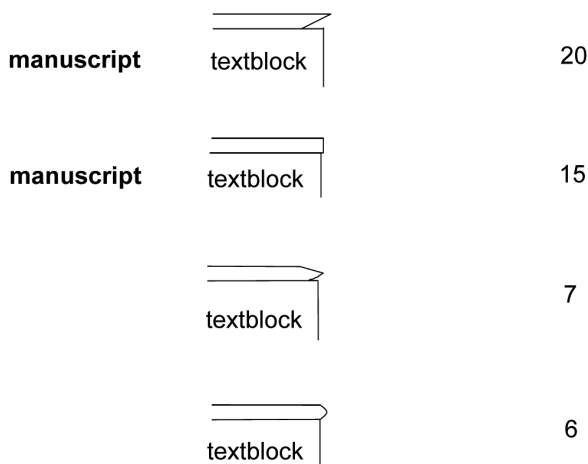


Fig. 7. Board edge shapes as seen in Armenian printed books at the Matenadaran. The top two are also found in manuscript bindings. Courtesy of Yasmeen Khan



Fig. 8. Book printed in 1705 shows spine lining with primary endband sewing. *Astuatsashunch Hnoy Ew Norots' Ktakaranats'ner Parunakōgh* (Constantinople: 1705), Matenadaran Collection. Courtesy of Tamara Ohanyan

In the surveyed collection of books, the manuscript method of board attachment continued in a majority of cases (45 of 52 books). The two sewing support cords for each sewing station were laced through the hole in the board from the outside to the inside, looped around themselves in the joint, tied off, and pasted down (fig. 6). After the text block had been sewn, using two cords as one support, the cords were divided again to attach the second board to the text block in the same manner. In a few non-contemporary bindings, the books were cased in.

Traditionally a rough, woven fabric spine lining was adhered to the back of the text block after attaching the boards. This spine lining usually overlapped the outer faces of both front and back boards by approximately 3 cm. The primary endband was sewn through the lining, which reinforced it and provided overall support to the binding by distributing the tension resulting from the laced-on boards (fig. 8). As the 18th century progressed, there was a move towards simplification, with full fabric linings replaced by partial ones at the head and tail, supporting the endbands. Finally, a volume from 1812 has no spine lining at all, as well as a front-bead European endband with four tie-downs.

ENDBANDS

Four distinct styles of endbands were found in the surveyed books, starting with the Armenian endband and ending with the type of European front-bead endband found on late-19th-century English books.

As stated in the introduction, the traditional Armenian endband had a raised profile because the board was cut flush with the text block and the endband sat on top of both the boards and the spine of the book. In the primary sewing,

binders used thin thread to anchor the primary endband support, a cord, to the boards of the book, passing the thread through multiple holes drilled into the wood (fig. 6). The sewing then passed through each section of the text block, ending on the opposite board. A secondary endband was worked in two or three colors over the primary support, with additional supports added on in rows to build up the chevron pattern (fig. 1a). These endbands reinforced the attachment of the text block to the boards. On printed books, traditional Armenian endbands were worked in the same manner. Twenty-one printed books, mainly dating from 1691 to 1725, had traditional Armenian endbands; one outlier from the set, dated 1790, had a badly-executed endband.

Nine of the surveyed books, dating from 1709 onward, have a specific hybrid Armeno-European endband. Most of them showed evidence of early rebinding or repair, possibly in the mid-1700s. This hybrid endband was similar to the traditional endband in that it was worked from one board through the text block and onto the other board. The differences were fewer anchor holes in the boards, fewer tie-downs in the text block, and a European front-bead endband—often in two colors—worked over a single cord support. The endband sat on top of the boards (fig. 1b). The most pristine of these endbands were found on volumes from 1724 to 1735.

In another type of hybrid endband (hybrid A), the corner of the board was excised to accommodate the cords and create a flat profile (fig. 9). This European front-bead endband was



Fig. 9. In the hybrid A style, the excised board edge accommodates the thickness of the endband support and a hole anchors the primary endband sewing. Constantinople Imprints #251 (ca. 1725), Matenadaran Collection. Courtesy of Tamara Ohanyan



Fig. 10a. Hybrid B style endband on a book with an excised board edge but no anchoring holes for the primary sewing. *Girk Kochets'eal Vēm Hawatoy* (Constantinople: 1733), Library of Congress Collection. Courtesy of Tamara Ohanyan



Fig. 10b. English-style front-bead endband with four tie-downs on a rebound printed book with gilt edges. *Koch'umn Ĕntsayut'ean" Kiuwregħ Erusaghēmatsi* (Constantinople: 1727–1728), Matenadaran Collection. Courtesy of Tamara Ohanyan

worked over both the text block and the boards, as there were primary endband sewing holes on the top and bottom spine edges of the boards. A further simplification of the endband was found in books from the same time period: a European front-bead endband was worked over an extended cord that was not anchored to the boards (hybrid B, fig.10a). This endband was set into the excised space on the board and worked only on the text block, unlike its hybrid A counterpart.

Towards the end of the 18th century, the bindings consistently had European front-bead endbands, worked through four or five sections, and attached only to the spine (fig. 10b). The supports were cut to the width of the text block and did not extend onto the boards; the sewing supports might or might not be laced onto the boards. These endbands usually accompanied books with sprinkled or gilt edges.

EDGE TREATMENT

In manuscripts, the edges of the text block were painted red, with the top and bottom edges ending in a characteristic horseshoe pattern approximately 1 cm before the endband (fig. 1a). The painting was done after the endband was sewn, and often after the book was covered in leather, as occasionally paint stains are found on the leather turn-ins. These books were shelved flat with the bottom edge facing out. This survey showed that the horseshoe-shaped edge was occasionally embellished with black line decoration (fig. 11a). Full red painted edges were also found in both the manuscript and print traditions, colored after the endband was made, as the paint does not extend under it (fig 11b). Gauffered gilt edges, like sprinkled edges, appear on bindings that show signs of later repair or rebinding (fig. 10b).

DOUBLURES

The doublures or pastedowns in manuscript bindings were made of cloth, from mundane textiles to luxury silks. They were adhered to the boards, extending approximately 2 cm onto the first and last leaves to cover the joint area. The books were then covered in leather, and the turn-ins were set down over the doublures. Two of the surveyed books in which the manuscript tradition was clearly maintained were bound in this manner (fig. 12a). In the rest, the doublures were pasted down after the cover was covered in leather (fig. 12b). The earliest printed books used manuscript or printed waste as doublures: reuse of textual material was considered a sign of respect in Armenian manuscript and print culture. Plain sheets were the next most common. Finally, various European decorative papers, including Dutch marbled papers, appear in the bound volumes.

EXTERIOR

The profile of the spine was affected by the manner in which the book was sewn. The sewing recessed into the W-shaped notches in manuscript bindings led to a flat spine, which was



Fig. 11a. Edge treatment of the text block commonly found in bound manuscripts: while the fore-edge is painted overall, the head and tail end in a horseshoe or arched pattern. *Meknutiwn Srboy Awetaranin Orē Hohannu* (Constantinople: 1717), Matenadaran Collection. Courtesy of Tamara Ohanyan



Fig. 11b. Most of the surveyed books had colored edges that stopped at the endband. *Girk Kochets'eal Vēm Hawatoy* (Constantinople: 1733), Matenadaran Collection. Courtesy of Tamara Ohanyan

either tooled with vertical lines to increase the flexibility of the leather-covered spine or left blank. More than half of the printed books, without a raised endband profile and heavily weighted towards the second half of the 18th century, are tooled on the spine with horizontal lines to accentuate the cords, clearly showing the development of a taste for shelving books vertically, as was the practice in Europe at the time.

Although a fore-edge flap did not appear more than once in the survey—on a traditionally bound 1709 book—evidence for fore-edge leather fastenings did appear: mainly pins and ties on more than 20 bindings with different types of endbands and doublures. The Armenian method of attaching the boards to the text block left no shoulder along the spine, and the front and back boards of the bindings gaped open if no ties were used. This gaping was accentuated by the horizontal grain of the boards and was found in books of all sizes.



Fig. 12a. Cloth doublure under leather turn-ins, as in Armenian bound manuscripts. *Girk Ssahmanats' Dawt'i Anyaght' P'ilisop'ayi Ew Astuatsatsaban Vardapeti* (Constantinople: unknown date), Matenadaran Collection. Courtesy of Tamara Ohanyan



Fig. 12b. Paste paper over leather turn-ins, commonly found in Armenian printed books. *Meknutiwn Srboy Awetaranin Vor Ĕst Ghukası* (Constantinople: 1824), Library of Congress Collection. Courtesy of Tamara Ohanyan

CONCLUSION

Based on a timeline of the books surveyed (fig. 13), different endband styles overlapped, although some were made as repairs for earlier imprints. A general trend was the movement from the traditional Armenian endband to the contemporary European front-bead endband.

To check the trend, 44 books printed in the late 17th and 18th centuries in other centers of the diaspora—namely Echmiazin, Amsterdam, Nor Julfa, Nor Nachijevan, Madras, and Calcutta—were checked for comparison. Three of the four endbands were represented, but not a single book had the hybrid Armeno-European front-bead endband with the raised profile.

The authors speculate that this particular endband, which they call the “Western Armenian endband,” was produced in Constantinople during a 25-year period by one or more binding establishments. Along with endband hybrids A and B, they represent an interim phase in the Armenian movement from traditional to European attitudes toward books, both in terms of bookmaking and of use. The survey has led to more questions and speculation; to find answers, the authors plan to expand the survey to include other large collections of Armenian books printed in the 18th century.

Armenians in Constantinople were intermediaries between the Western European community of traders and diplomats and the Ottoman authorities. From the early 19th century onwards, this role expanded as community members moved to the forefront of the modernization of Ottoman Turkey, heading banks and publishing houses and spreading the ideas of the Enlightenment in Western Asia. This outward, syncretic attitude is epitomized by the manner in which the books were printed and bound: there appeared to be open movement of ideas and materials in the diaspora community from Amsterdam to Calcutta.

It is ironic that much more was written about bookmaking by its practitioners during the manuscript era, and that much more is known about it due to the information scribes

Endband Timeline

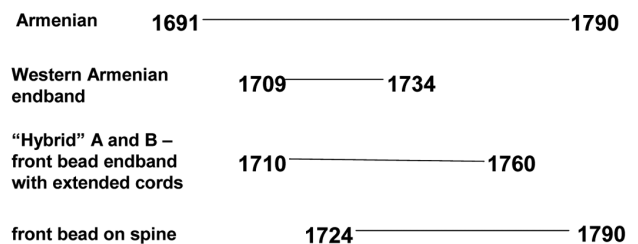


Fig. 13. Timeline of endband styles found in the survey of books printed in Armenian in Constantinople from the Matenadaran Collection

provided in colophons and commentaries. By contrast, Armenian printers wrote only about printing and its politics in their colophons. At present, there is little known literature on Armenian bookbinders practicing in Constantinople, but other sources of information may come to light with the resurgence of interest in the Armenian community in Ottoman Turkey within the academic community.

ACKNOWLEDGMENTS

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Notes on Aluminum-Walled Book Boxes: Large and Strong but Lightweight

ABSTRACT

Boxes for large books and other items in collections can be made strong yet lightweight using a thin sheet of bent aluminum for the walls. With basic modifications and simple fabrication, this strong and lightweight material can be used to make the types of storage boxes that are commonly found in libraries and archives. This paper describes how thin aluminum roll stock, commonly used by building contractors, can be used to make the walls in two styles of standard boxes: traditional drop-spine boxes and custom-made corrugated boxes.

TRADITIONAL DROP-SPINE BOX COVERED WITH BOOKCLOTH

The use of thin aluminum sheeting in place of binders' board for drop-spine boxes originated when five very large and heavy books needed protection. Each of the leather-bound volumes in the set was 16 x 24 inches and weighed about 22 lbs. While a standard phase box would have been inexpensive, there were concerns about handling the large flaps. Alternatively, a standard drop-spine box would have required double-wall construction for strength, and the resulting box could easily have weighed 10–12 lbs. That extra weight seemed excessive. These books needed boxes that were strong yet lightweight. One possibility was to make the walls of each box from the thin aluminum used by building contractors for roofing and window trim.

In this first style of box, large sheets of aluminum (0.019 in. thick) were lined with acid-free paper using ColorMount heat-set adhesive. The paper laminate was necessary because most conservation adhesives will not bond to aluminum. To allow for better adhesion, the painted aluminum surface was abraded before applying the heat-set adhesive and paper. The laminated aluminum was then cut into long, 5-inch-wide strips, which were bent along their length so their cross-section was an L

shape with a base of 2 inches and a height of 3 inches. The book's thickness was measured, and the height of the wall was easily trimmed to the correct dimension in a board shear. Using the height and width measurements of the book, the base of the long L-shaped strip was then marked for the 90-degree miter cuts that were needed at the corners of the box. These miters were easily cut with tin-snips, and the aluminum was then bent to form the strong corners and walls (figs. 1, 2).

For these large drop-spine boxes, two separate pieces of aluminum were used to form the walls of the bottom tray. This configuration provided two side openings for easy access to the large book (fig. 3). An insert of 20-point cardstock was cut to fill the space between the two U-shaped wall units, then the bases of the aluminum wall angles and the insert were laminated between two more pieces of 20-point cardstock before covering with bookcloth. When using water-based adhesives, this lamination can be a bit tricky because of the expansion and contraction of the cardstock. A possible alternative would be to use pressure-sensitive adhesives, but no tests have been done. The assembled tray was adhered to 40-point cardstock for more rigidity; a fore-edge flap of 20-point cardstock was added.

To further reduce the weight of the box, the top tray was made in a similar way, using a single piece of L-shaped aluminum to make three walls only 0.5 inch deep (fig. 3). This shallow tray was designed to secure the fore-edge flap of the box. Again, the base of the tray was made from three pieces of 20-point cardstock laminated together, while the spine piece was cut from 40-point cardstock. After covering with bookcloth, the resulting box was very sturdy and weighed about 4 lbs., which is much less than a standard double-wall drop-spine box.

In the completed box, an elevated platform with hand notches also improves access to the book (figs. 3, 4). Initially, acid-free corrugated board was used for the platform, but Volara foam was eventually substituted. The foam was covered with Stonehenge paper for a suitable look. Each book was also provided with a protective cotton flannel wrapper (fig. 5) to prevent scratches.

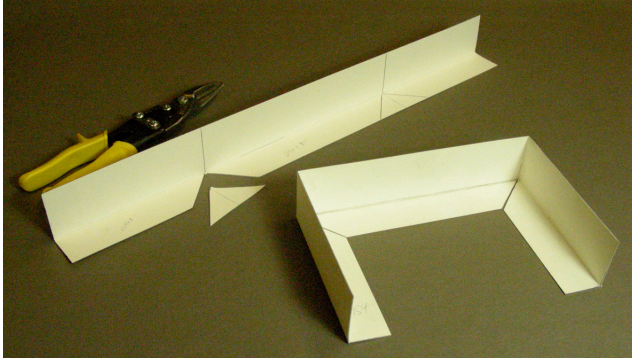


Fig. 1. L-shaped aluminum strip with paper laminate, mitered and bent for the walls of a box



Fig. 2. This thin aluminum wall, laminated with acid-free paper and covered with starch-filled buckram, measured 0.045 in. thick, whereas a double wall of binders' board would have been 0.140 in. thick and weighed much more.



Fig. 3. The completed box includes a bottom tray with hand notches, lined with paper-covered Volar foam, and a shallow, lightweight top tray that secures the fore-edge flap, thus stabilizing and sealing the box from dust, etc.



Fig. 4. This completed drop-spine box contains a book previously owned by J. J. Audubon; book conservation treatment was also completed.



Fig. 5. Each book was protected by a cotton flannel chemise.

CUSTOM-MADE STORAGE BOX USING CORRUGATED BOARD

The same L-shaped aluminum can also be used as reinforcement for custom-made boxes of alkaline corrugated board, which may be needed for very large items. The aluminum is laminated with paper, marked, and bent, and the corners are mitered as described above. Three walls with two corners are needed for the bottom of a drop-front box, four walls and four corners for the top. For the sample described here, acid-free E-flute corrugated board was used.

After the aluminum was bent and cut to dimension, the corrugated board was measured, cut, and scored to tightly cover the aluminum framework, thus avoiding the use of most adhesives (fig. 6). A single sheet of corrugated board can be used, or—for additional strength and rigidity—a second

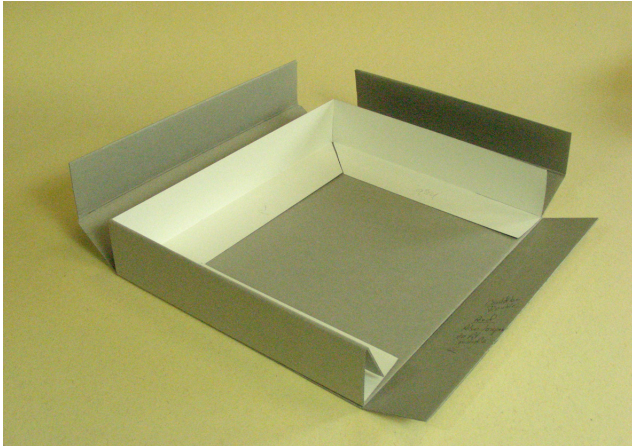


Fig. 6. This custom-made, corrugated drop-front box has aluminum-reinforced walls and corners. Two sheets of E-flute board are being used in perpendicular directions.

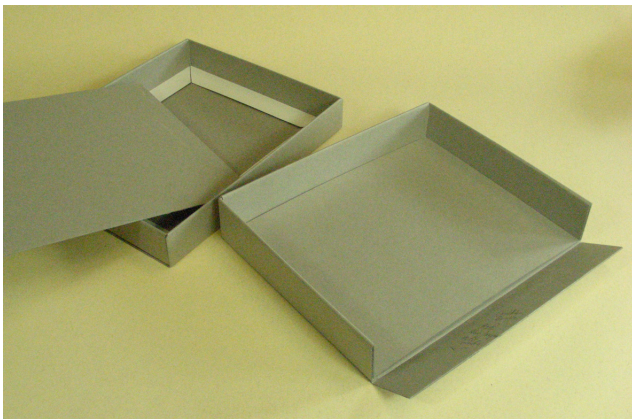


Fig. 7. The bottom of the drop-front corrugated box is assembled with three aluminum walls and minimal adhesive. The cover, made in the same way, has four aluminum walls and corners.

sheet with grain perpendicular to the first can be scored to fit over it. These sheets can be laminated for additional strength. The exact formulas for measurement will be familiar to anyone who has made boxes. The resulting custom-made box is easily assembled and should be very strong (fig. 7).

MATERIALS

- *Aluminum trim coil* is available from most building material suppliers. The laminated aluminum can be cut and bent locally by a building contractor or sheet-metal shop. Finished material is also available from the author.
- *Acid-free paper* stock of any weight can be used.
- *ColorMount heat-set adhesive* and *Vólara polyethylene foam* are available from many sources, such as Hollinger/Metal Edge conservation supply (www.hollingermetaledge.com).
- *Cotton flannel*—8 oz. single-sided and Oddy tested—is available from Benchmark (www.benchmarkcatalog.com).

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Notes on Coated Japanese Paper for Opaque and Sympathetic Fills

ABSTRACT

Japanese paper is ideal for most of the mending that is needed on a book. When there are missing areas, however, Japanese paper is usually too transparent. One common method of toning the paper is to use acrylics, but the resulting paper may not allow for a suitable water-torn edge. Papermaker's clay and calcium carbonate can be applied to sheets of Japanese paper to provide a more opaque and sympathetic fill.

CLAY-COATED JAPANESE PAPER

Book conservators work with a variety of materials to meet the task at hand. Japanese paper meets most mending needs because it is thin, strong, and transparent. That transparency is ideal in most cases, except when an area is missing and needs to be filled, such as the corner of a book leaf. While one or two layers of Japanese paper may be the correct thickness, the mend is still too transparent. In order to match the original paper, the Japanese paper may be toned with acrylics, but the resulting paper does not readily water-tear for a suitable mend.

While the author was working on a special book in which many fills were required, this lack served as an inspiration: since papermakers normally add clay and/or calcium carbonate for opacity when making paper, could a mixture of these substances be added to water and then applied to a finished sheet of Japanese paper? During experimentation, 20 g of kaolin clay and 10 g of calcium carbonate, plus a small amount of watercolor, were mixed with 200 mL calcified distilled water. The solution was then carefully sprayed onto Japanese paper using a Sure Shot air-pressurized atomizing sprayer. Since the solution was quite dilute, several applications were needed to avoid runs and drips, and this also helped with the uniformity of the finished product. In the initial trials, only the rough side of the paper was coated about five times. The

entire process, as well as the proportions of the mixture, can be further refined.

The resulting coated paper can be water-torn for an opaque and sympathetic fill (fig. 1). Surprisingly, neither the coating nor the watercolor moves or bleeds during water tearing. After attaching one fill layer using wheat starch paste, a second layer can be added with dilute paste, and the clay coating is sized and further stabilized. If the color is not quite right, more watercolor can be added without bleeding. The result is a Japanese paper fill that is much more compatible with the original paper (fig. 2).

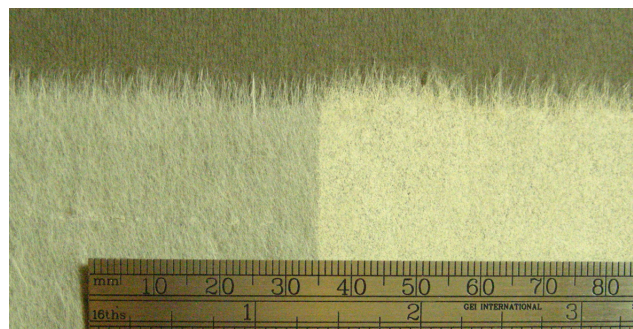


Fig. 1. Uncoated and coated Japanese paper with a water-torn edge

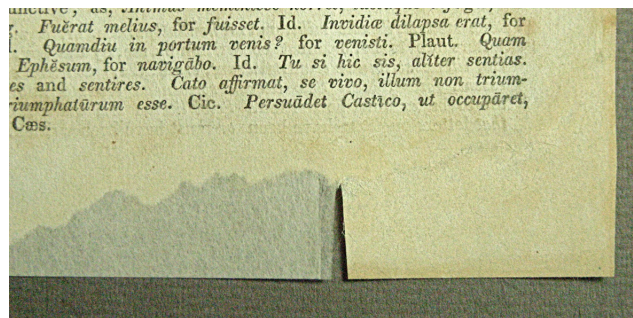


Fig. 2. Left: a fill made from two layers of uncoated Japanese paper laminated with dilute wheat starch paste. Right: a fill made from two layers of the same Japanese paper, coated with a solution of kaolin clay, calcium carbonate, and watercolor prior to mending

MATERIALS

- *Kaolin clay and calcium carbonate* are available from Twin-Rocker Papermaking Supplies, Brookston, Indiana (www.twinrockerhandmadepaper.com).
- *The Sure Shot atomizing sprayer* is available from McMaster-Carr Industrial Supply (www.mcmaster.com, cat. #7054T7).
- *Finished sheets of coated paper* may be obtained from the author.

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Reanalysis of Yellowing of Digitally Printed Materials in Cultural Heritage Collections

ABSTRACT

This paper is a retraction and re-analysis of data presented previously (Nishimura et al. 2011). As it turned out, the program running the GretagMacbeth spectrolino/spectroscan outputs the data in a different order depending on which device the reading head is attached to. This error was not obvious either during measurement or analysis and was discovered quite by accident. For further details about the original work, please refer to *Book and Paper Group Annual 30*.

The purpose of this project was to quantify the effects of temperature and humidity on the yellowing rates of digital prints in cultural heritage collections. Heat and humidity are the only two material stresses that can't be eliminated from storage and therefore ultimately determine the maximum limit of how long a digitally printed object can last. Heat is damaging by itself, but it also amplifies other chemically driven decay forces. The thermal and humidity decay rates of many library and archive objects have already been studied, but no comprehensive study has been done to determine these rates for modern digitally printed materials. Understanding the thermal decay rates of materials can lead to the development of storage conditions that will ensure the objects' accessibility and usability for extended periods. The Arrhenius method was applied to a large variety of papers used in digital printing (including inkjet, dye sublimation, and electrophotography) at three different humidities with incubation periods of up to 94 weeks. It was found that the yellowing rates are highly dependent on both temperature and humidity and that digitally printed photographs were more prone to yellowing than digitally printed documents or prints made on digital presses. The yellowing differences among individual samples within a category were sometimes greater than between categories, meaning that the prime determinant of a given print's stability may be the specific

products (brands of colorants and paper) from which it was made rather than its category (e.g., inkjet photo paper).

INTRODUCTION

Digital print papers are known to yellow from a variety of deterioration forces including pollution (Burge et al. 2010, Burge et al. 2011), light (Venosa et al. 2011), and enclosures (Burge and Rima 2010). The purpose of this project was to quantify the effects of heat and humidity on the yellowing rates of digital prints in cultural heritage collections, as these are the only two stress factors that can't be removed from the storage environment. Prints can be stored in opaque boxes or in dark storage rooms to prevent light damage. The air within storage and display areas can be filtered to prevent pollution damage. Proper enclosures can also be selected, but there will always be some level of heat and humidity. Thus, heat and humidity are factors that ultimately determine the maximum limit of how long a digital print will last. The thermal and humidity decay rates of many library and archive objects have already been studied (Browning and Wink 1968, Adelstein et al. 1970, Brown et al. 1983, Adelstein et al. 1992, Nishimura 1992, Van Bogard 1995), but no comprehensive research has been done to determine these rates for modern digitally printed materials. Understanding the thermal decay rates of materials will aid in the development of appropriate storage environment standards that can ensure the long-term accessibility and usability of these objects.

The quantity of digitally printed materials in collections is enormous and continues to grow. A 2008 survey of libraries, museums, and archives found that 87% of institutions already have digital prints and 30% of them have seen yellowing of some portion of their digital print collections (Burge et al. 2009). Below are descriptions of the major digital printing technologies that were studied in this project:

- *Inkjet* – This technology, in which small drops of liquid ink are rapidly jetted onto the printing paper, is used in many home and office desktop printers. It is also used in

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Table 1. Photo Papers

Printing Technology	Paper Type	No. of Examples
Inkjet	Porous-coated photo	2
Inkjet	Polymer-coated photo	2
Inkjet	Porous-coated plain	3
Inkjet	Porous fine art	3
Dye sublimation	Dye sublimation paper	1
Color silver halide	Chromogenic	2

Table 2. Document Papers

Printing Technology	Paper Type	No. of Examples
Inkjet	Inkjet-treated office paper	1
Inkjet	Inkjet-sized office paper	1
Electrophotography	Laser-specific office paper	1
Electrophotography	Color laser-specific office paper	1
Inkjet/Electrophotography	Virgin-pulp office paper	1
Inkjet/Electrophotography	50% recycled-pulp office paper	1
Inkjet/Electrophotography	100% recycled-pulp office paper	1

Table 3. Press Papers

Printing Technology	Paper Type	No. of Examples
Digital Press paper	Coated glossy	1
Digital Press paper	Coated matte	1
Digital Press paper	Uncoated	1
Offset lithography paper	Coated glossy	1
Offset lithography paper	Coated matte	1
Offset lithography paper	Uncoated	1

wide-format printers to produce fine art and commercial signage. Production digital presses are just starting to use this technology.

- *Dye Sublimation* – This system, in which the image-forming colorants are transferred by heat to the printing paper from a donor ribbon, is only used for printing images – never documents.
- *Color Electrophotography* – This process, in which color toner particles are temporarily held on to the printing paper by an electrostatic charge before being “fixed” to the paper by pressure, heat, or both, is primarily used to produce documents, although it is also used for large-scale commercial digital presses.

This project also included traditional print materials as benchmarks. Direct comparison with these older and more familiar print materials should provide an important context for the results of this project. Two types of printing papers were used as comparison controls in the experiment: traditional silver-halide color photographic paper and offset lithographic paper.

METHOD

The Arrhenius Method (ISO 2013) was used to create predictions based on test results from high temperature incubations. In this method, replicate samples were incubated at six temperatures and three humidities (18 total conditions) to determine approximately how long it might take them to yellow at room condition and to determine their sensitivity to humidity and temperature.

Since this project dealt only with the substrates and not the colorants, non-imaged substrate samples were used. Currently, a separate study is underway to examine the thermal fading of colorants. For this yellowing project, an increase in Status A blue density¹ of 0.05 was used as the endpoint, representing a clearly noticeable level of yellowing without requiring incubation times beyond the end of the project. However, this level does not represent the point at which the print is no longer readable or usable.

Because the goal of the project was to determine the thermal stability of collections of digital prints rather than specific digital print products, a large number of different digital print types with multiple representations of each were required to create a realistic surrogate test population. A total of 28 different printing papers were used to cover the range of the

Table 4. Photo Categories

<i>Printing Technology</i>
Inkjet
Dye sublimation
Color silver halide

Table 5. Document Categories

<i>Printing Technology</i>
Inkjet
Electrophotography

Table 6. Press Categories

<i>Printing Technology</i>
Digital press
Offset lithography

major digital printing technologies and their common sub-categories. The materials tested and their primary end uses are listed in tables 1–3.

The individual papers were then grouped into categories that collection-care personnel could be trained to differentiate, and these categories were used to report the results. These categories are listed in tables 4–6.

The papers were all unprinted except the color silver-halide photographic paper, which was unexposed and processed to paper white, and the dye sublimation paper, which was printed with no image so that the clear overcoat used in the system would be applied. All papers were tested in triplicate.

The samples were measured with a GretagMacbeth Spectrolino for Status A blue density. This device conformed to ISO 5-3: 2009 *Photography and graphic technology – Density measurements – Part 3: Spectral conditions* and ISO 5-4: 2009 *Photography and graphic technology – Density measurements – Part 4: Geometric conditions for reflection density*.

It was assumed that since none of the samples were printed with an image, all samples for each paper would be similar enough to one another that initial readings on each of the more than 12,000 samples included in this test would not be necessary. Instead, a representative group of 30 samples from each paper was measured and averaged, with the average representing the initial value for each paper. However, all samples were measured after each incubation period for every temperature and humidity combination.

Six temperatures were used for the accelerated aging: 55°C, 65°C, 70°C, 75°C, 80°C, and 85°C. The moisture content of the samples was held constant by conditioning the samples to 21°C and 20% RH, 50% RH, or 80% RH for one week and then sealing the samples in foil bags. Samples were incubated at various intervals depending on temperature up to 94 weeks until the 0.05 endpoint was reached. Using the standardized Arrhenius prediction methodology, the logarithm of the incubation times to reach

0.05 D_{\min} gain for each temperature was then plotted against the reciprocal of the absolute test temperatures, and the predicted time to reach 0.05 D_{\min} gain at 10 °C, 20 °C, and 30 °C extrapolated. While any range of temperatures could show the relative effects of temperature on the yellowing of digital print substrates, this particular range was chosen to cover a common range of temperatures one might find in typical collections from cool to fairly uncontrolled conditions. In addition, years to endpoint would also be predicted for 21°C at 20% RH, 50% RH, and 80% RH to compare the impact of humidity on yellowing.

RESULTS

Tables 7–9 illustrate the effects of temperature on predicted years to noticeable yellowing for the various categories of digitally printed materials: photographs, documents, and production press printing. The worst and best case samples in each category are reported along with the average for the category.

Tables 10–12 show the effects of humidity on predicted years to noticeable yellowing for the various categories of digitally printed materials: photographs, documents, and production printing.

Inkjet prints were the most prone to yellowing of the digital technologies, followed by electrophotography and dye sublimation. Digital photographs were more prone to yellowing than digitally printed documents.

Statistical tests on the data across the range of 20 Celsius degrees for temperature and across 60 percentage points for relative humidity showed that temperature had the most significant effect on the time to noticeable yellowing, followed by RH. However, a drop in humidity from 50% to 20% did have a profound effect on extending the life of the worst case samples. There is also a significant synergistic effect of temperature and RH, so the largest benefit would be obtained by reducing both temperature and RH. This benefit is greater than can be accounted for by simply adding the effects of changing temperature alone and humidity alone. Note that the RH data for the dye sublimation and chromogenic papers were somewhat erratic. The reason for this is not known.

The values in tables 10–12 indicate an extreme range of responses for the materials, from 1 to nearly 15,000 years. Low values such as a single year will be highly alarming to collection caretakers, while 15,000 years is probably far beyond their concerns. It may be helpful to think in terms of percentages within each category that may reach the reasonable preservation goals of 50 or 100 years. Table 13 shows the percentage of materials within each category expected to yellow by 50 and 100 years. Inkjet was the most prone to yellowing by 50 years, though the number that yellowed by 100 years was not much higher, indicating that yellowing may appear quickly and then slow down with additional time. At

Table 7. Effect of Temperature on Digitally Printed Photos (in Years)

		Worst case	Average	Best case
Inkjet Photo	10 °C	7	1515	5054
	20 °C	3	222	673
	30 °C	1	37	102
Dye Sublimation	10 °C	715	2570	4454
	20 °C	165	502	892
	30 °C	42	110	199
Chromogenic	10 °C	3	7477	14950
	20 °C	2	783	1564
	30 °C	1	95	190

Table 8. Effect of Temperature on Digitally Printed Document (in Years)

		Worst case	Average	Best case
Inkjet Document	10 °C	49	3898	8017
	20 °C	12	530	1045
	30 °C	3	83	156
Electrophotography	10 °C	568	3770	8017
	20 °C	100	515	1045
	30 °C	19	81	156

Table 9. Effect of Temperature on Digital Press Prints (in Years)

		Worst case	Average	Best case
Digital Press	10 °C	305	1255	2946
	20 °C	56	193	425
	30 °C	11	34	70
Offset Lithography	10 °C	310	1470	3222
	20 °C	59	216	448
	30 °C	13	36	71

100 years, the electrophotographic samples caught up with the inkjet. The dye sublimation prints were highly resistant to thermal yellowing.

Given the large number of papers available on the market (and over the history of digital printing), for most of the printing technologies, the sample set was unfortunately small out of necessity.² However, assuming that the sample sets were, in fact, fairly representative of the population, room-condition storage of these materials can be expected to result in significant, widespread yellowing at 100 years.

ACTIVATION ENERGY

Activation energy is the energy necessary to initiate a reaction and provides a measure of the temperature dependence of the reaction rate. It therefore provides an idea of how much benefit colder storage will have and, conversely, how bad warmer storage will be. Table 14 ranks the materials based on their activation energy from low to high. Acetate film base is included as a reference because many collection-care personnel are familiar with its behavior.

The vast majority of digital printing papers had fairly high activation energies. This is both a blessing and a curse. On

the positive side, just dropping the storage temperature by a few degrees can greatly improve the time to yellowing for these materials. On the negative side, papers in poor storage conditions are in very serious trouble.

Importantly, the range of individual sample performances within categories was quite wide, such that samples within a category often varied more than the categories themselves. Unfortunately, this means that stability may not be so much a function of paper type, but rather of the specific product (brand of paper) from which the print was made. Strategies for preserving collections of digital prints should still be made for each of the different print categories and sub-categories, but collections care staff must be aware that there may be prints that differ from general category trends. The data also suggested that at least some of the yellowing reported by institutions in the 2008 survey may be thermally induced, though it may have been made worse by exposure to atmospheric pollutants.

Table 10. Effect of Humidity on Digitally Printed Photos (in Years)

		Worst case	Average	Best case
Inkjet Photo	20% RH	17	528	1804
	50% RH	2	185	555
	80% RH	2	60	159
Dye Sublimation	20% RH	165	284	403
	50% RH	143	429	764
	80% RH	162	426	899
Chromogenic	20% RH	39	280	521
	50% RH	1	630	1259
	80% RH	4	48	92

Table 11. Effect of Humidity on Digitally Printed Documents (in Years)

		Worst case	Average	Best case
Inkjet Document	20% RH	56	994	2056
	50% RH	11	438	859
	80% RH	5	185	343
Electrophotography	20% RH	194	1002	2056
	50% RH	84	425	859
	80% RH	81	191	343

Table 12. Effect of Humidity on Digital Press Prints (in Years)

		Worst case	Average	Best case
Digital Press	20% RH	112	292	580
	50% RH	48	161	353
	80% RH	9	73	134
Offset Lithography	20% RH	133	675	1585
	50% RH	50	180	371
	80% RH	14	80	142

Table 13. Percentage of Test Samples Yellowed After 50 and 100 Years at 21°C and 50% RH

Material	% Yellowed by 50 years	% Yellowed by 100 years
Inkjet photo	40%	56%
Dye sublimation	0%	0%
Inkjet document	20%	20%
Electrophotography	0%	20%
Digital press	0%	67%

Table 14. Activation Energies (in $\text{kJ mol}^{-1} \text{K}^{-1}$)

Material	Activation energy
Acetate film base	88
Chromogenic	106
Dye sub	111
Inkjet photo	119
Digital press	122
Offset lithography	126
Inkjet document	129
Electrophotography	131

CONCLUSIONS

The following conclusions were drawn from the data:

- Digitally printed photographs are more prone to yellowing than digitally printed documents
- Inkjet was the most sensitive to yellowing, followed by electrophotography, while dye sublimation was highly resistant to thermal yellowing
- Yellowing rates are highly dependent on both temperature and humidity
- Yellowing rates were often more variable between individual products within a category than between categories

This project only dealt with yellowing of the printing paper. The physical integrity of the support and the stability of the colorants must also be considered. Final recommendations for storage conditions for these materials will need to wait until such additional research is completed. As mentioned earlier, work is currently underway at IPI to evaluate colorant stability.

ACKNOWLEDGMENTS

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NOTES

1. Status A blue density is the base 10 logarithm of the reciprocal of the reflectance as measured through a blue filter with spectral properties and geometry as defined by ISO 5-3: 2009 *Photography and graphic technology – Density measurements – Part 3: Spectral conditions* and ISO 5-4: 2009 *Photography and graphic technology – Density measurements – Part 4: Geometric conditions for reflection density*. Reflectance is the fraction of the light received by the object that is reflected.
2. Given that six temperatures and three humidity conditions were used with a potential for 12 pull times, each additional paper would add 216 specimens to the project.

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The deadline for submissions is July 1. Send submissions to:

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